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Advanced Methodologies and Technologies in Media and Communications

Mehdi Khosrow-Pour, D.B.A.

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Mehdi Khosrow-Pour, D.B.A.
Information Resources Management Association, USA

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Preface

Advanced Methodologies and Technologies in Media and Communications is a single-volume major reference work comprised of 50 unique chapters focusing on some of the most innovative technologies and methodologies in the world of media and communications.

Aiming to serve the needs of libraries, corporations, research organizations, independent researchers, practitioners, linguists, scientists, policymakers, and instructors, this publication encompasses advanced cross-disciplinary knowledge on the conceptual, methodological, and technical aspects of a wide range of subject matter – from data journalism to social media.

Attention is also given to emerging topics including but not limited to collaborative learning, natural language models, online communication, digital games, and hypermedia systems.

The concepts presented within these chapters are sure to support a wide range of future advancements and new research initiatives in numerous industries and/or fields. Additionally, this publication could be extremely beneficial for use in coursework by instructors of various media and communications programs.

Advanced Methodologies and Technologies in Media and Communications is organized into six sections that provide comprehensive coverage of important topics. These sections are 1) Communications Theory, 2) Gaming, 3) Language Studies, 4) Multimedia Technology, 5) Social Networking and Computing, and 6) Sports and Entertainment.

The following paragraphs provide a summary of what to expect from this invaluable reference source:

Section 1, "Communications Theory," is comprised of four chapters and opens this extensive reference source by highlighting the latest coverage of communications across various mediums and disciplines. The first chapter in this section, "Communication, Information, and Pragmatics," authored by Profs. Adriana Braga from Pontifical Catholic University of Rio de Janeiro, Brazil and Prof. Robert K. Logan from the University of Toronto, Canada, clarifies the relationship between communication and information by considering pragmatics. For communication to occur, the information that is transmitted must be processed within the social context of the sender and the receiver, or in other words, through the use of pragmatics.

The second chapter in this section, "Data Journalism," authored by Profs. Andreas A. Veglis and Charalampos P. Bratsas from the Aristotle University of Thessaloniki, Greece, explores the issue of data journalism. It includes a definition of data journalism as well as a discussion on the necessary ICT skills that journalists should have in order to cope with this new type of journalism. Also, it examines the relation between data journalism and open data.

The third chapter in this section, "Investigating Diachronic Variation and Change in New Varieties of English," authored by Prof. Rita Calabrese from the University of Salerno, Italy, focuses on the pro-

cesses of language feature convergence which gradually led to linguistic stabilization over time, whereby specific attention will be given to the process of Englishization in the South-Asian area.

The fourth and final chapter in this section, "Negotiating Local Norms in Online Communication," authored by Prof. Jonathan R. White from Högskolan Dalarna, Sweden, investigates the norms of English usage in a community of novice students on a net-based MA program.

Section 2, "Gaming," is comprised of 10 chapters and explores emerging innovations in the use of games for educational purposes and across other disciplines. The first chapter in this section, "Application of Gamification to Blended Learning in Higher Education," authored by Profs. Kamini Jaipal-Jamani and Candace Figg from Brock University, Canada, illustrates the application of gamification to blended learning in higher education. It also discusses the design and implementation of gamified blended courses.

Another chapter presented early within this section, "Clinical Use of Video Games," authored by Prof. Ben Tran from Alliant International University, USA, covers the history of video games, video games in psychotherapy, and the different types of video games and their usages in psychotherapy.

Another noteworthy chapter in this section, "Learning With Games and Digital Stories in Visual Programming," authored by Prof. Wilfred W. F. Lau from The Chinese University of Hong Kong, China, traces the recent development and the use of games and digital stories for engaging students in learning in visual programming environments. It reports on the application of game development-based learning and educational digital storytelling to engage students in learning in visual programming environments.

One of the closing chapters, "Serious Games Advancing the Technology of Engaging Information," authored by Profs. Peter A. Smith and Clint Bowers from the University of Central Florida, USA, focuses on various features of serious games that have emerged that are building very personal and informational games that combine the power of well-designed good games and a personal passion for the topic that the game covers.

The final chapter in this section, "Towards Modelling Effective Educational Games Using Multi-Domain Framework," authored by Profs. Mifrah Ahmad and Lukman Ab Rahim from the Universiti Teknologi PETRONAS, Malaysia, Prof. Kamisah Osman from the Universiti Kebangsaan Malaysia, Malaysia, and Prof. Noreen Izza Arshad from the Universiti Teknologi PETRONAS, Malaysia, highlights modeling and design methods to provide an effective development of educational games (EG) with assurance of effectiveness. It also examines the relationships among educational game elements in order to provide game developers, software engineers, and game designers with a medium of understanding the connections, interrelations, and interactions between game elements and game domains.

Section 3, "Language Studies," is comprised of three chapters on the use of technology in developing language skills and difficulties and challenges of language translation. The first chapter in this section, "Mobile Testing System for Developing Language Skills," authored by Prof. Svetlana Titova from Far Eastern Federal University, Russia, investigates the pedagogical impact of both the mobile testing system PeLe and enquiry-based approach on language skills development in the context of mobile-assisted language learning. The study aims to work out a methodological framework for PeLe implementation into a language classroom through immediate feedback and formative assessment.

The second chapter in this section, "Nominalizations in Requirements Engineering Natural Language Models," authored by Prof. Claudia S. Litvak from the Universidad Nacional de La Matanza, Argentina & Universidad Nacional del Oeste, Argentina, Prof. Graciela Dora Susana Hadad from the Universidad Nacional del Oeste, Argentina, and Prof. Jorge Horacio Doorn from the Universidad Nacional del Oeste, Argentina & Universidad Nacional de La Matanza, Argentina, analyzes the influence of nominalization on the quality of requirements engineering documents. There are sometimes appreciable differences

between using a verb form or its nominal form, while in other cases they may be synonyms. Therefore, the requirements engineer must be aware of the precise meaning of each term used in the application domain in order to correctly define them and properly use them in every document. In this chapter, guidelines about treatment of verb nominalization are given when constructing a specific glossary, called Language Extended Lexicon.

The third and final chapter in this section, "Word Formation Study in Developing Naming Guidelines in the Translation of English Medical Terms Into Persian," authored by Prof. Ali Akbar Zeinali from the Universiti Sains Malaysia, Malaysia, provides a comparative analysis of the characteristics of Persian medical terms, using the universal naming guidelines and local naming principles in Persian. It also examines the similarities and differences of the compatible and incompatible terms (Persian equivalents) with respect to the applied translation procedures and the employed word formation processes.

Section 4, "Multimedia Technology," is comprised of six chapters on multimedia technologies within their specific application areas as well as developing trends for the future. The first chapter in this section, "Adaptive Hypermedia Systems," authored by Prof. Ana Carolina Tomé Klock from the Federal University of Rio Grande do Sul (UFRGS), Brazil, Prof. Isabela Gasparini from the Santa Catarina State University (UDESC), Brazil, and Profs. Marcelo Soares Pimenta and José Palazzo M. de Oliveira from the Federal University of Rio Grande do Sul (UFRGS), Brazil, highlights the importance of the improvement and the use of adaptive systems. It also identifies some methods and techniques used to adapt the content such as the applications ELM-ART, Interbook, AHA!, AdaptWeb®, and the trends of standardization, data mining, social web, device adaptation, and gamification.

The second chapter in this section, "Group Synchronization for Multimedia Systems," authored by Prof. Dimitris N. Kanellopoulos from the University of Patras, Greece, illustrates various issues on intra- and inter-media synchronization and presents the basic schemes for inter-destination media synchronization (IDMS). It also presents in short IDMS standardization efforts and novel solutions for new multimedia applications.

The third chapter in this section, "Metadata Standards in Digital Audio," authored by Prof. Kimmy Szeto from Baruch College, City University of New York, USA, examines how audio metadata enable the re-contextualization, repackaging, and commodification of audio, integrating it with multimedia contextual elements and transforming it into a new cultural product.

The fourth chapter in this section, "Multimedia-Enabled Dot Codes as Communication Technologies," authored by Prof. Shigeru Ikuta from the Otsuma Women's University, Japan, outlines a state-of-the-art dot code technology including a recently developed new application for a smart phone and presents basic information regarding the creation of original handmade materials using dot codes and the use at both general and special needs schools.

The fifth chapter in this section, "Semantically Enhanced Authoring of Shared Media," authored by Profs. Charalampos A. Dimoulas, Andreas A. Veglis, and George Kalliris from Aristotle University of Thessaloniki, Greece, examines current trends and future perspectives of semantically enhanced media/multimedia, considering all forms of non-linear storytelling, sharing, and authoring.

The sixth and final chapter in this section, "Transmedia and Transliteracy in Nemetical Analysis," authored by Dr. Michael Josefowicz from the Nemetics Institute Kolkata, USA, Dr. Ray Gallon from The Transformation Society, France, and Dr. Maria Nieves Lorenzo Galés from The Transformation Society, Spain, provides terms and definitions for transmedia and for the new set of personal skills and abilities required to participate in it. It also presents the nemetic system, which facilitates analyzing, tracking, and visualizing communication interactions in virtual transmedia environments.

Section 5, "Social Networking and Computing," is comprised of 25 chapters on the application of social networking across various disciplines. The first chapter in this section, "Adolescents' Food Communication in Social Media," authored by Prof. Christopher Holmberg from the University of Gothenburg, Sweden, elucidates the complex and interwoven relationship between food and nutrition, social media, and adolescents from a health communication perspective. The chapter draws upon empirical studies and results, as well as related conceptual literature.

Another chapter presented early within this section, "Agent-Based Social Networks," authored by Profs. Federico Bergenti, Agostino Poggi, and Michele Tomaiuolo from the Università degli Studi di Parma, Italy, explores the goal of introducing social networks and how they can take advantage of a decentralized architecture and how the use of multi-agent technologies help to cope with its security and design issues and, in addition, support the creation of innovative services for its users.

Another noteworthy chapter in this section, "Online Dating/Dating Apps," authored by Profs. Vladimir Santiago Arias and Narissra Maria Punyanunt-Carter from Texas Tech University, USA, examines the role of human perception of physical appearance during first impression formation which may better tune with Tinder's interface. The concept of technological affordance tuning is also discussed to explain the success of online dating in addition to the new media pervasiveness argument.

One of the closing chapters in this section, "Using Social Media to Increase the Recruitment of Clinical Research Participants," authored by Prof. Saliha Akhtar from Seton Hall University, USA, explores how clinical research continues to have difficulty recruiting participants. This chapter examines how social media could be a promising new avenue for clinical trial recruitment that allows for a more positive experience for both investigative site personnel and potential participants.

The final chapter in this section, "Why It Is Difficult to Disengage From Facebook," authored by Prof. Sonda Bouattour Fakhfakh from the University of Tunis El-Manar, Tunisia, offers a theoretic attempt to analyze the reasons of attachment to Facebook but through another perspective: the disengagement phenomenon. The theoretical framework is based on the attachment theory and the actor network theory. It investigates the relations between user attachment style and Facebook use and between Facebook user and the Facebook platform (hardware and software).

Section 6, "Sports and Entertainment," is comprised of two chapters on the application of sports in computer science and education. The first chapter in this section, "Mining Sport Activities," authored by Profs. Iztok Fister Jr. and Iztok Fister from the University of Maribor, Slovenia, focuses on opportunities of data mining in sports. The current applications of mining sports activities are also discussed.

The second and final chapter in this section, "Sport Exergames for Physical Education," authored by Profs. Pooya Soltani and João Paulo Vilas-Boas from the University of Porto, Portugal, reviews some of the relevant applications of sports exergames for inclusion in physical education and characterizes one of these games (swimming) from different aspects of biomechanics, physiology, and psychology.

The comprehensive coverage this publication offers is sure to contribute to an enhanced understanding of all topics, research, and discoveries pertaining to media and communications. Furthermore, the contributions included in this publication will be instrumental to the expansion of knowledge offerings in this area. This publication will inspire its readers to further contribute to recent discoveries, progressing future innovations.

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Section 1
Communications Theory

Chapter 1
Communication, Information, and Pragmatics

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ABSTRACT

In this chapter, the authors first examine the meaning and significance of information, which will entail a critique of Shannon information theory. They show it is really a theory of the transmission of signals. They describe how MacKay and Bateson adds the element of meaning to the definition of information. They then examine the proposition of Kauffman et al. that organization is a form of information. Assuming that it is not possible not to communicate, the authors emphasize the pragmatic dimension of communication. They argue that information, communication, and social interaction are inseparable elements of production of meaning. Thus, as in any communication there are three simultaneous dimensions operating as a system—syntactic, semantics, and pragmatics—and it is also the case that information, communication, and social interaction are operating as a system.

INTRODUCTION

The intention of this article is to clarify the relationship between communication and information by considering pragmatics. Although these terms are closely related, they are not the same. In order for communication to occur the information that is transmitted must be processed within the social context of the sender and the receiver or in other words through the use of pragmatics. That is, there is no communication between the sender and the receiver if the receiver does not understand the information sent by the sender. Information before it is interpreted is therefore nothing more than the signal. It only becomes communication, if it is properly interpreted by the receiver of the information. And it is only through the context or the pragmatics that the receiver can understand the intended meaning of the sender and therefore as a result communication can take place. Misinterpretation leads to miscommunication. As no interpretation is perfect as pragmatics between the sender and the receiver is never perfect the content of

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the communication depends on the user and the user's interpretation, which McLuhan formulated with his iconic one-liner *the user is the content*. In actuality the sender, the receiver and their understanding of each other are all part of the content.

BACKGROUND

The context in which the information is interpreted is the only way that the meaning that was intended by the sender can be understood by the receiver, but the meaning that the receiver attaches to the information sent by the sender will always vary to some degree (Chan, Walker & Gleaves, 2015; Gibbs et al, 2015; Gui & Argentin, 2011; Introna & Nissenbaum, 2000). Because the 'user is the content' all communication is miscommunication to a certain degree. Perfect communication is an ideal that all communicators strive to achieve through the art of rhetoric. To sum up what we have just posited: information is required for communication but does not necessarily result in communication and never results in perfect communication. The extra ingredient that is required to transform information into communication is context or pragmatics, which is never perfect. Recent methodological innovations try to account for the pragmatics on digital environments (Boyd and Crawford, 2012; Hine, 2005; Lee and Chen, 2015).

In this article we will first examine the meaning and significance of information, which will entail a critique of Shannon Information Theory. We will show it is really a theory of the transmission of signals. We describe how MacKay and Bateson with their respective formulations of "information is the distinction that makes a difference (MacKay, 1969)" and "information is the difference that makes a difference (Bateson, 1973)" adds the element of meaning to the definition of information. We then examine the proposition of Kauffman, Logan et al. (2007) that organization is a form of information and that life entails the propagation of organization.

Assuming that it is not possible not to communicate, we emphasize the pragmatic dimension of communication. We argue that 'information,' 'communication' and 'social interaction' are inseparable elements of production of meaning, even if analytically they can be conceived as independent concepts. Thus, as in any communication there are three simultaneous dimensions operating as a system – syntactic, semantics and pragmatics, and it is also the case that 'information,' 'communication' and 'social interaction' are operating as a system. In this sense, speech acts owe their meaning to performances in the context of what information the sender sends, the interpretation of the receiver and the social context that exists between the sender and the receiver. We argue that, from the differential emphasis on the syntactic, semantic or pragmatic dimensions of communication, lies a major difference between models for the theory of communication: communication as transmission of information or communication as a relational activity.

Information: From Origins to Shannon's Information Theory

The English word information according to the Oxford English Dictionary (OED) first appears in the written record in 1386 by Chaucer. It is derived from Latin through French by combining the word "inform" meaning "giving a form to the mind" with the ending "ation" denoting a noun of action. This earliest definition refers to information as an item of training or molding of the mind. Information is not an object but a process of forming or informing the mind.

The notion of information as something capable of storage in or the transfer to something inanimate and the notion of information as a mathematically defined quantity does not arise until the 20th century. The beginning of the modern theoretical study of information is attributed to Claude Shannon (1948), who is recognized as the father of information theory. He defined information as a message sent by a sender to a receiver. Shannon wanted to solve the problem of how to best encode information that a sender wished to transmit to a receiver. Shannon gave information a numerical or mathematical value based on probability defined in terms of the concept of information entropy more commonly known as Shannon entropy. Information is defined as the measure of the decrease of uncertainty for a receiver. The amount of Shannon information is inversely proportional to the probability of the occurrence of that information, where the information is coded in some symbolic form as a string of 0s and 1s or in terms of some alpha-numeric code.

MacKay's Counter Revolution: Where Is the Meaning in Shannon Information?

According to Claude Shannon (1948) his definition of information is not connected to its meaning. However, as Shannon suggested, information in the form of a message often contains meaning but that meaning is not a necessary condition for defining information. So it is possible to have information without meaning, whatever that means.

Not all of the members of the information science community were happy with Shannon's definition of information. Three years after Shannon proposed his definition of information Donald Mackay (1969) suggested that information should be defined as "the change in a receiver's mind-set," and thus with meaning. He defined information as "a distinction that makes a difference." and not just the sender's signal (Hayles, 1999). The notion of information independent of its meaning or context is like looking at a figure isolated from its ground. As the ground changes so too does the meaning of the figure. This is a central idea of Marshall McLuhan's (1964) approach to communications known as media ecology.

[McLuhan] believed that to understand the meaning of a figure one must take into account the ground in which it operates and in which it is situated. The true meaning of any "figure," whether it is a person, a social movement, a technology, an institution, a communication event, a text, or a body of ideas, cannot be determined if one does not take into account the ground or environment in which that figure operates. The ground provides the context from which the full meaning or significance of a figure emerges. The concern with the figure/ground relationship is consistent with McLuhan's emphasis on interface and pattern rather than on a fixed point of view (Logan 2011, p.2).

The problem with MacKay's definition was that meaning could not be measured or quantified and as a result the Shannon definition won out and changed the development of information science. The theorizing that Shannon conducted through his combination of electrical engineering and mathematics came to be known as information theory. It is ironic that the OED cites the first use of the term "information theory" as that of MacKay's who used the term in a heading in an article he published in the March 1950 issue of the Philosophical Magazine. Gregory Bateson (1973) defined information as "the difference that makes a difference," which is now more often quoted than MacKay's formulation. Both MacKay's and Bateson's formulation contain the notion that it is the meaning of the information that makes the difference. Another one-line definition of information that incorporates the notion of its mean-

ing is Fredkin's "The meaning of information is given by the processes that interpret it." This is a very insightful definition because it explicitly incorporates the notion that information depends on context.

If information is the distinction (MacKay) or the difference (Bateson) that makes a difference then if there is no distinction or no difference then there can be no information. This would mean chaos or random numbers contain no information because there is no difference or distinction in one part of the stream of numbers as opposed to another part of the stream because of a lack of organization. This is opposite to the conclusion of Shannon who claims that a stream of random numbers contains the maximum information. While it is true each element is different from the next and is a complete surprise it is also true that the overall pattern of chaos and randomness is the same and hence there is no distinction nor is there any difference in the stream of random numbers.

Feedforward and Cybernetics

I. A. Richards' area of research was rhetoric, which he considered to be more than just the art of persuasion. Richards was concerned with the accuracy of human communication. He considered the field of rhetoric to be about finding remedies for avoiding misunderstandings and hence improving communication as well as understanding how words work. He believed the notion of feedforward was an important tool for achieving these ends. Feedforward is basically a form of pragmatics where pragmatics is the use of context to assist meaning.

Richards first introduced the term feedforward in his address to the Macy conferees in 1951:

Perhaps this thing on which I want to put the spotlight will be considered to be included in some ingenious way under the word "feedback." But what I am going to stress stands in an obvious and superficial opposition to "feedback," and it will, in certain frames of thought, be given nearly, if not quite so much, importance, and sometimes more importance than feedback itself in certain connections. It is certainly as circular. You have no doubt fed forward enough to see that what I am going to talk about from now on is feedforward. I am going to try to suggest its importance in describing how language works and, above all, in determining how languages may best be learned (Richards, 1952, p. 54).

The coining of the term by Richards was no doubt influenced by the term feedback used by cyberneticians and according to the OED first introduced into the English language in 1920. But as Richards pointed out feedforward stands in superficial opposition to feedback. Feedback is basically reactive whereas feedforward is proactive. Feedforward anticipates where one is headed and sets one's goals. Feedback allows one to see how close one gets to their goals. Richards who stressed the importance of providing the context of what one wanted to communicate might have coined the term feedforward to complement the term feedback used by cyberneticians precisely because the audience that he was addressing at the Macy Conference included the man who coined the term cybernetics, namely Norbert Wiener. The term feedforward as used by Richards suggested that in order to have one's communication understood it was necessary to literally feedforward the context of what one was planning to talk about.

Organization as Information

In an article entitled Propagating Organization: An Enquiry (POE) Kauffman, Logan, Este, Goebel, Hobill and Shmulevich (2007) argued that Shannon's (1948) classical definition of information as the

measure of the decrease of uncertainty was not valid for a biotic system that propagates its organization. The core argument of POE was that Shannon information "does not apply to the evolution of the biosphere" because Darwinian preadaptations cannot be predicted and as a consequence "the ensemble of possibilities and their entropy cannot be calculated." Therefore a definition of information as reducing uncertainty does not make sense since no matter how much one learns from the information in a biotic system the uncertainty remains infinite because the number of possibilities of what can evolve is infinitely non-denumerable. This contradicts Shannon who specified that the number of possible messages was finite.

Instead of Shannon information we defined a new form of information, which we called instructional or biotic information, not with Shannon, but with constraints or boundary conditions. The amount of information will be related to the diversity of constraints and the diversity of processes that they can partially cause to occur. By taking this step, we embed the concept of information in the ongoing processes of the biosphere, for they are causally relevant to that which happens in the unfolding of the biosphere.

We therefore conclude that constraints are information and... information is constraints... We use the term 'instructional information' because of the instructional function this information performs and we sometimes call it 'biotic information' because this is the domain it acts in, as opposed to human telecommunication or computer information systems where Shannon information operates (Kauffman, Logan, et. al., 2007).

A living organism is an open system, which von Bertalanffy (1968) "defined as a system in exchange of matter with its environment, presenting import and export, building-up and breaking-down of its material components." Instructional or biotic information may therefore be defined as *the organization of that exchange of energy and matter*. The fact that a biotic system is an open system can be used to argue against the association of instructional or biotic information with cybernetics because cybernetics focuses strictly on the flow of information and does not deal with the flow of energy and matter.

In POE it has been the associated biotic or instructional information with the organization that a biotic agent is able to propagate. This contradicts Shannon's definition of information and the notion that a random set or soup of organic chemicals has more Shannon information than a structured and organized set of organic chemicals found in a living organism.

The biotic agent has more meaning than the soup, however. The living organism with more structure and more organization has less Shannon information. This is counterintuitive to a biologist's understanding of a living organism. We therefore conclude that the use of Shannon information to describe a biotic system would not be valid. Shannon information for a biotic system is simply a category error. A living organism has meaning because it is an autonomous agent acting on its own behalf. A random soup of organic chemicals has no meaning and no organization (Kauffman, Logan, et. al., 2007).

According to Shannon's definition of information a set of random numbers transmitted over a telephone line would have more information than the set of even numbers transmitted over the same line. Once 2, 4, 6, 8, 10, 12 was received the receiver would be able to correctly guess that the rest of the numbers to follow the sequence would be the set of even numbers. The random numbers have no organization but the even numbers are organized so the mystery of the relevance of Shannon information deepens, as one must counter-intuitively conclude that information and organization can be at cross-purposes in Shannon's scheme of things.

This argument completely contradicts the notion of information of a system biologist who would argue that a biological organism contains information. It is by virtue of this propagating organization that an organism is able to grow and replicate, as pointed out by Kauffman (2000) in *Investigations.* From the contradiction between Shannon and biotic information we already have a hint that there is possibly more than one type of information and that information is not an invariant like the speed of light in relativity theory, which is independent of its frame of reference. We also see that perhaps Shannon's definition of information might have limitations and might not represent a universal notion of information. After all Shannon formulated his concept of information as information entropy to solve a specific problem namely increasing the efficiency or the signal to noise ratio in the transmission of signals over telecommunication lines.

The term information is generally regarded as some uniform quantity or quality, which is the same for all the domains and phenomena it describes. In other words, information is an invariant like the speed of light, the same in all frames of reference. But as Kauffman, Logan et al. (2007) have argued the notion of Shannon information and biotic information are quite different.

Is It Possible Not to Communicate?

Living beings (be they bacteria, plants, fish or humans) interact with their environments by reacting to stimuli, that is, by defining their immediate surroundings and adapting their conduct to them. That means interpretation of signs, processing of information and choosing a definite line of conduct. That is, *communicating* with their environment. In the same way that syntax, semantics and pragmatics are inseparable in communication phenomena, information, communication and interaction are inseparable in biotic systems, human culture included.

Action is innate in humans, and is not just a reaction. Meaning is foundational for the direct feeling and perception of "reality". Meaning is not inherent in the objects, but the ownership of the propositions, statements, and beliefs belongs to the receiver through their interpretations of the originating signals of the sender. The sense of presence in the world presupposes a real world through experience.

Meaning is not inherent to objects, but attributed by people in particular social situations. Additionally, the attribution of meaning to things never ceases. In the presence of another person, an object, a message or a social situation, an individual immediately tries to define the situation and attribute to it a meaning in the context of the immediate situation.

Assuming that it is not possible not to communicate, we emphasize the pragmatic dimension of communication. We argue that 'information,' 'communication' and 'social interaction' are inseparable elements of production of meaning, even if analytically they can be conceived as independent concepts. Thus, as in any communicational process there are three simultaneous dimensions operating as a system – syntactic, semantics and pragmatics, and it is also the case that 'information,' 'communication' and 'social interaction' are operating as a system. In this sense, speech acts owe their meaning to performances in the context of what information the sender sends, the interpretation of the receiver and the social interaction that exists between the sender and the receiver.

The pragmatist motto of Peirce states that the production of meaning is oriented to action, and that the idea of what a thing 'is' lies on the somatory of the effects that can be conceived as possible from it.

Beside this two main branches of pragmatist philosophy, there is also the approach of Ludwig Wittgenstein (mainly in his *Philosophical Investigations,* 1953), in which the meaning of an expression lies on its practical uses; that of John Austin (1962) and John Searle (1965), in which ordinary language is

seen as a resource for philosophical analysis, as well as those who see in pragmatism an adequate technical resource for the renewal of a transcendent philosophy of communication, such as Jurgen Habermas (1984) and Karl-Otto Apel.

According to Charles W. Morris, a semiotician and disciple of George Herbert Mead, the study of language has been traditionally divided between: a) a semantic approach, dealing with the relation of signs with the things they represent, that is, of signs with their meaning; and b) a syntactic approach, dealing with the relation of signs with other signs, such as the relation between words within a sentence, searching for the rules that ensure its meaning.

To Morris, both approaches do not solve neither the problem of meaning nor the problem of truth. Thus, a third approach – pragmatics – is needed to deal with the relation of signs with its users, that is, of sentences with the people who speak them.

The main concepts of a pragmatist approach towards language are, thus, missing concepts in semantic and syntactic approaches.

Thus, under a pragmatist perspective, communication is inseparable from the social act in which it is embedded. Communication is the mediation that allows collective social action. G. H. Mead's masterpiece *Mind, Self and Society* (1934) expresses in its title the central spots from which he understands human activity. 'Mind,' 'Self' and 'Society' are different elements of the same social process, his basic analytical units.

To Mead, the *act* (a complete unit of human conduct) derives from an impulse that produces perception, attribution of meaning, evaluation by participants and a final outcome: a process, which cannot be analyzed from just one of its parts. Mead's notion of society presupposes conscious individuals, who actively interpret the world in a never-ending relational process.

FUTURE RESEARCH DIRECTIONS

The understanding of information as an inseparable part of the integral process of meaning production converges to some of the most urgent and imperative demands of our era. We live in a society of individuals, of advancing of human and political rights and a fast pace of technological development. The outcomes of the process of cultural integration to the newest technology of communication are yet unconcluded and unknown (Braga & Logan, 2014; Hargittai & Hinnant, 2008; Livingstone, 2004; Park, 2012; Van Deursen & Van Dijk, 2010, 2015; Van Dijk, 2005).

Thus, research on Human-Computer-Interaction (HCI) may have a significant development if it includes into its research agenda the sensibility to social contexts in which its phenomena take place.

Future research directions would include a re-evaluation of the use of Shannon Information theory in the various disciplines in which it has been implemented to determine in what manner information and signal have been conflated. A signal no matter how accurately it has been transmitted and how accurately its information content has been calculated using Shannon's mathematical formula still has no meaning if the context or the pragmatics has not been also considered.

Another research trend to be explored regards the role of technologies of information and communication in social environments, where those technologies are essential to their organization, strategic development and their outcome.

CONCLUSION

What is communication? There are two alternative communication concepts that have coexisted since the term began to be used in the mid-nineteenth century: "communication as transmission" and "communication as ritual". Trying to answer the difficult question: what is communication?, Carey states that "communication is a symbolic process whereby reality is produced, maintained, repaired and transformed" (1989, p. 23) This definition challenges the notion (of Cartesian origin) that there is a dualism between 'fact' and 'discourse', between 'reality' and 'language:' 'reality' is a symbolic, social product. "The reality is constructed by communication through the use of symbolic forms." (Carey, 1989, p. 25)

All these distinctions, apart from their metaphorical subtleties, point out to the difference between a group of communication theorists who see communication as a matter of *transmission of information* (that is, syntax + semantics), and, on the other side, a group of theorists that regard communication as a matter of *social interaction* (syntax + semantics + pragmatics). In the first group, focusing on 'information', people (the "audience" or the "public") are seen as simple recipients receiving their messages, regardless of what they can actually do or think about it. The second group of theorists, in order to account for the pragmatics of social situations of 'follow the actors', integrate cultural approaches with communication practices. (Braga, 2008)

Depending on the emphasis a theory places on transmission or interaction results a completely different picture of what is "communication", "information" or "reality". These approaches are in fact complimentary and would enhance each other's reach and analytic potential if integrated.

As we have stated before, 'information,' 'communication' and 'social interaction' are inextricable elements of the production of meaning. By denying the pragmatic dimension of communication (reducing communication phenomena to the 'content' – or information) makes it easier for a researcher to analyse (as the avoidance the pragmatics would certainly reduce complexity). However, this reduction will have a cost: as we have seen, when pragmatics is not considered, there is a loss of meaning, this reduction causes the phenomenon to 'disappear'.

The transmission and social perspectives are not contradictory, but complementary. To emphasize the relational perspective is to value the idea that communication is human action, made by people. Under ethnographic perspective, it is possible to observe values and principles of a system in place being contradicted or reversed, through social resilience and creative subversions of the industrial prescriptions. (Braga and Logan, 2014) This perspective stresses that communication problems are "community issues", which relate to the communities that they have created and in which we live.

Thus we conclude that the processes of 'transmission of information' and communication are not same. Communication requires that the information that is transmitted, which is only a signal after all, must be processed within the ground of pragmatics or social context. Put simply communication is contextualized information contextualized through pragmatics and social interactions.

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KEY TERMS AND DEFINITIONS

Communication: A symbolic process whereby the social reality is produced, understood, maintained and updated in a given situation. Communication is the mediation that allows collective social action. Communication is contextualized information through pragmatics.

Data: The pure and simple facts without any particular structure or organization, the basic atoms of information.

Information: Structured, organized data. It is composed by syntax and semantics, that is, with reference to a code and to a given meaning.

Knowledge: The ability to use information strategically in a social context to achieve one's objectives.

Naturalistic Perspective: Empiricist approach of the Social Sciences based on the premise of collecting data essentially from "natural" situations, those that happen despite of the presence or participation of the researcher.

Pragmatics: A discipline that stands between Philosophy and Linguistics, and tries to define to which degree the human sense of 'reality' is determined by language. The production of meaning is oriented to action, and that the idea of what a thing 'is' lies on the sum of the effects that can be conceived as possible from it. Pragmatics is the use of social context to assist meaning.

Social Interaction: Mutual action and/or influence among co-participants of the same social situation.

Wisdom: The capacity to choose objectives consistent with one's values and within a social context.

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Chapter 2
Data Journalism

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ABSTRACT

The introduction of information communication technologies (ICTs) has transformed the journalism profession through the digitalization of the work process as well as the introduction of the internet along with its services. Many new types of journalism have emerged, among which is data journalism, which requires journalists to have special ICT skills. Data journalism is a new form of journalism that has appeared gradually during the previous years, driven by the availability of data in digital form. This chapter studies the issue of data journalism. Specifically, the chapter include a definition of data journalism as well as a discussion on the necessary ICT skills that journalists should have in order to cope with this new type of journalism. These skills are closely associated with the stages of the development of a data journalism project. Also, the relation between data journalism and open data will be presented due the importance of the latter in the development of data journalism.

INTRODUCTION

The introduction of ICTs (Information Communication Technologies) had a profound impact on every aspect of human activities. In the case of journalism, the utilization of ICTS has transformed the profession through the digitalization of the work process as well as the introduction of the internet along with its services (Veglis 2009). Today the journalist is expected to have the ability to firstly employ many tools and services in order to be instantly informed about breaking news as well as current events, and secondly, use a variety of tools and applications in order to prepare and disseminate news articles (Veglis & Bratsas, 2017). Many new types of journalism have emerged, among which, data journalism (Gray, Chambers, & Bounegru, 2012), which requires journalists to have special ICT skills.

In the recent years, data journalism has drawn significant attention in the academic literature as well as in the area of new developments in digital news production (Appelgrena & Nygren, 2014; Fink & Anderson, 2015; Mair & Keeble, 2014). Data journalism is considered to be a new form of journalism.

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It has appeared gradually in the dawn of the new century. Many factors have contributed to the introduction of data journalism, but one of the most prominent is believed to be the availability of data in digital form (Veglis & Bratsas, 2017). Data Journalism is a journalistic specialty reflecting the increased role of the numerical data has in the production and distribution of information in the digital era. Data can be the source of data journalism, and/or it can be the tool with which the story is told (Gray, Chambers, & Bounegru, 2012).

This chapter examines current trends and future perspectives of data journalism. The background section provides historic evolution and definitions of data journalism. Next, the stages of data journalism are presented in detail. Also, the relation between data journalism and open data is discussed due to the importance of the later in the development of data journalism. Finally, recommendations and future research direction are briefly discussed.

BACKGROUND

Evolution and Definition

Although the term data journalism started to attract attention at the end of the previous century, initial examples of data journalism appeared quite early. According to Simon Rogers the first example of data journalism was published at Guardian in 1821. It concerned the number of students who attended school and the costs per school in Manchester (Gray, Chambers, & Bounegru, 2012).

At the end of the 20th century, employing large data to write an article was difficult and required skills that went beyond the capabilities of the average journalist. That resulted in the phenomenon that some news organization in the United States and Great Britain were hiring programmers that worked on novel news products (Parasied & Dagiral, 2013). Traditionally, journalists used to rely on information provided by various sources (governments, officials, research studies, etc.). Of course, there were some cases of investigative journalism where journalists were able to find resources to gather and analyze their own data and publish their results in articles (Veglis & Bratsas, 2017). But as a growing amount of data gradually became available online, and efficient tools with which anyone can analyze, visualize and publish large amounts of data appeared, things changed significantly (Sirkkunen, 2011).

The concept of data journalism in not new. It has been around since the beginning of the digitalization. Digital data has been utilized in news production since the late 60s in US newspapers (Parasied & Dagiral, 2012). Data journalism gradually emerged with the rapid introduction of ICTs and the availability of data in digital form. The term data journalism is synonymous with data-driven journalism while the older term, computer-assisted reporting has vanished since it was introduced at the early stages of computer history (Bradshaw, 2010). It is worth noting that in the case of data journalism there is an increased interaction between journalists and several other fields such as design, computer science and statistics (Thibodeaux, 2011; Veglis & Bratsas, 2017).

The term data journalism is attributed to Simon Rogers that first mentioned it in a post to the Guardian Insider Blog (Knight, 2015). It can be viewed as a process that begins with analyzing, and continues with filtering and visualizing data in a form that links to a narrative (Lorenz, 2010). It combines spreadsheets, graphics data analysis and the biggest news stories (Rogers, 2008). It is fundamentally the production of news graphics and includes elements of design and interactivity (Bradshaw, 2010; Lorenz, 2010; Rogers,

2008). Megan Knight (2015) describes data journalism as "a story whose primary source or "peg" is numeric (rather than anecdotal), or a story which contains a substantial element of data or visualization".

Veglis and Bratsas (2017) proposed a definition in order to better address the power of visualization and interactivity that are significant factors in data journalism. They defined data journalism as the process of extracting useful information from data, writing articles based on the information and embedding visualizations (interacting in some cases) in the articles that help readers understand the significance of the story or allow them to pinpoint data that relate to them.

Journalists' Skills

Today the journalist is expected to possess various ICT skills in order to cope successfully with the challenges in his everyday work (Veglis & Bratsas, 2017). Typical examples are writing news articles, constructing diagrams via spreadsheet applications, communication via e-mail, visualizing data with the help of various applications, publishing material on the WWW (Peebles 2011). Also, they often seek information on the web and by e-mail (Veglis, 2013). Veglis and Pomportsis (2012, 2014) organized the journalists' ICT skills into five categories, namely Basic skills, Web publishing skills, Web 2.0 skills, Web casting skills and Data Journalism skills. Veglis & Bratsas (2017) extended this categorization by adding a category that refers to Web 3.0. Next, the six categories are briefly presented:

- Basic Skills: The journalist has the ability to work efficiently with office automation suites (which include word processing, spreadsheet, presentation, database), and with the basic Internet services (WWW, email). Specifically, the journalist is expected to have basic typing and formatting skills, and he must be able to perform basic functions in a spreadsheet. He must have at least a general understanding of how to use data to support news stories and he must also be able to use relational database programs to cross-check those data files to find various information (Veglis & Pomportis, 2014).
- Web Publishing Skills: In this case, basic knowledge of HTML is considered to be a necessary prerequisite, as well as the ability to use Content Managements Systems. The journalist should have an understanding of the basic concepts of HTML and cascading styling sheet (CSS) (Peebles, 2011). Except web publishing, the journalist must be able to work with widely used Desktop Publishing Applications (Veglis & Pomportsis, 2014).
- Web 2.0 Skills: Web 2.0 includes the utilization of various tools and services such as blogs, RSS, wikis, social bookmarking, and social networking (Facebook, Google+, Twitter, etc.). The journalist must be able to update the media organization's profile on social networks, and also to interact with the audience through various services, such as blogs, Twitter, Facebook, Google+, etc. (Veglis & Pomportsis, 2014). It is worth noting that the majority of the Web 2.0 tools and services can also be used by the journalists in order to receive updates on current events from various news organizations.
- Webcasting Skills: In this case journalists must have the necessary skills to create and publish podcasts and videocasts. The journalist must be able to record the audio of an interview, perform simple editing on the audio recording of that interview, and upload it to the WWW for the audience to have access to the podcast. In the case of videocasts, the journalist must be capable of making, at least, a short video story even if it is shot with a smartphone and must have the skills of using entry-level nonlinear video editing software, to move scenes around, to create a basic news

video (Fletcher, 2008). Podcasts are considered to be an effective way to use audio to broadcast news stories since they are easy to create and their size is relatively small. Videocasts are considered to be powerful tools to convey news, but they are more difficult to create in comparison with podcasts and their sizes are quite large (Veglis & Pomportsis, 2014).

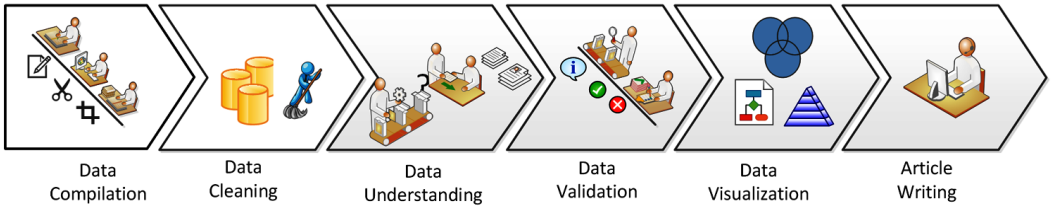
- Web 3.0 Skills: Include basic knowledge and experience with Web 3.0 technologies. Journalists must be able to a) understand the basics of Web 3.0, b) use the limited Web 3.0 tools currently available (but expected to grow exponential in the near future) c) create articles that comply with open data rules and link to other open data (Veglis & Pomportsis, 2014).
- Data Journalism Skills: Journalists must be able to find datasets, clean and filter the data, put them in context, find the story in the data, visualize the results and integrate them into a news story (Veglis & Bratsas, 2017).

DATA JOURNALISM STAGES

Veglis and Bratsas (2017) organized the data journalism workflow in six stages, entitled: Data Compilation, Data Cleaning, Data Understanding, Data Validation, Data Visualization and Article Writing. The workflow model is depicted in figure 1. Next, we briefly describe each stage.

- Data Compilation: A data journalism project begins in one of two ways: either the journalist has a question that needs data, or a dataset that needs questioning. The compilation of data can take one of the following forms: (i) data may be supplied directly by an organization (in some cases in the form of open data), (ii) data may be found with the help of advanced searching techniques, (iii) data may be compiled by scraping web pages, (iv) data may be collected by converting documents to other formats that can be analyzed, and (v) data may be collected by means of observation, surveys, online forms or crowdsourcing (Bradshaw, 2011). Data scraping is a process in which a software tool extracts data from a human-readable output that originates from other software. Also, there are free tools on the internet that allow users to convert documents to other forms that can be analyzed. For example, DocumentCloud is a web-based software platform created specifically for journalists to allow the searching, analyzing, annotation and publication of primary source documents used in reporting (Veglis & Bratsas, 2017).
- Data Cleaning: Also known as data scrubbing is the process of detecting and correcting corrupted or incorrect records from a dataset (Wu, 2013). This can be accomplished by removing human errors and converting the data into a format that is consistent with other data the journalist

Figure 1. Data journalism workflow



is using. Typical examples include empty entries, duplicate entries, the use of default values to save time or where no information was held, incorrect formatting (for example words instead of numbers), corrupted entries or entries with HTML code, multiple names for the same thing and missing data (Bradshaw, 2011). Cleaning data can be done in simple ways, for example using find and replace commands or filters in spreadsheets. There are also specialized tools, like Google's OpenRefine, which is a standalone open source desktop application for data cleanup and transformation to other formats. The application's interface resembles spreadsheet applications and it can open files of various spreadsheet formats (Veglis & Bratsas, 2017).

- Data Understanding: Datasets usually include various codes that represent categories, classifications or locations, and special terminology that it is not understood by journalists. Frequently further data is required in order for existing data to become meaningful. Overall journalists must be data-literate, meaning that they must be able to consume knowledge, produce coherently and think critically about data (Veglis & Bratsas, 2017). Additionally, journalists must possess statistical knowledge and also understand how to work with large datasets, how they were produced, how to connect various datasets and how to interpret them (Gray, Chambers, & Bounegru, 2012).
- Data Validation: This stage includes the process of cross-checking the original data and obtaining further data from sources in order to enrich the available information (Silverman, 2014; Veglis, 2013). It is worth noting that like any source, datasets cannot always be trusted since they come with their own histories, biases, and objectives. That means that journalists have to investigate issues like: who gathered it, when, and for what purpose, and how it was gathered (Bradshaw, 2011). This can be accomplished by investigating the history of the creation of the dataset, by finding references to the dataset or by using other sources of information that refer to the same subject (Silverman, 2014; Veglis & Bratsas, 2017).
- Data Visualization: Data visualization is a modern branch of descriptive statistics that involves the creation and study of the visual representation of data. It is the graphical display of abstract information for data analysis and communication purposes (Cairo, 2012). Static data visualizations offer only pre-composed "views" of data. Interactive data visualization supports multiple static views in order to present a variety of perspectives on the same information. Important stories include "hidden" data and interactive data visualization is the appropriate way to discover, understand and present these stories. In interactive data visualization, there is a user input (a control of some aspect of the visual representation of information) and the changes made by the user must be incorporated into the visualization in a timely manner (Veglis, 2015; Veglis & Bratsas, 2017).

It is worth mentioning that infographics are also part of the static visualization. Infographics are graphic visual representations of data or knowledge, which are able to present complex information quickly and clearly (Smiciklas 2012). They are often used in newspapers, to show the weather, as well as maps, site plans, and graphs for statistical data (Veglis & Bratsas, 2017).

There are many types of data visualizations. Heer, Bostock, and Ogievetsky (2010) defined the types (and also their sub-categories) of data visualization: (i) Time-Series Data (Index Charts, Stacked Graphs, Small Multiples, Horizon Graphs), (ii) Statistical Distributions (Stem-and-Leaf Plots, Q-Q Plots, Scatter Plot Matrix -SPLOM, Parallel Coordinates), (iii) Maps (Flow Maps, Choropleth Maps, Graduated Symbol Maps, Cartograms), (iv) Hierarchies (Node-Link Diagrams, Adjacency Diagrams, Enclosure Diagrams) and (v) Networks (Force-Direct Layout, Arc Diagrams, Matrix Views).

Today there are a lot of available online tools that can be used for creating interactive data visualizations. All of them are either free or offer a free version (except a paid one that includes more features). Some of the most widely used tools are CartoDB, Google Chart Tools, Google Fusion Tables, Tableau Public, Many Eyes, and Infogr.am. A complete list of the available tools can be found at http://selection.datavisualization.ch.

Article Writing: The last stage in a data journalism project includes the writing of the news article. Depending on the intended publication medium, the article may include special characteristics (for example external links other articles or related material, multimedia content, mashups, static or interactive visualizations) in order to fully take advantage of the medium's potentials (Veglis & Bratsas, 2017). The amount of text that is included in the data journalism article along with the visualizations may vary considerably. Specifically, we can have the case where the visualization supplements the text (which is quite extended) as well as the case where the visualization is the center of the project and the text plays a supplemental role, explaining parts of the visualization.

FUTURE RESEARCH DIRECTIONS

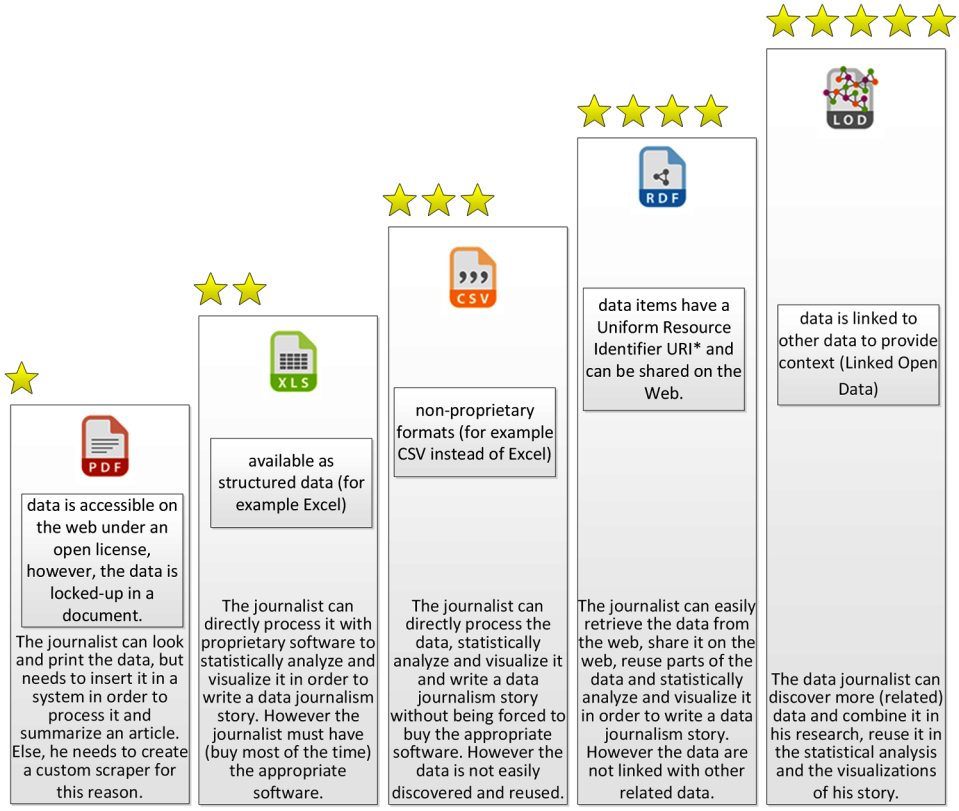
Tim Berners-Lee believes that "data-driven journalism is the future" and urges reporters to hunt for stories in datasets (Arthur, 2010). We are convinced that the Semantic Web and Linked Open Data will play a significant role in the evolution of data journalism. In the future, journalists should be able to comprehend and utilize advanced technologies which will include more "intelligent web" (Bradshaw & Rohumaa, 2011). Semantic Web technologies, smart devices (smartphones etc.) and tools are continuously being transformed and upgraded. Data journalism ought to adopt these technologies. It is worth noting that Web 3.0 and open data can play an important role in the case of data journalism as they support the acquisition and validation of data which are the main source of data journalism.

Tim Berners-Lee, the inventor of the Web and Linked Data initiator developed a 5-star deployment scheme for Open Data, in order to encourage people – especially government data owners to produce well linked Open Data (2010). Veglis and Bratsas (2017) proposed an adaptation of the system for the journalists in order to act as a guide for them to produce articles in the Web 3.0 era. The star rating system is presented in figure 2 and includes the steps that a journalist can take in order to accomplish good Web 3.0 practices in journalism.

One other issue that needs to be addressed is the lack of online platforms that can support all stages of a data journalism project. Today there are several online tools that can be used in different stages of a data journalism project. Each tool has its own unique interface and the journalist must spend time in order to learn how to use it effectively. The majority of them do not offer any interconnectivity with other tools. Thus, the journalist spends a lot of time in order to transfer data from one platform to another in order to exploit the strong points of each tool. Data journalists can strongly benefit from the introduction of an online platform that will interface various online tools that can be used in data journalism projects.

* it is a string of characters used to identify a name of a resource over the WWW. The most common form of URI is the uniform resource locator (URL), frequently referred as a web address.

Figure 2. Star rating system for the use of good linked open data for journalists



CONCLUSION

This chapter discusses the issue of data journalism. Data journalism is considered to be a journalistic specialty that is expected to flourish in the world of data that we are living today. Data journalism stages were presented and discussed in detail. These stages define the skills that a journalist ought to possess in order to develop data journalism projects.

The above findings can guide journalism educators in order to adapt their programs. This is already happening since the constant changes in market demands, as far as journalistic skills are concerned, has forced journalism educators to adjust their programs in order to better facilitate the needs of the industry (Wenger & Owens, 2012). Currently data journalism is taught in a limited number of journalism schools in Europe. Of course this is something worth investigating more thoroughly in the near future. A recent survey, concerning the use of data journalism in Greece, found a low penetration of data journalism practices in media organizations. Nevertheless the majority of the journalists appeared to agree with the importance of working with data and was interested in acquiring more knowledge and skills concerning data journalism (Veglis & Bratsas, 2017).

There is no doubt that the majority of the journalists today are not involved in data journalism projects, although they are willing to work on such projects in the future Online journalists appear to be more involved and more motivated towards data journalism and since there is an ongoing shift to online journalism (Cokley, Edstrom, McBride, & Ranke, 2015), we have to expect many new developments in the area of data journalism.

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KEY TERMS AND DEFINITIONS

Data Cleaning or Data Scrubbing: The process of detecting and correcting corrupted or incorrect records from a dataset.

Data Journalism: The process of extracting useful information from data, writing articles based on the information and embedding visualizations in the articles that help readers understand the significant of the story or allow them to pinpoint data that relate to them.

Data Scraping: The process in which a software tool extracts data from human-readable output that originates from other software.

Dataset: A collection of data that contains individual data units organized in a specific way and accessed by a specific access method that is based on the data set organization.

Data Validation: The process of cross-checking the original data and obtaining further data from sources in order to enrich the available information.

Data Visualization: The graphical display of abstract information for data analysis and communication purposes.

Open Data: Data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike.

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Chapter 3
Investigating Diachronic Variation and Change in New Varieties of English

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ABSTRACT

This contribution focuses on processes of language feature convergence which gradually lead to linguistic stabilization over time, whereby specific attention will be given to the process of Englishization in the South-Asian area. The chapter outlines some basic concepts pertaining language universals, contact, and change, as well as descriptive approaches to world varieties of English by referring to the feature classification proposed by Meshtrie and Bhatt. Then, as an explanatory case, it presents the results of a study of verb-particle constructions in a well-established variety of English (i.e., Indian English) obtained by sampling data from sources varying in time, genre, and register with a special focus on the methodological procedures and the analysis tools adopted to extract specific information from the data. Finally, the implications of those findings for future research on the process of language standardization in new varieties of English will be further explored.

BACKGROUND

The Study of Indian English From a Language-Contact Perspective

The issue of contact instantiating processes of pidginization and creolization can be differentiated according to varieties that arise through contact with languages coming outside the area, especially through colonialism and varieties that arise through internal contact among languages already indigenous to the area (Schiffman 2010, p.741). From this perspective, the South-Asian region can be considered a paradigm example of the phenomenon known as "convergence area" (Weinreich 1958) referred to phenomena specifically occurring in language contact situations that lead to changes in all areas of grammar.

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Some decades after Weinreich's descriptive study, Charles Ferguson (1992) published a comprehensive essay on some features of "language use" that make South Asia an interesting subject of study as "sociolinguistic area". His attention to "shared patterns of use" and not only of shared grammatical structures was an important step towards the understanding of general processes of language change in contact situations. Ferguson's particular perspective, in fact, "looks for the relationship between diachronic language change and language development, phonology and syntax, social conventionalization and cognitive processing, and language universals and individual differences" (Huebner 1996, p.12). Consequently, in studies concerning the development of new varieties, a crucial issue is the extent to which universals of language (Pinker 2003, p.23) and language contact exert their influence on shaping those language systems. Recent research has tested current hypotheses on the interrelationship between language universals and language variation and given rise to new challenging theories on contact varieties. Namely, the notion of "vernacular universals" (Chambers 2004) limits the supposed tendency towards the absolute creativity of these varieties relying on the identification of universally shared features across varieties of English around the world.

The Study of Indian English From a Comparative Perspective

To date, two important issues have not been exhaustively examined by experts in the field of variationist studies: the first deals with the characterization of Standard English at the time of colonization that was slightly different from today's standard against which new varieties of English are usually investigated, the second concerns possible internal and deterministically governed developments occurring in both early / late Modern English and its new emerging varieties[1].

When considering the peculiar contact situation in the Asian subcontinent English has played a major role in influencing local South Asian languages, though it was not the first European language to have an impact on them since Portuguese was already attested in the area before the founding of the East India Company in the early 1600s. By the end of the 18th century, the knowledge of English had grown greatly and replaced Portuguese as the lingua franca of India (Nihalani 2005, vi). However, it is worth noting that the General Report on the Census of India, 1891 still records a low average percentage (4.4%) of 'those who know English' (Baines 1893: 224) and "not anyone who learned English in India was taught directly by a native speaker of the language" (Nihalani 2005, vi). Moreover, the local British community is at that time supposed to be expanding to what Schneider (2007, p. 37) defines as "British plus: genuinely British no doubt, but seasoned with the additional flavor of the colonial experience which those who stayed 'home' do not share". 'Colonial lag' is the expression used to refer to the consequent conservatism in colonial varieties as a potential factor in distinguishing them 'from their home counterparts in all levels of language' (Bauer 2002, p. 5). Overall, some features of a colonial dialect can be predicted from the form used by the majority of the settlers (Bauer, 2002, p.11) who, in the case of India, came originally from the city of London (Salaja 2009, p. 95)[2]. Anyway, 'in the colonial situation, a lot of speakers of many different dialects come face to face, and in the short term the result is a period of diversity where everyone is accommodating to everyone else […]n most cases the form used by the majority will be the form that survives in the new mixed dialect' (Bauer 2012, p. 8).

The Emergence of a New Variety

Apart from deviations and occasional 'errors', it is therefore possible to classify the features of IndEng into three groups (Meshtrie & Bhatt 2008, p. 47):

1. Dialect features of the superstrate which have survived despite the norms of instructed English
2. Features of early modern English surviving in a particular colony
3. 'True' innovations in IndEng with no equivalent forms in modern English.

Some of the possible effects of these factors on the characterization of the emerging variety can be seen in Table 1. Significantly, when comparing the number of innovations characterizing IndEng and late Modern English, the distance between them dramatically reduces at least for some of those aspects that are generally considered as Indian English-specific (Calabrese 2012, 2015).

In particular, the increase in Verb + particle combinations[4] within the class of multi-word verbs, made up of a common verb, often one syllable combined with a preposition, has been considered as one of the most important characteristics of the modern English vocabulary (Baugh & Cable 2002, p.345). As a matter of fact, the changing uses of prepositions clearly reflect the idiomatic changes[5] in a language from one age to another (ibid., p. 248) following the developmental path from synthetic[6] to analytical constructions. This steady process dating back to Old English led to a gradual structural shift "from a productive system of verbal prefixes to a new system of post-verbal particles [in which] phrasal verbs as well as prepositional verbs come to be the functional equivalents of the older prefixed verbs" (Brinton 1988, p.185). The same tendency to favor phrasal verbs instead of simplex verbs to express aspectual meanings can frequently be observed in contact situations as well (Danchev 1992, p.30). The resulting poly-verbal constructions represent a type of paraphrase that has been described as an 'achievement strategy' that helps communication when the semantic components of a lexical gap in the interlanguage are rearranged linearly and made explicit through separate free morphemes (Danchey, 1992).

Earlier research (Sorace 2005; Calabrese 2008, 2010) on the interpretation of prepositional phrases (PPs) as adjuncts or arguments of verb phrases in Second Language Acquisition (SLA) had highlighted the difficulty by second language learners to automatically integrate syntactic knowledge and information from other domains of language (e.g. morphology and semantics). As a result, the most discriminative feature in determining the choice of a given preposition proved to rely on semantic factors directly depending on the class of the verb. The logical form associated with a given verb is supposed to enhance the interpretation and production of verbs with similar logical forms and sub-categorization frames (Calabrese 2010: 58). For example, the verb provide belongs to the same semantic domain as give so that the same sub-categorization frame and logical form are assigned to it in the process of SLA leading to deviant forms such as *provide to attested in IndEng.

Table 1. Linguistic features emerging in Late Modern English and Indian English

Linguistic feature	Late Modern English	Indian English
Increase in Verb+particle combinations	✔	✔
Extensive use of Verb+particle combinations as nouns	✔	✔
Tendency to eliminate 3rd pers –s marking of do[3]	✔	✔
Lexical expansion (borrowings, loanwords, neologisms)	✔	✔

A CASE STUDY

The concepts outlined so far and the related methodologies of investigation have provided the rationale for the present preliminary study aiming to diachronically investigate the development of new verb-particle combinations in spoken or speech-like data. Following a corpus-driven approach to the analysis of data, a sample diachronic corpus of Indian English has been queried in order to investigate the structural properties of this new variety from a diachronic perspective. Indeed, the study is based on the assumption that looking backwards at past stages of language development will contribute to identify convergence phenomena over time and gradually reconstruct the shape of a new variety as a standardized language. In particular, the main focus will be on changes in the lexico-grammar interface which shows more gradient properties typical of structural nativization (Schneider 2007).

Since a key aspect of corpus design for most studies concerning diachronic variation is including the range of linguistic variation that exists in a language in a given historical period and not the proportions of variation (Biber et al. 1998, p.247), a stratified approach has been adopted by sampling data from different genres and time periods to study the frequency and use of verb-particle constructions as a structural property of IndEng rather than an effect of its 'deviant use' of English.

METHOD

Materials

The corpus, on which the present study is based, combines data of the Diachronic Corpus of Indian English (henceforth DiCIE)[7] covering the years from 1835 to 2010 and parallel selected sections of the Indian component of the International Corpus of English (ICE-IND) dating back to 1978. The corpus has been designed on the model of both ICE-IND (Greenbaum 1996) and the Corpus of Contemporary Indian English (CCIE, Balasubramanian 2009) so that the final version of the entire corpus will have a comparable, balanced configuration with respect to the model corpora considered in the research. The corpus contains printed editions of the Indian national newspaper The Statesman that were copied from microfilms of the 19th century issues and are part of the British Library Newspaper Collection.

For the purpose of this preliminary study, certain sections of ICE-IND including spoken data such as speeches, reported legal cross-examinations and written data such as letters[8] to the editor (tagged as <S>, <LCE>, <LE> respectively) have been selected in order to be compared to similar samples from the DiCIE. More specifically, the spoken data includes audio files of Gandhi (<GANDH-S>), the past Prime Minister Singh (<SINGH-S>) and the MP Lalu Prasad's (<LP-S>) speeches sampled for the years 1930-47 and 2010 respectively[9].

Procedure

The sections of the corpus including <LCE> and <LE> were created by converting in electronic format the printed texts published in The Statesman between the years 1835-1951.[10] The oral data derive from audio/video files available online along with their transcriptions convertible in .txt files to make them readable by concordancers and annotation tools. The collected data were automatically parsed by using the language analysis tools available at the VISL website (http://beta.visl.sdu.dk/). The parsers provided

by the VISL interface are based on the theoretical framework of the Constraint Grammar, a methodological paradigm widely adopted in Natural Language Processing (NLP) which can provide both syntactic and semantic information on a given constituent structure by assigning tags of lemmatization, inflection, derivation, syntactic function, constituent dependency, valency, semantic classification. The system also marks the dependency relations between parts of speech (POS) with the symbol @ placed before (>) or after (<) the head and proves therefore to be particularly useful for investigations on lexico-grammatical and morpho-syntactic patterns in specific variety usage. Upper case tags describe word classes as well as morphological inflection (e.g. MV= main verb, PRP= preposition, N = noun, GN= genitive). Once annotated, the corpus can be therefore queried for specific tags using a concordancer to find out possible examples of convergence or divergence from the standard usage in the variety under investigation.

Verb-particle combinations were searched for in the corpus and then mapped onto VISL tags by observing the constituent structure of the Verb Phrases and the Prepositional Phrases along with their functional categories. In order to accurately classify and estimate all MV+PRP occurrences in the annotated corpus, a specific syntactic setting was established in the queries and all examples of MVs occurring with PRPs as their right collocates could easily be extracted. The features examined in the study and the corresponding VISL tags are shown in Table 2. As an example, the following tags have been searched for in order to study the frequency of Verb-particle combinations (tagged as PIV) as well as verb + adjunct constructions (tagged as ADVL) in Indian English.

Examples (1) and (2) show different annotations for different functional interpretations of the PPs in the annotated corpus.

In example (1) the PERS pronoun [him] is annotated as an argument of the preposition (P) on the left (@P<, while the prepositional phrase [upon him] is annotated as an adjunct/free adverbial.

(1) They[they] PERS 3P NOM @SUBJ> immediately[immediately] ADV @ADVL> sprung[spring] <mv> V PCP2 PAS @ICL-N< upon [upon] PRP @<ADVL him [he] PERS MASC 3S ACC @ P<, [,] PU @PU (<LE>, 1835)

In example (2), the prepositional phrase is not interpreted as an adverbial or adjunct and the noun (copies) is annotated as prepositional object / valency.

(2) you [you] PERS 2S/P NOM @SUBJ> can [can] <aux> V PR @FS-<ADVL be [be] <aux> V INF @ICL-AUX< furnished [furnish] <mv> V PCP2 PAS @ICL-AUX< with [with]PRP @<PIV copies [copy] <cjt-head> <sem> <cc-r> <idf> <nhead> N P NOM @P<

Table 2. Features examined in the study and corresponding VISL tags

POS	Functional Category	Definition
MV /PRP	@[<]ADVL[>]	adjunct [free] adverbial
MV /PRP	@P<	argument of preposition
MV /PRP	@[<]PIV[>]	prepositional object / valency

The starting point of the analysis was a selection of features (in grey) from the list of grammatical traits identified in past literature (Meshtrie and Bhatt 2008; Sailaja 2009; Schneider 2004, 2007, 2011; Schneider & Zipp 2013) as characteristic of IndEng (Table 3). Once annotated, tags for each selected feature could automatically be extracted from the corpus with the application of the ConcApp concordancer and then manually mapped to the corresponding structural patterns selected for the study (Table 3).

In order to estimate the occurrence of those patterns in British English as well, the findings were compared to sample data taken from an interactive database, namely Phrases in English (PIE) which provides quantitative information on recurrent phrase structures in the British National Corpus (BNC). The queries were ordered according to specific criteria such as minimum frequency of the searched item (e.g. n=1), data chunk size (e.g. n=1000 which corresponds to the average number of tokens examined in DiCIE) and word forms or POS tags to match or exclude from a given query within a specified range of n-grams (from 1 to 3).

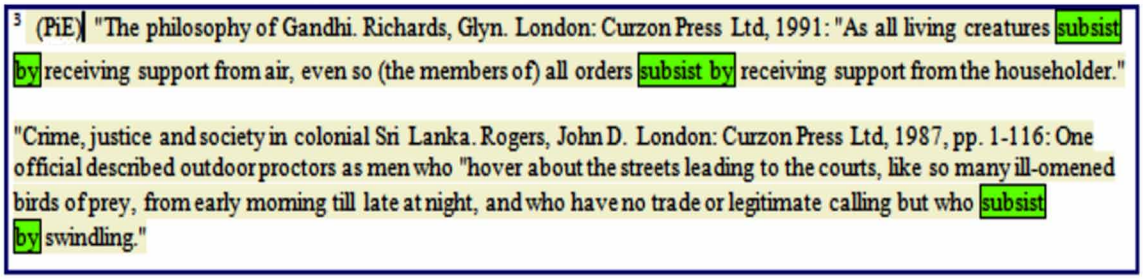
Figure 1 shows examples from BNC through Phrases in English (http://pie.usna.edu/) which are significantly attested in IndEng sources.

Then, the forms not attested in the BNC were searched for in the New Oxford English Dictionary (OED) in order to get a further matching with a valuable lexicographic source including information about the history of each entry under study. This procedure was necessary to find out possible rare as well as dated occurrences attested in BE as well as in the DiCIE. This method revealed that forms in the DiCIE such as be fathered upon/on, descanted on, lavished upon, removed to not attested in the BNC were archaisms attested in the OED. The comparative analysis was therefore carried out to test two main hypotheses:

Table 3. List of structural features (in grey) examined in the study

Grammatical Features	Type of VISL Tags Used
Verb Phrase: -Particle verbs -Changes in valency patterns Preposition Phrase: -Prepositions Lexico-grammar - Collocations/Phraseology	 MV PRP functionally specified as: @ADVL=adverbial; @PIV=prepositional object MV</> (as dependency markers)

Figure 1. Examples from BNC through phrases in English


[3] (PiE) "The philosophy of Gandhi. Richards, Glyn. London: Curzon Press Ltd, 1991: "As all living creatures subsist by receiving support from air, even so (the members of) all orders subsist by receiving support from the householder."

"Crime, justice and society in colonial Sri Lanka. Rogers, John D. London: Curzon Press Ltd, 1987, pp. 1-116: One official described outdoor proctors as men who "hover about the streets leading to the courts, like so many ill-omened birds of prey, from early morning till late at night, and who have no trade or legitimate calling but who subsist by swindling."

Hypothesis 1: Data dating back to different time periods show a number of shared traits of convergence toward a set of nativized / localized forms or linguistic habits.
Hypothesis 2: Data dating back to different time periods show clear signs of divergence with respect to: (a) the target norms (BE) and (b) the set of localized forms identified in previous literature.

Results

Particle Verbs

In previous descriptions of the IndEng variety, particle verbs have been pointed out as the most typical and innovative area of lexicosyntactic Indianisms (Sedlatschek 2009, p. 149). To test whether any of the early attested combinations (in 1835) had followed a gradual path toward integration and stabilization in IndEng over the years, the comparative approach of using each sub-corpus compiled for each decade side-by-side was employed to describe the development and use of those combinations.

Table 4 gives the occurrences of the individual combinations across decades in the DiCIE as well as in the British National Corpus.

Since the interpretation and selection of prepositions as arguments and/or adjuncts is a semantic class phenomenon rather than an item-specific phenomenon (see 'Background'), the forms attested in the corpus were then grouped by both semantic domains and following particles (Table 5).

Though the individual counts for each 'deviant' occurrence emerging from the analysis of the data are very low to reach statistical significance, their occurrence in the corpus is a 'linguistic event' that cannot be disregarded, 'since the corpus linguist is interested in assessing and interpreting the results anyway' (Schneider & Zipp 2013).

Discussion

The study of the data attested in the DiCIE has been carried out following two types of analysis. Following a purely data-driven procedure, the annotated corpus was first queried for the structural patterns underlying both phrasal verbs and particle verbs through their morphological features and syntactic dependencies. Then, the patterns of occurrence of the grammatical features identified in the DiCIE were compared to those attested in BE by querying the BNC. The results of previous analyses of the corpus had already shown that particular lexico-grammatical patterns are attested in DiCIE but not in ICE-IND where some other non-standard English patterns can occur (e.g. SINGH-S India's regard and respect in our ancient culture, My respects to all at home vs BE respect for) (Calabrese 2012). In some other cases (ib.), two competing constructions could co-occur within the same corpus (e.g. ICE-IND Health permitting I would like to attend to Platinum Jubilee along with It was a very good news that you attended a meeting of the Board). The current study has shown some changes in the valency patterns of some verbs (e.g. accept of, acquire of, approve of, lack in) resulting in the creation of new verb-particle constructions as well. From a diachronic perspective, therefore, a remarkable difference emerges between the data from 1835, 1909, 2010 sources and the BNC as far as the occurrence of verb- particle constructions is concerned. While the texts from the year 2010 contain examples of items such as quibble over, return +obj.+ to, no such constructions can be found in the samples from the year 1909.

Table 4. Occurrences of verb-particle combinations across time periods

	BNC (2011)	1835	1894	1909-1931	1940-1947	1951	1978	2010	N=
accept of	tr.	2					+obj.		3
acquire of	tr.	✔							1
approve of	tr.	2					✔	✔	4
be adapted into	To					✔		✔	2
chase to	after, in	✔	✔	✔					3
contain of[11]	tr.	✔	✔			✔	✔		4
convene on	(for/no obj.)				✔				1
excluded over	From	✔							1
be fathered upon	On		✔						1
fitted of	with, in		✔						1
justified in	tr.	✔						✔	2
lack in (of)[12]	tr..			✔					1
lavished upon				✔					1
quibble over	About				✔				1
reflect to	on, upon							✔	1
removed to	From	✔	✔	✔					3
sprung upon	up, from	✔							1
subsist by	(n=2)[13] on/in	✔	✔	✔					3
TOTAL									33

FUTURE RESEARCH DIRECTIONS

The comparison of data from different time periods suggests that, along with regular standard usage of common particle-verb combinations the creation of new combinatory lexico-grammar patterns is an overall phenomenon occurring regularly and steadily over time, even though regularity in the occurrence of individual items is attested only for a couple of items as shown in Table 4. At this stage, there is no definitively explanatory information from the available materials to establish whether the innovative elements attested in the corpus reflect an individual or an entire community of speakers' linguistic habit. Regular occurrence of innovative features in other sources across time needs to be further investigated to provide evidence of their stabilization in the variety.

CONCLUSION

The analysis of the data has shown rare signs of convergence over time. As matter of fact, some evidence of 'divergence' represented by innovations in lexico-grammatical patterns has emerged probably due

Table 5. Distribution of verb-particle constructions by prepositions and semantic domains

Prepositon	Example	Semantic Domain	n=
of	accept of	Mental	1
	acquire of	activity	1
	approve of	Mental	4
	contain(of[14])	Existence	4
	fitted of	Existence	1
in/into	be adapted into	Effort	2
	justified in	mental	2
	lack in	existence	2
	transmitted in	Activity	2
to	chase to	Activity	1
	reflect to	Existence	1
on/upon	convene on	Communicative	1
	be fathered upon	Existence	1
	sprung upon	Activity	1
	lavished upon	Activity	1
over	excluded over	Activity	1
	quibble over	Communicative	1
for	contend for	Communicative	1
by	subsist by	Existence	3

to an augmented transparency. Linguists generally tend to distinguish between intralinguistic and extralinguistic factors when discussing principles underlying change and evolution. Conditions which are purely internal to language depend on speech production, perception, and processing, whereas extralinguistic conditions include factors determined by language use in historical and sociolinguistic settings. Some of them can be explained by speakers' simplification strategies aiming to increase the economy of speech production in language contact situations which leads to the omission of inflectional endings, copulas, articles or the use of redundant form / meaning pairs. Some other forms attested only in 1909 sources far from being considered as individual or community innovations have simply become obsolete (e.g.DiCIE-LET-1909- I crave your indulgence) in modern English usage (see OED). Moreover, two of the most effective factors influencing any variety of English are represented by spatial distance and degree of contact with the changes that take place in the language among native speakers which will result in substantial differences across varieties. Although these findings cannot be given a highly statistical backing, they appear to reflect a general attitude on the part of IndEng speakers using such items more frequently in the years 1835, 1894, 1909 and 2010 than in the other years examined.

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KEY TERMS AND DEFINITIONS

Colonial Lag: The expression used to refer to the consequent conservatism in colonial varieties as a potential factor in distinguishing them from their home counterparts in all levels of language.

Convergence: Here used to characterize phenomena specifically occurring in language contact situations which lead to changes in grammar.

Diachronic: Linguistics investigates the historical development of languages and their changes over time.

Sociolinguistic Area: An area where shared patterns of use can be observed especially in contact situations.

Structural Nativization: Structural changes in a new variety combining features from both the substrate and the superstrate languages.

Synchronic: Linguistics describes a 'state' of a given language at one point in time.

Vernacular Universals: Universally shared features across varieties of English around the world.

ENDNOTES

1 Early Modern English covers the period when the first British settlers arrived in India; Late Modern English can be referred to the period when early attempts to introduce English in formal education were made in India (Mahmood 1895; Law 1915).

2 See for example Bauer (2002, p. 9) who motivates rothicity in North America with the origin of most English-speaking settlers from rothic regions of Great Britain.

3 See Baugh & Cable 2002, 344.

[4] A comprehensive and updated study of verb-particle constructions has been recently published by Thim (2012) who also provides an extensive review of past literature.

[5] To effectively illustrate the process of development from the literal meaning to the figurative one, Kennedy (1920, p.15) compares, among the others, the different meanings of compound verbs such as overlook, overtake, overturn, withdraw and withstand with the corresponding verb-particle combinations look over, take over, turn over, draw with and stand with. The aspectual meaning of post-verbal particles such as away, down, through, up is interpreted as a figurative extension of the concrete meanings of the original adverbs (ibid.).

[6] Synthetic constructions like pre-verbal incorporated adpositions can be found all over Germanic and Romance languages, in which prepositions have been incorporated as verb prefixes (Givón 2009, p. 109). The same process of incorporation can be said to be still going on in English in which prepositions are incorporated post-verbally in conformance with the current V(erb) O(bject) word order (ibid., p. 110).

[7] The DiCIE consists of 833,990 tokens of spoken and written data collected in the year 2010 as part of a four-year project funded by the University of Salerno, Italy.

[8] Letters signed with European names were excluded from the research.

[9] Other variables like the geographical distribution and educational background of the speakers were not considered for the purpose of the present study.

[10] The data conversion was carried out by using the Optical Character Recognition (OCR) system which turns scanned texts into digital .doc and .txt texts.

[11] This entry is also attested in Nihalani (2005).

[12] Also attested in Nihalani (2005).

[13] The forms attested in the BNC come from IndEng sources.

[14] This entry is also attested in Nihalani (2005).

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Chapter 4
Negotiating Local Norms in Online Communication

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ABSTRACT

This chapter investigates norms of English usage in a community of novice students on a net-based MA program. They communicated in academic seminars using textchat. They were found to develop their own norms for using reduced forms to speed up communication. Their teachers, who in the Vietnamese and Bangladeshi native cultures of the students should have been given great respect, did not have much influence on the norm-setting process, and even were addressed very informally in the discussions. The author argues that this is an affordance of net-based education that the discourse community sets its own norms of English usage, despite the members' lack of experience.

INTRODUCTION

This entry deals with norms of language use in online communication. Norms are a controversial issue for language learners, in particular when it comes to English usage. There are many varieties of English around the world, but they have different statuses. It is still the case that, for many learners, British and American English have the highest status, and are the only really "proper" varieties to learn; but for others the colonial and cultural hegemony associated with them makes them irrelevant, and even inappropriate, in local contexts.

The Internet has got the reputation of being very open regarding freedom of speech (cf. the Wikileaks scandals), and for being a place where very informal, speech-like language is used. Research has shown, though, that language use online can be a way for social minorities to find a voice, and for those with lower confidence levels to communicate more. Also, it has been demonstrated that non-native speakers contribute more in discussions online, especially with native speaker interlocutors, compared to face-to-face communication. Discourse communities in general have also been argued to develop their own language practices, through the act of using language. The issue under investigation here is what norms do Internet novices adopt in online communication with native speakers of English?

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Language production in online seminars by learners of English is analysed to see what norms they develop. The learners are studying on a net-based MA programme in English Linguistics. They were novice Internet users and had never taken a net-based course before this programme. Mostly they were native speakers of Vietnamese, apart from two speakers of Bangla, both cultures which value respect for teachers. The specific norm analysed are reduced forms, where users reduce either the form or formality of linguistic expressions, for example, writing *info* instead of *information*, or *yeah* instead of *yes*. Given this background, and given that it is an education context, we might predict that their language production will be more oriented towards the norms of their native English-speaking teachers, and be more formal. In fact, this was not the case, and there was evidence that the learners clearly developed their own norms of language use. Thus, this constitutes strong support for the idea that online communities develop their own local norms through using language.

The next section presents the theoretical background to these issues.

BACKGROUND

English in the World

The status of English as a global language is a phenomenon of a modern globalised world. However, the power of English is controversial, a controversy which for many has its roots in colonisalism and cultural hegemony. While English is the premier lingua franca for international communication, many see using its norms, and particularly those of British and American English, as betrayals of their cultural identity.

Kachru (1985) described the classic three concentric circles of English in the world, moving from the minority Inner Circle of native speaker norms, to the Outer Circle of the (mostly colonial) countries where English is the institutional language of government and education, etc., to the Expanding Circle of the rest of the world where English is a second or foreign language. Out of this World Englishes movement has come the strong belief that all varieties of English should have equal status, especially as targets for learners of English.

However, Expanding Circle varieties have had an equally controversial status, just as British and American English have. While some varieties have come to be viewed by the local population as acceptable varieties to learn and use, others have been derided as examples of "bad English". However, even such well-entrenched varieties such as Singapore English are not immune to criticism. Rubdy (2001) noted that the Singapore government had launched a "good English" campaign to clean up the use of Singapore English. In countries like China, there is even stronger criticism of the local variety, demeaningly named "Chinglish". In their surveys of attitudes of Chinese learners and teachers of English, Jin (2005) and Hu (2005) reported that speakers were very negative towards Chinglish, and for them, American English in particular was preferable. However, the situation among teachers of English is somewhat mixed. Hu (2005) noted that half of all teachers surveyed preferred to teach China English, and two thirds of them thought that it would become the standard for teaching English in China (the same has also been reported by He & Li, 2009 and Xie, 2014). The same debate is ongoing concerning Korean English or Konglish (cf. Rüdiger, 2014, for example).

An alternative view comes from the English as a Lingua Franca (ELF) movement. Given the fact that the Expanding Circle is much bigger than the rest, with roughly two-thirds of English speakers being non-native speakers (cf. the SIL Ethnologue, www.ethnologue.org), learners should be taught explicitly

how to communicate intelligibly with other learners. For instance, Jenkins (2002, 2007) has proposed a core of pronunciation features that are relevant for learners in lingua franca settings. However, this focus on communication involving non-native speakers only, plus the fact that there is still a prescribed set of norms that should be taught, has been criticised as being as extreme a position as one where native speaker varieties are seen as the only correct ones.

Canagarajah (2007: 94) refers to ELF as "a social process constantly reconstructed in sensitivity to environmental factors"; and Park & Wee (2012: 46) state ELF is "always shifting in form and situated within specific contexts". Regarding native speakers' place in such International Englishes, Berns (2008: 329) puts it that "native speakers have an important role, not as norm-setters, …, but as partners with non-native speakers…". Thus, we see it that all speakers need to adapt in cross-cultural communication settings, and it is in the interactions between speakers of English, both native and non-native, that norms of usage are negotiated. Indeed, we can even argue that the native/non-native dichotomy is obsolete, and that we should simply talk about "users of English".

This leads us onto norms in online discourse communities.

Norms in Online Discourse Communities

As argued by Pennycook (2010) and Park and Wee (2012) for example, language is a product of social action, and embodies the social practices that brought it about. According to Pennycook's (2010) ecological perspective, languages adapt to the environment they are used in. Language practices are negotiated and embodied in discourse communities, which are a "locally created social category" (Llamas, 2007: 581); and are "constituted by the language practices they engage in" (Pennycook, 2010: 124).

In the community of practice approach, discourse communities are seen as groups of individuals engaged in a particular task, with mutual engagement in that task, and with discourse practices to discuss that task (Lave & Wenger, 1991; Wenger, 1998). Communities set their own norms and practices internally, although there may be outside influence on them. As Canagarajah (2013: 7) puts it, "… grammatical norms … evolve from local language practices sedimented over time" but crucially adds that "…they are always open to renegotiation and reconstruction as users engage with new communicative contexts". So, norms in communities are fluid and can be changed. Li (2010) has noted that the Internet is leading to changes in perceptions of norms in English, which is why we will focus on online communication in our analysis.

Communities of language learners are an area of special interest to us, as they very much depend on the norms they are introduced to through pedagogical materials. The choice of what norms to promote and admit in assessment is of vital importance for teachers and learners alike. We mentioned in the introduction that we will concentrate on one particular norm of online communication, reduced forms. White (2011, 2014a, 2014b, 2015b) has argued in previous work that the use of reduced forms is evidence that a community of practice is being built and sustained, as they are examples of discourse practices negotiated by that online community. Thus, our basic question here is what kinds of norms for reduced forms are negotiated in online learner communities, those of native speakers or the learners' own?

Much research in online discourse has identified reduction processes for the purpose of speeding up communication, among other functions (cf. Herring & Zelenkauskaite, 2009). There are many different classifications of reduction processes, but we concentrate here on some very general categories. The following simplified system for reduced forms will be adopted for this analysis based on the common categories identified in the literature, as argued for in White (2015a: 76):

1. *Clippings (using pl for please, plus acronyms and initialisms).*
2. *Homophone respellings (using 4 for for).*
3. *Phonetic respellings (using yeah for yes, or evry for every).*
4. *Mixed categories of clipping plus homophone or phonetic respelling (using cos for because, or plz for please).*

The focus here is specifically on the reductions in orthography and morphology, although formality is an issue in phonetic respellings like *yeah* as well, as we see that these mark a particular type of discourse community. Other categories such as the orthographic expression of emotion and intonation, etc. are important features of CMC in textchat, but they are not of interest in this work.

Now, we present the data and participants in the study before we move on to the analysis.

NORMS IN ONLINE COMMUNITIES

Data and Participants

The participants in this study were users of English as a second language (30 in total), and were students on a net-based MA programme in English Linguistics run by a university in Sweden. They were not specially selected for a study, although they were told that the work they produced on the programme could be used by teachers for research purposes. Their consent was sought for the material to be used, informing them that they could say no at any time, and only those who gave their consent were included in the study. Two were Bangladeshi students studying in Sweden, and the rest were Vietnamese students based around Vietnam. The Vietnamese students were teachers of English at universities and colleges. All students required an average IELTS score of 7.0 to be admitted onto the programme. Their ages ranged from 23 to 45, and seven were men. An important reason why this material was used for a study was that the students were novice Internet users, and so it is unlikely they will have had access to native speaker norms in English computer-mediated communication before. As mentioned in the introduction, this was also their first experience of net-based education. Thus, the way they developed their discourse community and language practices was of particular interest.

The course where the data was taken from was the first course on their programme, an introduction to core topics in English linguistics, such as phonetics, morphology, and different sociolinguistic topics run in the Autumn semester of 2007. Thus, this was their absolutely first experience of net-based education. The data comes from seminar discussions with three teachers who are users of American, British and Irish English, respectively. The discussion in the seminars took place through Skype textchat. It is important to remember that the classes were not focused on proficiency, which will affect the way language is used. All students have been made anonymous in the presentation of the data, and are referred to as, e.g. Student 15. Typographical errors have been preserved.

The data was analysed linguistically through manual analysis first of all, by identifying reduced forms and counting which students used which forms. These were then checked by using the free concordancer software, AntConc, available from http://www.antlab.sci.waseda.ac.jp/antconc_index.html.

Having presented the data and discussed issues to do with the methodology employed, we present our analysis.

How Were Norms Negotiated?

If we consider first how the students interact and negotiate norms, we see that they generally support one another when a new reduced form is used:

Extract 1

Student 28: bb, *all you*
Student 6: *take care*
Student 4: *Goodbye*
Student 13: *Bye, Teacher 1*
Student 11: *Bye. will we meet tomorrow,summer group?*
Student 6: *bye everyone*
Student 8: bb
[Phonology seminar, Spring and Summer groups]

We find Student 28 using the informal *bb* for *goodbye*, which is then picked up by Student 8. There are, though, many examples of students persisting in their own norms:

Extract 2

Student 27: ex*: asked me in full pronunciation is {aSk t mi}, but when we speak fast we only pronounce {as mi}*
Student 23: *yes*
Student 22: *Elision is a process that not prouncing segment that might be present in the delibratelypronouncing of a word isolation*
Student 22: *Do you think so*
Student 25: *elision is typical of rapid, casual speech, the process of change in phoneme realisations produced by chanign th speed and cansulness of speech*
Student 21: *can you give more examples*
Student 24: *I agree with Student 22*
Student 25: eg: *loss of weak vowels*
[Phonology seminar, Winter group]

Student 27 uses *ex* for *for example*, but Student 25 uses *eg* which is the more standard (Inner Circle) norm.

In these communities, leaders in groups have a high status. The cohorts on the programme were divided into four groups, each with a leader. This leader was responsible for keeping order in discussions, and for arranging and leading group discussions without teachers. We see that leaders particularly strongly affect the others when they use particular reduced forms. Consider the following extract:

Extract 3

Student 21: *I think so*
Student 21: u *r just going too fast*

Student 20: *I agree*
Student 14: *I think so*
Student 22: *the same to me*
Student 18: u *have to describe the postion of each ending sounds and u know why*
[Phonology seminar, Autumn and Winter groups]

The leader of Winter group, Student 21, uses *u* as a reduction of *you*, and this is picked up by Student 18. However, it does happen that leaders are not followed, as the following shows:

Extract 4

Student 21: qu*3, page 69*
Student 25: *ing*
Teacher 1: *yes*
Student 25: Q*3*
[Morphology seminar, Winter group]

Here, we see Student 21 again using a reduced form, this time *qu* instead of *question*. In this case, though. Student 25 does not adopt this form, but uses *Q* instead, This non-adaptation, though, does not happen so often, and thus students are most often cooperative in adopting forms. It is also rarer, but we do also see non-leaders affecting other non-leaders:

Extract 5

Student 2: EX *pat -bat*
Student 12: *sorry I've lost which part are you discussing?*
Student 3: *how can we know that they are not overlap*
Teacher 1: *Are we all clear on how to establish if two sounds are allophones of one phoneme ?*
Student 2: *I mean minimal pair*
Student 4: *complemantary distribution, Student 12*
Student 9: *for* ***ex*** *in the words She and Shoe*
[Phonology seminar, Spring and Summer groups]

Student 2 uses ex for *for example*, which is then picked up by Student 9 (this form did not appear earlier in the discussion). Note that a similar form is supported in a separate group in Extract 2 above. Their groups are led by Students 1 and 7.

We have seen here, therefore, that students are generally cooperative when negotiating norms, but that individuals can persist in their own usage. High status individuals in the community in particular have power in this process. This is expected in dynamic communities where norms can be renegotiated, and it is also evidence that we have a community of practice which is in the process of negotiating its linguistic practices.

Next, we consider the role of the teachers in norm-setting.

Teachers and Norms

Given their status in Vietnamese and Bangladeshi cultures, we might expect the norms the English-speaking teachers follow would be adopted by the students. Indeed, we do find examples of this type:

Extract 6

Teacher 1: *Student 4, what exactly do you want* ***ex*** *of?*
Student 9: *very clear*
Student 8: *it's ok but two abstract*
Teacher 1: *Student 5? can you be specific?*
Student 8: *I mean too abstract*
Student 5: ***ex*** *of co-articulation effect*
[Phonology seminar, Spring and Summer groups]

This first extract has Teacher 1 using *ex* as a reduction of *example*, and this is adopted by Student 5. Thus, we see that native speakers do have some influence on norms in this community. However, these are rare examples, and mostly students do not adopt teachers' norms at all. The following is a representative example:

Extract 7

Teacher 1: ***T.Hanh***, *all sounds are allophones of some phoneme*
[… three contributions missing ...]
Student 18: *Can 2 allophones have the same envinronments?*
[… seven contributions missing ...]
Teacher 1: *Hanh, not if they are allophones of the same phoneme*
Student 17: *no, I mean*
Student 18: *Can I give an example of Vietnamese words?*
Student 17: *example of what?*
Student 7: *please go on* ***thuy hanh***
[Phonology seminar, Autumn and Winter groups]

Teacher 1 reduces the name of one student to *T.Hanh*, Student 18. However, Student 7 does not adopt this practice, though, but uses the full name, *Thuy Hanh*.

On the contrary, we find teachers adopting student practice, as in the following:

Extract 8

Student 15: *We all have done* ***Q.3***
Student 17: *Teacher 2, may be we should take another textbook.*
Student 18: *no problem with handout*
Teacher 2: *yes, i agree. we have one we use with other students that's much better*
Student 20: *that's good*

Student 15: *but with Research tasks*
Student 14: *yes*
Student 15: *difficult*
Student 17: *which one?*
Teacher 2: *so what did you get for* ***Q3****?*
[Morphology seminar, Autumn group]

Teacher 2 uses the reduction *Q* for *question*, following Student 15's use.

Thus, the teachers can be seen to have limited influence on the norms negotiated by the community. Given the background of these students, namely that they were novice Internet users and were new to net-based education, it is surprising that they still actively negotiated their own norms separately from those practiced by their teachers. We propose that it is an affordance of net-based education that they were able to do this. The community they formed were able to negotiate their own norms due to the distance created by the online environment.

Finally, we turn to how the teachers were addressed.

Addressing Teachers

When it comes to the status of teachers in this community, we see that they still do have high status. As mentioned in the introduction, teachers are held in high respect in Vietnamese and Bangladeshi society, and so should be addressed formally. We find this in the following common greetings:

Extract 9

Student 4: *Thanks,* ***teacher.*** *and I am still in vague about bound morpheme, are functions only as parts of words are bound morphemes?*
[Language and the media seminar, Autumn-Winter group]

Extract 10

Student 4: *more examples on co-articulation effect and assimilation,* ***Prof Una***
[Phonology seminar, Spring and Summer groups]

Extract 11

Student 25: *hOW ARE YOU,* ***Mrs Una****?*
[Phonology seminar, Winter group]

We see a variety of formal address forms. There are plenty of reductions, though, especially of this author's name which tended to be reduced to single syllables like *John/Jon* or *Jo*, as we see in the following:

Extract 12

Student 13: Jo *online now.*

[Morphology seminar, Spring group]

As the teachers were told informally by the students, they would not be able to refer to their Vietnamese teachers in this way, and this social pressure is still apparent, in that we see students asking whether it is ok to use a particular reduced form to address a teacher:

Extract 13

Student 17: *Hello,* ***Jon.*** *Can we call you like that?*
[Morphology seminar, Autumn group]

Student 17 asks if it is ok to use *Jon* as an address form. In face-to-face interactions with the same teachers at a university in Hanoi, the students were much more reluctant to use similar shorter forms, and even to use the teachers' given names. Given that very different behaviour is evidenced in online discussions, we see that this is further evidence that it is an affordance of net-based education to create closer, less formal discourse communities, and to create new social environments for interaction. The same sorts of conclusions have been made for computer-mediated communication regarding the amount and quality of communication by non-native speakers in much literature (cf. Sauro, 2012; Jenks, 2014, among others).

Recommendations

We have given evidence that even novices to net-based education create their own norms through using language. These norms are negotiated by the discourse community itself, mostly not adopting the norms that their teachers practiced. This suggests that communities act independently in negotiating their own language practices. This can be argued to promote the conditions for community autonomy and will lead more readily to learner autonomy. Therefore, we would like to propose that as teachers in academic discussion classes we should be more allowing of these practices. Such discourse environments have specific language practices, and other communities will adopt similar or completely different norms. It is up to the community itself to negotiate and adopt these practices. Through this, they strengthen the community and thereby facilitate the individual autonomy necessary for learning.

FUTURE RESEARCH DIRECTIONS

This research can be taken in a number of directions. Firstly, similar communities can be followed over a longer period of time to see if similar practices are negotiated, especially in an academic environment. Less formal communities may well negotiate in very different, and even more explicit, ways. In terms of pedagogy, an experiment can be set to compare a group that is allowed freedom to set their own language practices with one whose norms are restricted. How would the latter group react to these restrictions? A hypothesis that could be tested here is that the restricted group would prove to be less autonomous than the open group.

CONCLUSION

To conclude, we have seen that communities set their language practices independently of outside control. Groups of novices at net-based education were found to negotiate and adopt their own practices. This was argued to be strong evidence that a community had formed and was able to independently set its own practices. We hope we have convincingly demonstrated that in spite of cultural and linguistic influences, users of English can still practice and create their own language. To us, this is a sign of a strong community which allows its own norms to be negotiated and practiced.

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KEY TERMS AND DEFINITIONS

Discourse Community: A group of language users who communicate on a particular topic.
Inner Circle: The highest status varieties of English consisting of the "colonist" varieties.
Lingua Franca: A language variety used for communication between non-native speakers.
Net-Based Education: Education taking place primarily through online resources.
Norm: A linguistic form agreed upon by a discourse community as appropriate in a particular situation.
Reduced Form: Linguistic expressions reduced in form or formality.
Textchat: Quasi-synchronous use of language in written form.

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Section 2
Gaming

Chapter 5
Application of Gamification to Blended Learning in Higher Education

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ABSTRACT

Digital game-based learning (DGBL) has been identified as an effective digital teaching strategy to foster 21st century learning. The inclusion of digital game-based learning in instruction is challenging for educators to structure in higher education learning environments, often because of the lack of coherence with curriculum. Gamification is a recent DGBL strategy that enables the instructor to incorporate the motivational and engagement elements of games in ways that can be adapted to curriculum requirements. Gamification, supported with digital technologies such as web-based tools and learning management systems, offers the instructor the benefits of both face-to-face traditional instruction and online learning. An example of how blended learning in higher education incorporates gamification is presented. Study findings indicate that the blended gamified learning environment motivated learners and promoted cognitive, skill, and attitude development.

INTRODUCTION

Digital games have been identified as a teaching strategy that goes beyond conventional notions of pedagogy to create learning environments that feel "new, meaningful, and 21st century" (Johnson, Adams, Becker, Estrada, & Freeman, 2015, p. 34). The motivational aspects of games make them highly applicable in higher education to foster student engagement in learning (Connolly, E.A. Boyle, MacArthur, Hainey, & J.M. Boyle, 2012). However, a recent review shows that digital games are not being utilised to their potential in educational settings (Boyle et al., 2016). Research shows that the inclusion of digital game-based learning (DGBL) is often challenging for educators to implement in formal education

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learning environments (Faria & Wellington, 2004; Ritzhaupt, Gunter, & Jones, 2010; Van Eck, 2015). This chapter proposes the use of gamification in a blended learning environment as a low-risk strategy to promote more widespread use of DGBL in higher education courses. While gamification is an emerging strategy with many definitions associated with it, there is consensus that it involves "the integration of game elements, mechanics, and frameworks into non-game situations and scenarios" (Johnson, Adams, Becker, Estrada, & Freeman, 2013, p. 20). In this chapter, the relevant literature on blended learning, gaming, and gamification are reviewed, and an empirical case is presented, to illustrate the application of gamification to blended learning in higher education. The design and implementation of a gamified blended course are discussed and future research directions are proposed.

BACKGROUND

Blended Learning

A current trend in higher education is the implementation of blended learning (Halverson, Graham, Spring, Drysdale, & Henrie, 2014; Johnson et al., 2015). According to Graham (2013, p. 334), blended learning is commonly used to "denote a combination of traditional face-to-face and online instruction." Blended learning evolved from the research into effective teaching practices in higher education which indicated that teacher-directed, lecture-style instruction prominent in higher education learning environments often resulted in "surface-learning" of content (Marton & Saljo, 1976). Deep and meaningful learning promotes metacognitive and higher order thinking skills which are supported by learning strategies such as collaborative tasks, engagement in discourse, reflection, and self-regulated learning (Garrison & Vaughan, 2008). Nonetheless, it has been found that some learning strategies tend to be more effective in one learning environment compared to the other. For example, collaborative tasks in face-to-face learning environments provide emotional support through opportunities "to create a sense of community and connectedness more quickly," which is lacking in the online environment (Garrison & Vaughan, 2008, p. 28). On the other hand, reflection and discourse through self-regulation of learning is not as strongly supported by face-to-face learning interactions. It is the asynchronous nature of online learning activities that encourages collaborative discourse, reflection, and self-regulation of learning outside of class (Vaughan, Cleveland-Innis, & Garrison, 2013). Blended learning environments are therefore beneficial for mitigating emotional distance (Vaughan et al., 2013) and developing metacognition and higher order learning skills (e.g., S. K. Taradi, M. Taradi, Radic, & Pokrajac, 2005; Tsai, 2014).

Various frameworks have been proposed for designing blended learning. For example, Wu, Tennyson, and Hsia (2010) found that a combination of the following factors: cognitive (e.g., computer self-efficacy), technological (e.g., flexible access to online activities) and social interactions, contributed to learner satisfaction. Another framework that has been most prevalent for informing blended learning design is Garrison and Vaughan's (2008) community of inquiry (Halverson et al., 2014) where social and cognitive presence is addressed in the face-to-face and online environment. According to this framework, social presence is best promoted through learning activities (e.g., wikis, blogs) that engage students in small group discussions, collaborative research, and cooperative group work (Vaughan, Cleveland-Innis, & Garrison, 2013). Cognitive presence in the online environment is developed through inquiry with the community of learners, using ongoing reflection and critical discourse. Many online learning activities,

such as WebQuests, videos, simulations, and games provide learners with opportunities to gain knowledge and participate in a community of online inquiry (Figg & Jaipal-Jamani, 2015).

Digital Games

Generally, digital games are identified by a set of common characteristics that include explicit rule systems and players, visual and auditory components, action and conflict, players competing against each other, or the game system, and the attainment of an outcome or a clear and quantifiable goal (Gee, 2013; Salen & Zimmerman, 2004). Additionally, it is the interactions among the technology, player thinking, and social interaction that create the gaming experience for players (Shaffer, Squire, Halverson, & Gee, 2005). Three corresponding constructs, rules, play, and culture, as described by Salen and Zimmerman (2004), provide educators with a simple framework to understand how games are designed to promote the gaming experience. Rules refer to the features used to organise the game such as the structure, elements, and mechanics. These design features determine player input and output, what choices players make, and what the outcomes or rewards of the game are. Play describes players' immersion experiences with the game and includes motivation to play and the tactics and strategies used while playing. Culture encompasses the larger context of the game which could be fictional or nonfictional and includes values, narrative, and community building. It is the use of a combination of these game features (rules, play, and culture) that capture the player's attention and enable the player to experience emotional well-being (e.g., happiness, pleasure) and satisfaction of psychological needs such as autonomy, competence, and relatedness (Ryan, Rigby, & Przybyiski, 2006; Weber & Shaw, 2009).

Digital Games in Educational Settings

The use of digital games in educational settings has gained momentum because of the many benefits for the workplace and learning attributed to playing games. For example, many of the workplace skills employees are expected to have are similar to the skills that lead to success in gaming, such as strategic thinking, problem solving, and adapting to change (Federation of American Scientists, 2006). Many characteristics of the gaming environment are also purported to support development of 21st century learning skills or competencies (Granic, Lobel, & Engels, 2014), such as critical thinking and problem solving, collaboration and teamwork, and computer literacy (Trilling & Fadel, 2009). The motivational benefits of digital games, through entertaining and capturing the attention of the player for long periods of time, are well documented (Deterding, Dixon, Khaled, & Nacke, 2011; Gee, 2003). Additionally, digital games have contributed to cognitive, skill, and attitude development (e.g., Egenfeldt-Nielsen, 2007; Vogel et al., 2006). Research also points to the applicability of games in educational settings because the game experience is consistent with experiential views of how students learn (Gee, 2013). As Gee (2013, p. 18) succinctly points out, "games are just well designed experiences in problem solving" where factual knowledge is used as a tool to solve a problem. When digital games are used for educational purposes, characterised by some type of learning that occurs by interaction of the player with the mechanics of the game, this learning experience is called digital game-based learning, or DGBL (Van Eck, 2015). The most prevalent forms of DGBL in education are the use of commercial off-the-shelf games (COTS) which are easily accessible or serious games, ones designed to train or teach specific skills and content. The application of DGBL in higher education settings is not widespread (Boyle et

al., 2016) and this situation may be attributed to pedagogical and implementation issues and challenges experienced by instructors.

Issues and Challenges Using DGBL

A pedagogical issue that crops up when using COTS and serious games in educational settings is that commercial games may not meet a wide range of course learning outcomes. For example, the scope of the content covered by a video game may not adequately reflect the content as described in the course curriculum or provide sufficient scaffolding for learning complex content (Faria & Wellington, 2004; Lean, Moizer, Towler, & Abbey, 2006). This limitation has led to instructors making teaching modifications to teaching strategies and assessment tools. Therefore, serious video games or COTS are often not used as primary instructional activities and are perceived as "most useful as a supplemental resource or a consolidation tool for student learning of [the content]" (Jaipal & Figg, 2009, p. 5). Another pedagogical issue is the type of learning promoted by DGBLs. Instructors wanting to promote reflection and higher order thinking processes in their subject areas are challenged to find suitable games promoting such learning goals. Many serious games primarily support the learning and reinforcement of factual information or acquisition of knowledge (Kiili, 2005) and professional training (e.g., medicine and business; Boyle, et al., 2016) through drill and practice, quizzes and tests, and training simulations.

Factors that contribute to implementation challenges have also been identified in the literature. Technical competence, especially lack of expertise or prior experiences playing games, influences instructor confidence in their ability to incorporate digital games in instruction (Faria & Wellington, 2004, Ritzhaupt et al., 2010; Van Eck, 2015). Instructor perceptions of games as an effective learning strategy, also affect their adoption of games. Research shows that perceptions of games are "based upon [instructor] professional judgement of benefit and risk, rather than on the resources available" (Lean et al., 2006, p. 239). In light of these barriers to faculty adoption of DGBLs, gamification offers instructors a way to take advantage of the motivational and cognitive affordances of games, in spite of modest technical competence levels. Gamification also enables the tailoring of the learning activity to match specific student needs and learning goals with fewer changes to existing instructional practices (Figg & Jaipal-Jamani, 2015).

GAMIFICATION IN HIGHER EDUCATIONAL SETTINGS

Gamification

Gamification is a recent trend in many public sectors, including education, because it incorporates aspects of games that can motivate, increase participation and engagement, and has the potential to improve learning (Dicheva, Dichev, Agre, & Angelova, 2015; Seaborn & Fels, 2015). Admittedly, there is controversy around the use of the term gamification. Critics argue that gamification as described in the literature, with its emphasis on the use of points, badges and leaderboards for task completion and achievement, is really pointsification (Robertson, 2010, para 11). While gamification does include the strategy of pointsification, there is consensus in the education literature that gamification involves the application of a range of game design elements in non-game contexts (Deterding et al., 2011). Seaborn and Fels (2015) further characterise gamification as: 1) being designed for non-entertainment purposes

and 2) using elements of games, without creating a "fully-fledged game. In this way, gamified systems are game-like, but not a game" (p. 27). Studies on gamification in educational contexts do incorporate game elements beyond the points system (Dicheva et al., 2015). Besides the motivational game elements identified such as choice and rewards, Kapp (2012) and Stott and Neustaedter (2013) identify other dynamic gaming elements such as "providing learners with permission to fail, encouragement of out-of-box thinking, and fostering a sense of control" (Kapp, 2012, p. xxii) that contribute to rich learning experiences. It should be noted, however, that simplifying the complexity of the game application to a few game mechanics could result in less engagement of students and lead to an alienation of interest (Lee & Hammer, 2011; Stott & Neustaedter, 2013). As well, the use of game elements "is not practical for all learners, all content, all the time—any more than are lectures or textbooks" (Van Eck, 2015, p. 24) and will not meet all learning goals. Therefore, as Lee and Hammer (2011) point out, "we must carefully design gamification projects that address real challenges" (p.4).

Design Framework for Gamification

Kapp (2012) suggests that gamified learning environments are effective when they include these three components: 1) game-based mechanics, 2) aesthetics, and 3) game thinking.

- **Game-Based Mechanics:** The game-based mechanics most used in educational settings are the use of badges, point systems, leaderboards, goals, and time limits (Dicheva et al., 2011; Kapp, 2012; Deterding et al., 2011). Applying these game mechanics to non-gaming situations provide the engagement and motivational aspects found in games such as freedom to fail, rapid feedback, progression, and story-telling (Stott & Neustaedter, 2013). For example, incorporating tasks, quests, or challenges that can be repeated with no penalty for failure supports freedom to fail and mastery of content. Experience points provide immediate feedback to players and rewards with badges and levels provide recognition of achievements and a record of progress. Competition through leaderboards acknowledges and recognizes achievements while providing a comparison of performance with others.
- **Game Aesthetics:** Game aesthetics refers "to the way the game mechanics and dynamics interact with the game designer's artistry, to produce cultural and emotional outcomes" (Dicheva et al., 2011, p. 3). It includes the visual and aural presentation of the gamified activity such as the presentation of tasks through a cohesive interface theme, the design of an attractive layout, the use of appropriate graphics, and ease of navigation through the material. These aesthetic features contribute to feelings of satisfaction and how willingly a player accepts the gamification (Kapp, 2012).
- **Game Thinking:** Game thinking is described as, "thinking about an everyday experience and converting it into an activity that has elements of competition, cooperation, exploration, and storytelling" (Kapp, 2012, p.11). It is a mind-set where the element of fun or challenge is used deliberately to create an experience that motivates learners to engage in desired behaviors or learning goals (Werbach & Hunter, 2012) which are clearly communicated Figg & Jaipal-Jamani, 2015; Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015). Tasks should provide valuable information or skills, tap into personal interests and passions, provide an element of free exploration and play, result in mastery of skills, and vary in complexity and depth (Deterding, 2011; Van Eck, 2015).

There is consensus in the field that gamification holds potential to motivate and engage learners (Domínguez et al., 2013; Van Eck, 2015; Robson et al., 2015). Adding gamification to blended higher education courses through scaffolded, online learning activities is, however, a new practice which may be complex, and require some effort to make it motivating for students (de-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014). In the next section, we describe an example of a successful gamified, blended learning environment in higher education.

Blended Gamification in Action: The *TPACK Quest*

The strategy of gamification was used to redesign an instructional technology methods course in a Faculty of Education. The purpose for redesigning the course was to address the problem of lack of motivation among preservice teachers (student teachers) to engage with background information (e.g., textbook readings) assigned to enhance in-class learning experiences and to deepen their knowledge about teaching with technology, or technological pedagogical and content knowledge (TPACK; Mishra & Koehler, 2006). Drawing on aspects of the design frameworks of Wu et al. (2010) and Vaughan et al. (2013) for elements of blended learning, and Kapp (2012) for gamification components, a gamified, online learning environment, called the *TPACK Quest,* was created using Wordpress, a free blogging tool. To ensure a quality blended learning environment where online learning activities enhanced in-class activities, gamified, online activities addressed cognitive, technological, and social interactions respectively (Wu et al., 2010; Vaughan et al., 2013). For example, cognitive skills were developed by having preservice teachers learn about the characteristics and actions for effective teaching with technology through readings and interactive media; technological knowledge was developed through digital application tasks where new technical tools were used in authentic learning experiences, and social interactions were promoted through collaborative online discussions.

The design of the *Quest* was also informed by the three design elements discussed in the previous section (Kapp, 2012). *Game mechanics* included a pointsification scheme of ten badges and a *TPACK Quest* manifesto which guided game play. Grade points were awarded for each task, and badges were earned for completing a mission or series of tasks. The *Quest* badge missions included topics such as gamification, TPACK, digital citizenship, problem-based learning, and Web 2.0 learning objects. Acquiring ten of these badges resulted in earning the *Cup of Wisdom*. Four additional badges were awarded for a digital portfolio, professional conduct, completion of in-class activities, and attendance and punctuality. Completion of the latter tasks resulted in the *Professional Order of the TPACK Teacher* award. The *Quest* also incorporated a limited narrative introduced by an avatar in a video to provide a purpose and overall context for the activities. *Game aesthetics*, such as the colorful interface of the *Quest*, the consistent navigational elements, and a variety of interactive learning objects throughout the online environment, promoted ease of participation. *Game thinking* was employed in three ways to design the tasks. First, tasks incorporated a variety of activities, with varying levels of difficulty and complexity. Secondly, tasks incorporated an element of challenge, or problem solving, around pedagogical thinking. Lastly, the element of fun was incorporated by challenging 'players' to use Web 2.0 tools in ways teachers used the tools within classroom instruction. For example, to earn the *Digital Teacher* badge, 'players' examined videos about flipped and blended learning outside of class, then used Cube4Teachers (http://www.cubeforteachers.com/), an online repository of teacher-selected resources, to select an activity. The task was to write an introductory paragraph introducing the activity, and insert that text into the newspaper headline generator at Fodey.com. The resulting image (newspaper clipping

with their inserted text) was submitted to earn their badge. In class, the resources gathered through the experience were evaluated and top resources identified for the collaborative resource board, resulted in points towards the *Collaborator* badge.

The Research Study

A design-based research study (Anderson & Shattuck, 2012) was conducted over two years to investigate how gamification influenced teacher candidates' TPACK, or understanding of how to teach with technology (cognitive), collaborate and use technology (skill), and professionalism (attitude). Teacher candidates were enrolled in six different sections of the technology methods course in which the *Quest* was implemented. Data were collected from 133 teacher candidates and data sources were online surveys, written reflections, and artifacts in digital portfolios. Data sources also included email interviews with the five different instructors teaching the technology methods course, researcher field notes from weekly instructor meetings, and instructors' records. Instructors met weekly to discuss any issues or concerns with the course. Any changes to the *Quest*, or the process for playing the *Quest*, were implemented into all sections. All data were analysed and coded by two independent raters with 100 percent unity of agreement.

The findings from online surveys and written reflections revealed that the gamified learning environment motivated teacher candidates to complete tasks Figg & Jaipal-Jamani, 2015) and is consistent with other findings on gamification (Lee & Hammer, 2011; Hamari, Koivisto, & Sarsa, 2014). All written artifacts by preservice teachers were subjected to content analysis for evidence of TPACK learning gains. Results showed that the gamified blended learning environment stimulated cognitive development (progress of learning) through the visual tracking of learning, promoted self-regulated learning (at their own pace), and facilitated risk taking with technology (Figg & Jaipal-Jamani, 2015). Results were corroborated by survey data. For example, in response to the statement, "I feel I gained more knowledge about TPACK from playing the TPACK Quest than I would have from reading a textbook on the topic," more than two thirds of students agreed or strongly agreed with the statement.

In this case, a blended learning environment enabled the instructors to teach existing curriculum using face-to-face pedagogical practices while incorporating the benefits of an online gamified learning environment. However, there is no doubt that instructors need technical skills to be able to create the digital interfaces and learning objects that comprise the learning environment. Instructors also need to have pedagogical expertise to be able to design a series of game tasks that are varied in depth, complexity, and difficulty while scaffolding the learning process (Figg & Jaipal-Jamani, 2015; Deterding, 2011).

FUTURE RESEARCH DIRECTIONS

Studies of gamification have focused on investigating how gamification influences motivation, engagement, and enjoyment of students during learning (Hamari et al., 2014). The case reported in this chapter is one of the few examples in higher education that provides empirical evidence of the effectiveness of gamification to achieve learning goals related to a course with a large sample of students. There is a need for additional empirical studies to examine gamification and learning outcomes in different higher education disciplinary contexts. As well, studies show that the appropriateness of the context being gamified and the characteristics of students play a role in how effective the gamification strategy is (Hamari et al.,

2014). As such, a future area of research could be to examine how context and characteristics of students influence the blended gamified learning environment. Another area for future research is investigating how instructor knowledge base to design blended gamified learning environments develops. This is important because instructors need knowledge in two areas, creating blended learning environments and using game design elements within instruction.

CONCLUSION

The barriers encountered by instructors when trying to implement digital games such as video games and simulations, often hinder the widespread use of games as an instructional strategy. This chapter presented current perspectives on how the affordances of games, such as choice, feedback, autonomy, and freedom to fail, can be incorporated into a gamified blended learning environment in higher education. Gamification is another digital game-based strategy that utilizes game mechanics, game aesthetics, and game thinking to achieve the motivational and engagement benefits of digital games within the constraints of curricular content that has to be taught. Furthermore, incorporating gamification into blended learning environments provides instructors with opportunities to use traditional face-to-face instruction thereby scaffolding faculty adoption of unfamiliar instructional strategies. A gamification strategy provides many of the benefits derived from games, without requiring instructors to have the knowledge and experience to create or play games. Hence, gamification in blended learning environments is a promising instructional strategy that draws motivational and engagement aspects from game-based learning, and provides learners with opportunities for cognitive, skill, and attitude development.

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KEY TERMS AND DEFINITIONS

Blended Learning: An instructional practice that involves using both online and traditional face-to face learning experiences where a part of the face-to-face instruction is replaced by online activities completed outside the classroom.

Digital Games: An interactive system on a digital device that is rule-based, played by one or more players, with variable or quantifiable outcomes that are ranked.

Digital Game-Based Learning (DGBL): Digital games created for learning purposes characterized by learning that occurs by interaction of the player with the mechanics of the game.

Gamification: One form of DGBL that uses game-based elements such as mechanics, aesthetics, and game thinking in non-game contexts aimed at engaging people, motivating action, enhancing learning, and solving problems (Borgos et al, 2014).

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Chapter 6
Chemistry Learning Through Designing Digital Games

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ABSTRACT

Students in the 21st century need to become proficient in both chemistry and the 21st century skills. Chemistry is often called the central science. Indeed, the knowledge of chemistry is the foundation for innovation, scientific literacy, and most notably, problem solving in connection with sustainable development. Apart from knowledge, innovation and problem solving in the 21st century requires a new range of skills known as 21st century skills. Unfortunately, chemistry is usually considered difficult. Moreover, there are fewer studies that focus simultaneously on enhancing conceptual understanding and developing the 21st century skills. Therefore, the authors initiated an innovation by designing a new module, known as MyKimDG, to support the acquisition of concepts and provide opportunities for them to apply the 21st century skills. The purpose of this chapter is to present conceptual framework of MyKimDG and demonstrate a brief lesson in MyKimDG to the teaching and learning of a specific chemistry unit.

INTRODUCTION

As the labour market of the 21st century become increasingly emphasize on skilled human capital which are highly knowledgeable and innovative, STEM (Science, Technology, Engineering and Mathematics) education has slowly been making its way into classrooms. Efforts have been undertaken to improve the quality of STEM education in order to produce STEM literate students, i.e. students who are capable of identifying, applying, and integrating the STEM concept to understand complex problems and generate innovation to solve the problems (Chew, Noraini, Leong & Mohd Fadzil, 2013).

STEM literate students must have mastered the knowledge of science, particularly chemistry because chemistry is essential as the basic of most of the fields of science, technology and engineering (Balaban & Klein, 2006). Indeed, chemistry is often called the central science (Brown, LeMay, Bursten, Murphy

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& Woodward, 2011; Chang, 2007). Chemistry is also the foundation for innovation, scientific literacy and most notably problem solving in connection with sustainable development (Risch, 2010). Using chemistry knowledge, for instance, one can make judicious decisions to design new materials that are environmentally safe to solve various problems in everyday life. In the 21st century, chemistry will continue to play a leading role in providing solutions to ensure sustainable development.

Apart from knowledge, innovation and problem solving in the 21st century requires a new range of skills known as 21st century skills. For example, innovation and problem solving in today's world is driven by the formation of networks with multiple parties including experts and researchers with related interests as well as consumers and customers. The 21st century skills enable one to communicate and collaborate effectively with various parties.

Clearly, students in the 21st century need to become proficient in both chemistry knowledge and the 21st century skills. Therefore, the authors have initiated an innovation instructional strategy to support the acquisition of chemical concepts and the 21st century skills. A module known as MyKimDG has been developed as a mechanism for accomplishing the desired goals. The purpose of this article is to present conceptual framework of MyKimDG and demonstrate a brief lesson in MyKimDG to the teaching and learning of a specific chemistry unit.

BACKGROUND

Chemistry is usually perceived as a difficult and unpopular subject due to the abstract nature of chemical concepts. Previous studies on students' conception have revealed that students have many alternatives conception in chemistry. While the literature is replete with studies and papers, which investigate students' understanding of chemical concepts and suggest potential remedies, fewer studies focus simultaneously on improving conceptual understanding and developing the 21st century skills. Hence, educators should be encouraged to design innovative and effective learning strategies to enhance both students' conceptual understanding and their 21st century skills. In this case, a change in chemistry teaching and learning approaches is critical. This is especially more crucial when educating today's students who are 'digital natives' (Prensky, 2001). The teaching and learning approaches must befit the needs of these digital natives and subsequently achieve the desired aspiration.

One approach suggested by researchers to educate the digital native generation is the integration of digital games in the teaching and learning processes as digital game is a medium favoured by students. Nowadays, the integration of digital games in learning or digital game-based learning (DGBL) is gaining popularity parallel with their popular reputation among students (Kamisah & Nurul Aini, 2013). Many studies have reported that DGBL can provide positive impact on students' learning. In general, the studies on DGBL were carried out through two approaches, namely (1) student as game consumer or player, and (2) student as game designer.

In the first approach, the students were involved in playing commercial digital games in the market or educational digital games developed by educators. However, there are many obstacles to implementing the student as game consumer approach. For instance, the contents of commercial digital games are inaccurate or incomplete (Van Eck 2006) and the development of professional educational digital games is time-consuming(Hwang et al. 2013). In addition, many gamers do not play educational digital games as they find these games not compelling (Pivec 2009). This happens because educational digital games are designed by academics who do not really understand the art, science and culture of digital

game design (Van Eck 2006). As a result, the product has failed dismally as a game. Prensky (2008) also raised this issue and states '...the students had no input into its creation, and the stuff came out cute to the adults, but boring to the kids'. According to Prensky (2008), students even told straight forwardly: 'Don't try to use our technology, you'll only look stupid.'

One alternative of DGBL approach that has been proposed by some scholars (such as Kafai, 1996; Papert, 1998; Jung & Park, 2009; Kamisah & Nurul Aini, 2013) is for students to design their own digital games. Many studies have reported that this approach provide opportunities for students to explore ideas according to their own interests (Kafai & Ching, 1996); acquire knowledge of programming (Kafai, Ching & Marshall, 1997); as well as become active participants and problem solvers, engage in social interaction by sharing their designs and helping each other, and take ownership of their own learning (Baytak & Land 2010).

In addition, Vos, van der Meijden and Denessen (2011) has reported that the student as game designer approach is a better way to increase student motivation and deep learning compared to the student as game consumer approach. Lim (2008) and Prensky (2008) also recognized the potential of this approach in improving student motivation and engagement. According to Lim (2008), when students are given the autonomy to take responsibility for their own learning and co-design learning experiences with teachers and other students, they are more inclined to engage in their own learning process. Hence, one way to do so is by allowing students to become designers of their own digital games based on their own interpretation of the school curriculum. For Prensky (2008), students will be motivated if they are allowed to do something extraordinary in learning at school and gain recognition for producing digital games. Therefore, the authors have initiated an innovation to take advantage of the student as game designer approach to support the acquisition of chemical concepts and the 21st century skills.

CONCEPTUAL FRAMEWORK OF MYKIMDG

Principles derived from learning theories play an important role in guiding MyKimDG development. Two important theories in learning and education that incorporate into MyKimDG development are constructivism and constructionism.

According to constructivist theory of learning, learner is knowledge builder. Learner does not receive knowledge passively, but he/she interpret the knowledge received and then modify the knowledge in a form that acceptable to him/her. In other words, individual learner actively constructs new knowledge pursuant to his/her existing knowledge. In addition, the process of knowledge construction can be improved through social interaction and discovery. Vygotsky (1978) believed that interaction between learner and teacher or more skillful peers will provide scaffolding to learner within the Zone of Proximal Development to construct new knowledge. However, no interaction would be beneficial if the new information is presented to students traditionally. Instead, students should be given the opportunity to explore or discover the new knowledge. Bruner (1966) believed that learning and problem solving emerged out of exploration of new knowledge.

In addition to the constructivist theory, constructionist theory of learning asserts that the construction of new knowledge happens felicitously in a context where students are consciously involved in the production of external and sharable artefacts (Papert 1991). This theory goes beyond the idea of learning-by-doing as indicated by Papert (1999a) that 'I have adapted the word constructionism to refer to everything that has to do with making things and especially to do with learning by making, an idea that includes but

goes far beyond the idea of learning by doing.' Indeed, Papertian constructionism challenges the learner applying the knowledge being explored to construct more complex ideas or larger theory. This theory emphasizes the role of design (making, building or programming) (Kafai & Resnick, 1996) and external objects (Egenfeldt-Nielsen, 2006) in facilitating the knowledge construction. The constructionist theory of learning also values the diversity of learners and social aspects of learning (Kafai & Resnick, 1996). In the constructionist learning environment, the designers or learners create artefacts which are significant to themselves based on their interests, learning styles and their experience, and shares their artefacts as well as the artefacts' designing process with peers. In this process, peers act as collaborators, coaches, audiences and co-constructors of knowledge.

Computers play a role in the constructionist learning theory. Computers can be used as a building material (Papert, 1999a). According to Papert and Franz (1988), a computer is a 'material to be messed about with'. Learning occurs when learners are 'messing about' with the computer. The introduction of computers is also able to change the context of learning (Papert, 1991). Computers can serve as a convivial tool (Falbel, 1991). The willingness of learners to learn will increase because they can use the computer in building artefacts (Papert, 1991).

Both constructivist and constructionist theories imply that learning depends on the learners themselves and learning can be enhanced through social discourse and discovery. Figure 1 illustrates the interconnections among the learning theories. Additionally, constructionist theory suggests that learning can be further enhanced if learners are involved in collaborative artefact designing projects using ICT as construction material.

Learning Approach

Based on constructivist and constructionist theories, learning approaches such as collaborative learning, discovery learning and learning through designing digital game (student as game designer) are integrated in MyKimDG. Figure 2 summaries the focus of each learning approach in manoeuvring learning activities in MyKimDG.

- **Collaborative Learning:** Activities in MyKimDG are designed so that students engage in discussion, share and exchange ideas in groups. Through this approach, triggering of cognitive conflict and restructuring of ideas will occur when students share their ideas from their own perspective. It also improves students' 21st century skills such as collaboration, communication and interpersonal skill because students are able to practice in the real world.
- **Discovery Learning**: Students are guided towards exploring chemical concepts. Students will gain deeper understanding when they are given opportunities to discover or construct new con-

Figure 1. Interconnections among the constructivist and constructionist learning theories

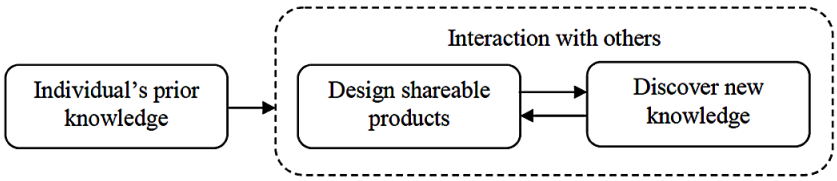
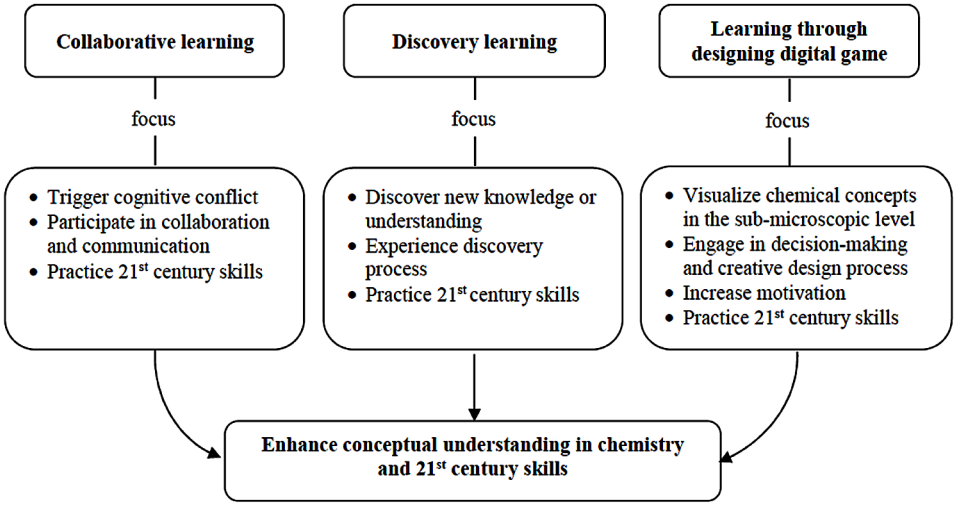


Figure 2. Focus of learning approaches in MyKimDG



cepts or understanding for themselves. It also lets students experiencing the discovery activities, and stimulating their own thinking. As students embark on the discovery process, teacher reminds them of the important of the process in learning. If they can perceive the values of the process, they will be motivated to learn chemistry. In this approach, students are empowered to take responsibility for their own learning and practice the 21st century skills in real situations.

- **Learning Through Designing Digital Game:** In MyKimDG, students are involved in designing PowerPoint games related to chemical concepts. They discuss in groups and apply the concepts learned to design PowerPoint games. With this, students can visualize the concepts in the sub-microscopic level. This approach can also create or learning environment that allows students to make decisions about the design of the desired PowerPoint game, apply ICT and collaborate in a social context.

PowerPoint game is selected as Microsoft PowerPoint software is available at all schools and the use of the software does not involve additional cost and complicated programming languages. The only technical skill that students need to master to design PowerPoint games is how to create custom animations. In addition, existing PowerPoint game templates are available online and can be modified by students to help them progressively master the game designing skills. This strategy is parallel with the development phases proposed by Rieber, Barbour, Thomas and Rauscher (2008). However, students are also encouraged to use other software like *Game Maker* and programming languages such as *Java*, *Logo* and *Scratch* if they are skilled in the software.

When students carry out their digital game designing project, they are guided to move through the creative design spiral (Rusk *et al.*, 2009) in order to assist them develop new ideas. Students are also given the autonomy to choose their own game design, plan and carry out the project based on the group's consensus. The students are also told that the PowerPoint game will be used to help their peers who face difficulty in learning the chapter. It is expected that this strategy will improve students' perceived competency, autonomy and relatedness, and hence increase their motivation in chemistry.

The learning through designing approach aims to deepen students' conceptual understanding in chemistry as cognitive conflict may be triggered during activities and hence, new understanding may discover. As the same time, it provides a platform for students to develop their 21st century skills.

Instructional Model and Strategy

Over the past decade or so, there has been a significant effort to improve conceptual understanding. Studies have revealed that mastery of science concepts will be enhanced if students become aware of their misconception. To help students realize their misconception and replaced it with scientifically acceptable concept (i.e. conceptual change), cognitive conflict strategy has been proposed by scholars such as Piaget (1977) and Posner, Strike, Hewson and Gertzog (1982). Therefore, the BSCS 5E Instructional Model (Bybee et al., 2006) designed to facilitate conceptual change is applied in MyKimDG.

To help students understand the chemical concepts, students are guided to explain macroscopic experience at the sub-microscopic and symbolic levels. It is known that conceptual understanding in chemistry involves making use of three main representations or levels. The triplet relationship is the key model in chemical education (Gilbert & Treagust 2009).

In MyKimDG, the phases of the BSCS 5E Instructional Model and Creative Design Spiral have been modified and standardized. The resultant phases are Inquiry, Discover, Produce, Communicate and Review (IDPCR). Table 1 shows the IDPCR phases in MyKimDG and related phases of the BSCS 5E Instructional Model and Creative Design Spiral.

During implementation of MyKimDG, students are guided to experience and realise the IDPCR phases. As the process is done repeatedly, new ideas are always generated and students' 21st century skills such as inventive thinking skills are developed. Students are expected to practice the process in everyday life and in the workplace. Apart from that, it is expected that the acronym IDPCR can help students remember the five important clusters of 21st century skills, i.e. Inventive thinking, Digital-age literacy, high Productivity, effective Communication and spiritual values (*nilai Rohani*). The five clusters of 21st century skills have been identified by Kamisah and Neelavany (2010).

Table 2 shows the outline of instructional activities in MyKimDG.

Table 1. Phases in MyKimDG and related phases of the BSCS 5E Instructional Model and Creative Design Spiral

MyKimDG	BSCS 5E Instructional Model	Creative Design Spiral
Inquiry	Engage	Imagine
Discover	Explore	Experiment
Produce	Elaborate	Create
Communicate	Explain	Share
Review	Evaluate	Reflect

Table 2. Outline of instructional activities in MyKimDG

Phase	Purpose	Activity
Inquiry *Predict, ask, hypothesize, identify problem, brainstorm*	1. Arouse students' interest 2. Access students' prior knowledge 3. Elicit students' misconceptions 4. Clarify and exchange current conceptions	1. Teacher shows discrepant events. 2. Students make observations and explain the phenomena at the sub-microscopic and symbolic levels. 3. Students discuss in groups and compare their ideas with their peers.
Discover *Investigate, experiment, explore*	1. Expose to conflicting situations 2. Modify current conceptions and develop new conceptions 3. Provide opportunities for students to demonstrate their conceptual understanding, and skills	1. Students perform hands-on and minds-on activities in groups. 2. Students are encouraged to engage in discussions and information seeking using ICT. 3. Students generate explanation of the observed phenomenon. 4. Students practise the skills needed in an experiment or activity. 5. Students are asked to communicate in groups and report back with their findings.
Produce *Create, construct, invent, build, design, tinker, elaborate*	1. Challenge and deepen students' conceptual understanding and skills 2. Provide additional time and experiences that contribute to the generation of new understanding	1. Students apply their new ideas by conducting additional activities 2. Students perform additional tasks that are more complex and involve higher order thinking skills (HOTS). 3. Students carry out open-ended projects. 4. Students create digital games.
Communicate *Explain, share, discuss with peers, ask an expert, defend*	1. Provide opportunities for students to share their new understanding and skills 2. Provide opportunities for students to exchange their new understanding	1. Students report back with their new ideas and skills. 2. Students also listen to input from peers and defend their ideas. Peer's input may guide them towards deeper level of understanding. 3. Students compare their ideas with the teacher's explanations.
Review *Check, evaluate, reflect, improve, repair*	1. Students assess their understanding, skills and competencies 2. Students think creatively for the purpose of improvement 3. Teachers evaluate student progress toward achieving the learning outcomes	1. Students reflect upon the extent to which their understanding, abilities and competencies have changed. 2. Students improve their ideas or skills based on reflection or input from peers. 3. Teacher conducts a test to determine the level of understanding of each student.

IMPLEMENTATION OF MYKIMDG

In the following section, the authors present a brief lesson in MyKimDG to the teaching and learning of a specific unit which involved precipitation reaction (see Figure 3). The lesson is designed to created learning environment that allows students to work together to learn and discover ideas or concepts. Activities are designed to engage students in self-assessing their ideas, communicating their ideas and making decisions based on the group's consensus. To assist students understand why precipitation reaction is used in the preparation of insoluble salt, they are engaged in discovery activity (see the Inquiry phase). Afterwards, they are given opportunity to plan and conduct investigation based on the conclusion made (see the Discover phase).

To extend students' understanding about the observed phenomenon (i.e. precipitation reaction), they are given tasks to design digital games using ICT to teach their peers who face problems in the learning of the chemical concept (see the Produce phase). At this phase, students are engaged in designing *PowerPoint* games to represent the dissolution and precipitation reactions at the sub-microscopic level. First, each student develop an 'expressed model' to represent his/her own visual perception (or mental

model) about the reactions. An individual's mental model is inaccessible to others but the expressed models can be used for discussion (Gilbert, 2005). Eventually, a final model is developed based on group's consensus. Figure 4 shows example of dissolution model created by students. Through this activity, students gain knowledge about what occur between particles during reactions, hence increase students' conceptual understanding. Additionally, students need to carefully plan, utilize time and 21st century tools and resources toward the goal. At the end of project, they are also asked to improve and produce higher quality *PowerPoint* games that incorporates the best aspects of other groups' designs. The strategy is able to increase students' 21st century skills because students are able to immerse themselves in the real-world practice.

Figure 3. A brief lesson in MyKimDG

Phase 1: Inquiry

1. Teacher demonstrates two reactions that may be used to prepare lead(II) sulphate:

	Reaction	Observation	Chemical equation
A	Lead(II) nitrate solution + sodium sulphate solution		
B	Excess solid lead(II) carbonate + dilute sulphuric acid		

2. Students record the observations and write the chemical equations involved.
3. Students describe how to obtain lead(II) sulphate from the mixture in Reaction A and B.
   (a) Draw the set-up of the apparatus is involved.
   (b) In your opinion, which reaction is more appropriate to prepare insoluble salts such as lead(II) sulphate? Explain your answer.
4. Students make a conclusion about the appropriate reaction to prepare insoluble salts.
5. Students share their findings with other groups.
6. Students are asked to explain the strategy used, i.e. inquiry-discovery.

Phase 2: Discover

1. Students plan experiments to prepare lead(II) iodide and silver chloride in group.
   (a) Discuss the materials needed to prepare lead (II) iodide and silver chloride.
   (b) Write the chemical equations involved.
   (c) Plan the procedures for experiment by constructing flowchart.
2. Students carry out experiment to prepare lead(II) iodide and silver chloride.
3. Students generate explanation of each phenomenon.
4. Students are asked to report back with their findings.

Phase 3: Produce

1. Students play a game related to the precipitation reactions involved in the preparation of insoluble salts.
2. Students are asked to differentiate between a good game and a bad game.
3. Students are asked to improve the game to make it more educational and entertaining following phases of IDPCR, in order to help their peers who face difficulty in learning the concept.
   3.1 **Inquiry:** Students convey his/her idea about the chemical concept and design of game through model (i.e., diagram, drawing, physical replica, etc.). Students select a promising model from their brainstorming session.
   3.2 **Discover:** Students create their designs using *PowerPoint*. Students are encouraged to test frequently and think critically about their designs, and rebuild as needed.
   3.3 **Produce:** Students produce their *PowerPoint* games based on improvements suggested through testing.
   3.4 **Communicate:** Students share their designs and *PowerPoint* games and get input from other groups.
   3.5 **Review:** Students describe the key strengths and weaknesses of their designs and *PowerPoint* games. Students create their own *PowerPoint* game in groups that incorporates the best aspects of all the designs.
4. Students are told that they may commercial their innovative product to benefit financially.
5. Students are reminded to apply 21st century skills during the project.

Phase 4: Communicate

1. Students share their digital games with other science or chemistry educators.
2. Students improve their digital games.

Phase 5: Review

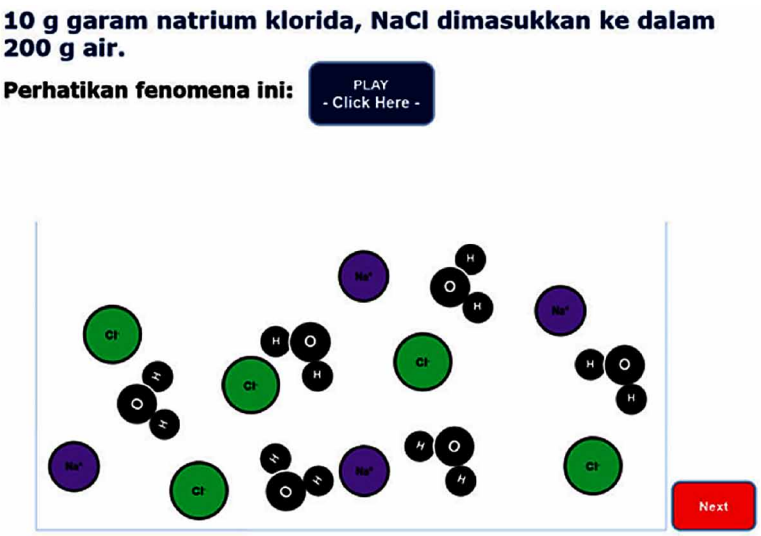
1. Students plan and carry out experiments to prepare lead(II) chromate and barium sulphate in group.
2. Students write the chemical and ionic equation involved.
3. Students reflect upon the extent to which their understanding, abilities and competencies have changed.

Students are also engaged in design or product justification (see the Produce and Communication phases). Students listened to input from peers and teacher, and defended their ideas. Input from peer and teacher may triggered cognitive conflict and result in reconstruction of existing ideas. Such support or scaffolding deepen students' understanding. At the end of lesson, students are assessed to determine their level of understanding. Students also reflect on how the IDPCR phases have contributed to their own development.

CONCLUSION

Students can be assisted to improve their conceptual understanding in chemistry and develop their 21st century skills. In this study, the authors have tried to provide an innovative chemistry instructional strategy by integrating collaborative learning, discovery learning and learning through designing digital games. The learning strategy will create supportive learning environment for student to learn chemistry meaningfully. Most importantly, MyKimDG allows students to practice the 21st century skills in real situations. In conclusion, the implementation of MyKimDG can lift students' achievement in chemistry and their 21st century skills.

Figure 4. Example of dissolution model created by students



FUTURE RESEARCH DIRECTIONS

Quality assessment is essential in measuring the effectiveness of MyKimDG. Assessments enable teachers to evaluate learning while it is occurring. However, assessing of 21st century skills learning can be quite challenging. For instance, when faced with a collaborative task, teacher need to decide how to assign credit to each member of the group, as well as how to account for differences across groups that may bias a given student's performance (Binkley et al., 2012). Hence, further study need to be carried out to develop ways or specific rubrics to assess the 21st century skills. Assessment rubrics offer clear guidelines or expectations to students on how the expectations are being met as well as the acceptable level of achievement. The assessment results inform teachers and students about their progress. It can also be leveraged to inform the revision of the MyKimDG module being developed.

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KEY TERMS AND DEFINITIONS

21st Century Skills: A set of skills that students need to develop in order to succeed in the 21st century.

Constructivism: A learning theory that suggests that individual learner actively constructs new knowledge pursuant to his/her existing knowledge.

Constructionism: A learning theory that suggests that construction of new knowledge happen best through designing external and sharable artefacts.

Digital Game: Any game played using electronic device, either online or stand-alone.

Digital Game-Based Learning: An instructional approach that integrates digital games in learning.

Learning Through Designing: An instructional approach that integrates design activities in learning.

MyKimDG: A module that incorporates collaborative learning, discovery learning and learning through designing digital game in chemistry learning.

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Chapter 7
Clinical Use of Video Games

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ABSTRACT

Despite the extreme popularity of video games among adolescents, researchers in the fields of developmental and social psychology examining video games have focused mainly on the association between video game use and negative outcomes, while research on positive outcomes is more limited. Video game, and the usage of video games, in (adolescent) therapy and (adolescent) psychotherapy is anything but ubiquitous. The research and clinical potential for combining video games and the communicative possibilities of the internet are immense. Hence, the purpose of this chapter is on video game and their usages in (adolescent) therapy and psychotherapy. This chapter will cover the history of video games, video games in psychotherapy, and the different types of video games and their usages in psychotherapy.

INTRODUCTION

Video game play is the fastest growing form of entertainment in the world and many adolescents play video games for hours every day. For example, a nationally representative study of video game play among adolescents in the United States showed that 97% of adolescents aged 12 to 17 years play computer, web, and portable or console video games (Lenhart, Kahne, Middaugh, Macgill, Evans, & Vitak, 2008). In terms of frequency, 31% of adolescents play video games every day and another 21% play video games 3 to 5 days a week. Similarly, Gentile (2009) conducted a large survey study in the United States and found that 88% of youth aged 8 to 18 years play video games and the average amount of time spent playing video games per week is 13.2 hours. Furthermore, in the United States, 91% of children between the ages of 2 and 17 play video games (Granic, Lobel, & Engels, 2014), and a nationally representative study of U.S. teenagers found that up to 99% of boys and 94% of girls play video games (Lenhart et al., 2008).

A video game, according to Wikipedia (2016), is an electronic game that involves human interaction with a user interface to generate visual feedback on a video device such as a television screen or computer monitor. The word video in video game traditionally referred to a raster display device, but in the 2000s, it implies any type of display device that can produce two- or three-dimensional images. The electronic systems used to play video games are known as platforms and these platforms range from large main-

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frame computers to small handheld computing devices (Wikipedia, 2016). Hence, in the United States alone, video games brought in over $25 billion in 2010, more than doubling Hollywood's 2012 box office sales of $10.8 billion in the United States and Canada (Motion Picture Association of American, 2012). Despite the extreme popularity of video games among adolescents, however, researchers in the fields of developmental and social psychology examining video game have focused mainly on the association between video game use and negative outcomes, while research on positive outcomes is more limited. Video games, and the usage of video games, in adolescent therapy and psychotherapy is anything but ubiquitous. Hence, the purpose of this chapter is on video games and their usages in adolescent therapy and psychotherapy. This chapter will cover a brief and condensed history in the usage of video games in relations to clinical usage (and not on the historical development of video games and the video game industry per se), video games in psychotherapy, and the different types of video games and their usages in psychotherapy.

BACKGROUND

According to Ceranoglu (2010), the first video game materialized on an oscilloscope screen in 1958 (Kent, 2001) featuring a game of simulated tennis that amused visitors to Brookhaven National Laboratory. Thereafter, video games have become a major part of pop culture and the entertainment medium of choice for millions of people (Gettler, 2008; Poole, 2000). However, for many, video games were first created in the 1970s and since then have grown into a multibillion-dollar industry: the annual U.S. retail sales of video games reached more than $9.9 billion in 2004 alone (Greitemeyer & Osswald, 2010; Sestir & Bartholow, 2010). According to Greitemeyer and Osswald (2010), large-scale surveys show that 70% of homes with children ages 2 to 17 years have computers and 68% have video game equipment (Woodard & Gridina, 2000). Eighty-seven percent of children play video games regularly (Walsh, Gentile, Gieske, Walsh, & Chasco, 2003). Children ages 2 to 7 years spent an average of 3 to 5 hours a week playing video games (Gentile & Walsh, 2002), while 8th and 9th-grade students average 9 hours per week (Gentile, Lynch, Linder, & Walsh, 2004).

Video Games in Psychotherapy

A review of the available literature on video game use in psychotherapy takes a dynamic perspective in regards to psychotherapy, although it should be noted that the issues addressed here can be applied to many forms of psychotherapy. A literature search was conducted, according to Ceranoglu (2010), on Medline and PsycInfo with keywords *video games*, *psychotherapy*, *computer games*, and *child and adolescent*, and relevant manuscripts were also identified through citations in the articles identified during the primary search. In so doing, video game, is defined as a game that employs electronics to create an interactive system that includes a user interface to generate a visual feedback on a video device (Wolf, 2002), and found their way into the clinical care of youth in mental health care as well as other fields, and academic interest in clinical use of video games is increasing steadily.

Review of a database of academic manuscripts reveals that 1,121 of 1,474 total reports on video games (76%) were published in the past decade. Reported clinical uses of video games include psychoeducation in chronic disease management to increase treatment adherence (Yoon & Godwin, 2007) and physical

therapy and rehabilitation following traumatic brain injury (Jannink, van der Wilden, Navis, Visser, Gussinklo, & Ijzerman, 2008). Video games also serve as valuable adjuncts in pain management during medical procedures (Das, Grimmer, Sparnon, McRae, & Thomas, 2005; Gold, Kim, Kant, Joseph, & Rizzo, 2006), induction of anesthesia (Patel, Schieble, Davidson, Tran, Schoenberg, Delphin, & Bennett, 2006), or cancer chemotherapy (Kato, Cole, Bradlyn, & Pollock, 2008; Redd, Jacobsen, Die-Trill, Dermatis, McEvoy, & Holland, 1987).

Video Games and Their Usages in Psychotherapy

The usage of video games that have received some attention of video game researchers is that of therapeutic sessions (Annema, Verstraete, Abeele, Desmet, & Geerts, 2013). According to Annema et al. (2013), video games can help motivate patients, develop skills and serve as a distractor in pain management. Video games have been used in physiotherapy, occupational therapy, and psychotherapy (Burdea, 2003; Griffiths, 2003). As such, when considering the use of video games in therapy, a distinction can be made between games specifically made for therapeutic purposes and games made for the general public but that are used in therapy as well. An example of the last category, dating back almost two decades, is the use of the *Super Mario Brothers* and *(The Legend of) Zelda* games in addition to the regular psychotherapy program to assess and assist various abilities of children, such as problem solving strategies and means of dealing with success and failure (Gardner, 1991). Hence, literature survey revealed that different kinds of software are used in different types of clinical practice and research. These included serious games, commercial video games, computer programs developed for use in assessing cognitive abilities, and virtual reality used in psychiatric symptom research and training of health care professionals. Literature was also diverse in regard to delivery format of the games, such as computers, specifically designed hardware, handheld devices, and gaming consoles. With that said, Wilkinson, Ang, and Goh's (2008) article, is one of few articles that outline the video game revolution.

First Usage of Video Games

Specific video games are also designed for use in mental health care. The repeatability aspect of video games, as compared with other media forms, is useful in delivering manual-behavioral interventions such as those involved in cognitive-behavioral therapy (USAB, Holzinger, & Gesellschaft, 2007). Recently, the first video game developed to support cognitive-behavioral therapy by offering attractive electronic homework assignments and rehearsing basic psychoeducational parts of treatment has been reported in the literature (Brezinka, 2007, 2008). Video games were also found useful in group therapy for youth in distress, and have been noted to facilitate change in the moral developmental stage of adolescents involved in such therapy (Sherer, 1994). Another game is still in the testing phase for use in a solution-focused intervention for adolescents and is available to mental health professionals participating in studies of its efficacy. Therapists observe the game play to provide a structure to sessions, help build an effective patient-therapist relationship, and improve patient engagement in the therapeutic process (Coyle, Doherty, & Sharry, 2009). Games to enhance social skills training for children with developmental disorders also exist (Mineo, Ziegler, Gill, & Salkin, 2009). These programs feature virtual environments where the player controls as *avatar*, an actor within this environment, using a keyboard, mouse, or a gamepad. Through interactions with the virtual environment, the player may rehearse learned and problem-solving skills.

Some researchers from a psychology/psychotherapy background have developed their own games for use in therapy (Clark and Schoech, 1984; Oakley, 1994) while others have surveyed the use of computers in the area (Resnick & Sherer, 1994; Griffiths, 1997). Thereafter, in 1984, a psychotherapeutic text based game entitled *Adventures of Lost Loch* was developed for use in therapy by adolescents with low impulse control (Clark & Schoech, 1984). Hence, clients were more cooperative with their therapists, with whom they developed effective therapeutic relationships and their session attendance rate greatly improved (Coyle, Matthews, Sharry, Nisbet, & Doherty, 2005).

Other games have incorporated subject matters particularly relevant to therapy. For example, SMACK (Oakley, 1994) deals with the decisions and consequences related to drugs. Furthermore, there has been increasing use of biofeedback-based video games for the treatment of anxiety disorders and attention problems. At NASA's Langley Research Center, Alan Pope has developed methods for using off-the-shelf Nintendo and Playstation games in combination with electroencephalogram (EEG) biofeedback, to train children with attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD), and hyperactivity disorders. Results concluded that the inclusion of games in normal biofeedback treatments increased the therapeutic effect on ADD symptoms. Both children and parents rated as significantly higher enjoyment of coming to video game based sessions. Children found the sessions more inherently motivating and remained more focused on tasks (Pope & Paisson, 2001).

Second Usage of Video Games

Although the 1980s saw a variety of controlled experiments on the effectiveness of video games in therapy, mental health research on video games in the 1990s came to be dominated by their adverse effects, and only in the 2000s does the argument for video game therapy reappear with frequency. In the 1980s Larose, Gagnon, Ferland, and Pepin (1989) reported significantly improved spatial abilities of adolescents with minimal brain damage or attention problems by means of a modified Atari game. During the following decade video games were increasingly studied as medical and psychosocial hazards (Griffiths, 1996) or addictive (Griffiths & Hunt, 1998). Recent reviews of the positive advances in video game therapy (Griffiths, 2004; Salonius-Pasternak & Gelfond, 2005) consistently respond to this preconception by opening on a defensive note. Despite this diversion of attention, video game therapy has been applied to a wide range of mental health concerns, all of which might now be extended by online treatment.

- **Aggression:** Given the trend to view video game violence as a factor in aggression, it is interesting to note that handful of researchers who have opted to explore an alternative viewpoint whereby video games might play an active role in curbing aggressive behavior. One team has pursued the long-term, development of a multimedia program called SMART Talk (Bosworth, Espelage, DuBay, & Daytner, Karageorge, 2000), which incorporates video games and simulations as part of a computer-based intervention that significantly diminishes middle-school students' beliefs that are supportive of violence and increases their intentions to use non-violent strategies.
- **Anxiety Disorders:** Inquiries into 2D video games for anxiety treatment can be found alongside a variety of graded exposure therapies using virtual reality. Sharry, McDermott, and Condron (2003) propose *Relax to Win*, a biofeedback-based 2D game for the treatment of children with general anxiety problems. With Relax to Win, two on-screen dragons would race each other, and the more relaxed the players are, the faster the dragon would run, as measured by the players' galvanic skin response. Video games also prove realistic enough to generate successful graded

exposure trails against phobias of spiders (Bouchard, Cote, Saint-Jacques, Robillard, & Renaud, 2006), heights or enclosed spaces (Emmelkamp, Krijn, Hulsbosch, De Vries, Schuemie, & Van Der Mast, 2002; Robillard, Bouchard, Fournier, & Renaud, 2003), and fear of driving after an accident can be comparably reduced by virtual reality driving games, on their 2D equivalents (Walshe, Lewis, Kim, O'Sullivan, & Wiederhold, 2003).

- **Attention Deficit Hyperactivity Disorder:** Video game therapy for children with ADHD has elicited a relatively large amount of scholarly attention, because many children who do not inhibit their hyperactivity in other contexts will do so when playing intrinsically motivating video games. Lawrence, Houghton, Tannock, Douglas, Durkin, and Whiting (2002) highlighted that 6- to 12-year-old boys with ADHD perform beneath a normally developing control group when playing a cognitively demanding adventure video game, an even more so on a route task outside the laboratory, but perform equally well on a motor-skill targeting game that does not involve high working memory or distractor loads. This engagement makes video games ripe for therapeutic applications. Furthermore, there is some evidence that video games can contribute to reducing ADHD symptoms. The first therapeutic video game for children with ADHD was by Pope and Bogart (1996), whose Extended Attention Span Training (EAST) system modifies a NASA program that assesses the engagement of pilots using automated flight management systems. Pope and Palsson (2001) further develop this NASA patent as an ADHD intervention that decreases players' control over off-the-shelf PlayStation games when their EEG reports lower attention, measured as higher theta-to-beta wave ratio.
- **Autism:** Therapeutic computer games are of special interest for autism, since rules-based environments present a safe- appealing vehicle for interventions to improve socialization. More recently, it has been demonstrated that 13- to 18-year-olds with autistic spectrum disorder interact with virtual environments on a par with control groups, suggesting a potential for virtual environments to serve as a medium for education about social conventions (Parsons, Mitchell, & Leonard, 2004, 2005). Furthermore, several researchers have worked on therapeutic video games for autistic children. Tanaka, Klaiman, Koenig, and Schultz (2005) are developing Let's Face It!, a suite of games designed to teach ability-appropriate distinctions between faces and objects, and recognition and labelling of facial expressions (Tanaka et al., 2005). Whalen, Liden, Ingersoll, Dallaire, and Liden (2006) developed a rigorously tested computer-assisted instructional program called TeachTown, which uses a suite of game-like tests and professionally designed visual reinforcements to make a demonstrated positive impact on receptive language, social understanding, self-help, attention memory, auditory processing and early academic skills for children with autism and other developmental delays.
- **Personality and Psychotic Disorders:** Scattered efforts have been made to bring video games to bear on the most challenging personality and psychotic disorders. On one end of the spectrum are Sieswerda, Arntz, and Wolfis (2005), who employ the simplest of worm and tennis games not for any therapeutic content, but to tease out responses involving potential differences in dichotomous evaluations among subjects with border-line personality disorder, cluster or antisocial personality disorders, and a control group with no diagnosed personality disorder. On the other end is Shrimpton and Hurwirth's (2005) account detailing the development of an elaborate adventure game to educate young people who have experienced their first psychotic episode. An interdisciplinary panel of experts is convened to study the prototype, and they demand substantial redevelopmental in order to make the intervention an effective aid in young people's recovery

from psychosis. Studies of video games applied to schizophrenia include Crookes and Moran (2003), who prepared a simple joystick-controlled game in order to assess how quickly subjects of different ages and genders can find cheese hidden on a 4x4 grid according to certain classical conditioning rules that healthy adults naturally filter out, but that schizophrenics do not, and Da Costa and De Catvalho (2004), who established that a group of medicated schizophrenics respond positively to completing cognitive tasks in virtual reality, suggesting a new medium for therapeutic interventions.

- **Children and the Elderly:** It is evident from the foregoing that children and adolescent have been the primary targets of therapeutic video games. While adults are comfortable with direct face-to-face dialogue, many children struggle to express themselves with words alone and use of therapeutic channels such as video games and other means provide children with an avenue for indirect communication (Coyle, Doherty, Matthews, & Sharry, 2007; Coyle, Matthews, Sharry, Nisbet, & Doherty, 2005). Several comprehensive overviews of the literature for this entire age range have appeared (Goh, Ang, & Tan, 2008; Griffiths, 2003; Salonius-Pasternak & Gelfond, 2005), and beyond these, several reports on subgroups can be found. Kokish (1994) presents the first recommendations on materials for computer play with preschoolers, and Aymard (2002) discusses a computer drawing game for projective use, to stimulate catharsis and affective expression in preschoolers and school-age children. Reaching at-risk youth by means of video games is also a recurring theme. For example, Resnick (1995) reports on BUSTED, a computerized game to promote reflection on antisocial behavior in young offenders, and Sherer (1994) reports a controlled study of the effects of a moral development game on youth in distress. Dominic Interactive is an example of a DSM-IV-based diagnostic tool for children aged 6-12, in which a series of yes/no questions aim to give children greater scope for self-expression via a format akin to a video game. It has undergone validity testing in the U.S. (Valla, Bergeron, Saint-Georges, & Gaudet, 1997) and other countries (Villa, Kovess, Chan-Chee, Berthiaume, Vantalon, Piquet, Gras-Vincendon, Martin, & Alles-Jardel, 2002). The elderly, on the other hand, represent another demographic that has received its share of attention from therapeutic video game developers. Counting for Goblins is a computerized version of the counting Span task, which older subjects found more interesting than the offline equivalent, and which features automatic measurement of accuracy and response times (Barnes, Yaffe, Belfor, Jagust, DeCarli, Reed, & Kramer, 2006; Ryan, 1994).

FUTURE RESEARCH DIRECTIONS

When it comes to video games and their usage in psychotherapy in the future, only technology, and the imagination of software programmers and innovative therapists/psychologists can tell. Approximately a decade ago, Berker, Brinkman, and Deardorff (1995) tested a computer intervention for adolescent children of divorce that involved a trip to the lab to play a therapeutic video games, mail-out a post-test one week later, and a 10-minute follow-up telephone interview one week after that. Many practitioners will prefer the immediate warmth of the traditional face-to-face encounter for its associations and its proven benefits, but as we shall see, certain researchers have begun to explore such alternative virtual spaces as well. The entire community stands to gain from this growing wealth of therapeutic options.

CONCLUSION

Nearly three decades after the first wave in change due to the home computer explosion, we can see that the mental health community's early concerns about low computer literacy and poor computer communication have turned out not to pose the expected barriers to therapeutic use. While the immense appeal of video games went on and caused a backlash among scholars who saw harm to their players, pioneering researchers have not harnessed the intrinsic motivation that they elicit to help treat ADHD, anxiety, and other psychiatric conditions. A second wave in change arrived with the advent of the internet, causing computers to be seen less as potential replacements for the therapist and more as conduits for therapeutic interactions (Wilkinson et al., 2008). The research and clinical potential for combining video games and the communicative possibilities of the internet are immense.

Future research into online video game therapy for mental health concerns might focus on two broad types of game: simple society games such as cards or chess, online versions of which are freely available, and elaborate online worlds such as massively multiplayer online role-playing games (MMORPGs), whose worldwide membership numbers is the millions. Both genres might be used for assessment and training purposes, and with an online chat component, both provide a limitless platform for social interaction that could be incorporated as part of the intervention program. Society games present the advantage of being accessible and enjoyable to players of all ages, while online worlds offer a unique opportunity for narrative content and immersive remote interaction with therapists and fellow patients. Congruent to Coyle et al. (2007), more collaborative efforts among therapists, engineers, and computer software programmers to make such innovations more widely used.

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KEY TERMS AND DEFINITIONS

Aggression: Is overt, often harmful, social interaction with the intention of inflicting damage or other unpleasantness upon another individual.

Anxiety Disorders: Are a category of mental disorders characterized by feelings of anxiety and fear, where anxiety is a worry about future events and fear is a reaction to current events.

Attention Deficit Hyperactivity Disorder (ADHD): Is a developmental neuropsychiatric disorder in which there are significant problems with executive functions that cause attention deficits, hyperactivity, or impulsiveness which is not appropriate for a person's age.

Autism: Is a neurodevelopmental disorder characterized by impaired social interaction, verbal and non-verbal communication, and restricted and repetitive behavior.

Commercial Video Games: Games that, in their original license, were not considered freeware, but were re-released at a later date with a freeware license, sometimes as publicity for a forthcoming sequel or compilation release.

Game: A voluntary activity structured by rules, with a defined outcomes or other quantifiable feedback that facilitates reliable comparisons of in-player performances.

Personality Disorders: A class of mental disorders characterized by enduring maladaptive patterns of behavior, cognition, and inner experience, exhibited across many contexts and deviating markedly from those accepted by the individual's culture.

Psychosis: Refers to an abnormal condition of the mind, and is a generic psychiatric term for a mental state often described as involving a "loss of contact with reality".

Psychotherapy: Is the treatment of a person's problems by (typically) conversing with another person.

Serious Game (or Applied Game): Is a game designed for a primary purpose other than pure entertainment.

Therapy: Is the attempted remediation of a health problem, usually following a diagnosis.

Video Game: Games that are designed for players to actively engage with their systems and for these systems to, in turn, react to players' agentive behaviors.

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Chapter 8
Leveraging the Arduino Platform to Develop Information Technology Devices

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ABSTRACT

Arduino is a famous board, which incorporates serial communication interfaces, including universal serial bus (USB) and an integrated development environment (IDE) based on Processing, a programming language that supports C and C++. It consists of a microcontroller with several other components that provide easy interconnections with other devices. Arduino and its components have been studied during the class of Computer Architecture for the degree in Computer Science at the University of Cagliari in 2016. At the end of the class, seven groups of students have been selected and chosen to carry out a device prototype on top of Arduino and show their methodology, the sensors they embedded on top, how data could be extracted, collected, stored in database for further processing and analytics. The development has been performed following the open source best practices; documentation and codes of these projects have been made online for free downloading and sharing in order to further contribute to the advancement and widespread usage of the Arduino platform.

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INTRODUCTION

Arduino is a famous board, which incorporates serial communication interfaces, including universal serial bus (USB), and an integrated development environment (IDE) based on Processing, a programming language that supports C and C++. It consists of a microcontroller with several other components that provide easy interconnections with other devices.

An increasing number of developers utilizes Arduino for projects related to information technology and its community is growing and expanding in different domains, areas and countries creating several opportunities both in research and within the market sector. It is not surprising that several start-ups have initiated their business basing their services on Arduino. If the reader browses Kickstarter[1], the world's largest funding platform for creative projects, he would notice that there have been a number of successful projects revolving around the Arduino platform. Moreover, there are also many devices that are Arduino's compatible that represent information technology products where companies and individuals can exploit for their business.

A lot of information is today exchanged within the domain of home automation. Home automation is what makes houses getting smart giving the users the possibility to monitor it using an interface on their computer, tablet or smartphone, or even panels mounted around the house. More in detail, home automation involves the control and automation of lighting, heating, ventilation, air conditioning, appliances and security. With a simple push of a button or a voice command it is possible to control items around the house, setting up a lamp to turn on or off according to certain events, switching on or off particular appliances depending on specific actions, etc. It is even possible to check the operating status and power consumption of any appliances through the web when they are connected to the Internet. As there are very few world-wide accepted industry standards and the fact that the smart home space is heavily fragmented, today, thanks to the availability of tools such as Arduino, it is possible to easily design, build and use smart appliances self made. Sometimes, it is even possible to disassemble a certain device to see how it is made or getting its core and build around a desired sub-device that can provide functions not present within the original hardware. One example that we provide in this chapter is represented by a joypad used for video games that has been taken apart to see how it was designed and an Arduino board has been embedded to provide a mechanism that counts all the times a button is pressed or a certain position of the controller has been pushed. In fact, the signals and data that the sensors on top of Arduino collect can be easily stored in a database for further processing and analytics.

Arduino and its components have been studied during the class of Computer Architecture for the degree in Computer Science at the University of Cagliari in 2016. At the end of the class, seven groups of students have chosen to carry out an information system prototype on top of Arduino and show their methodology and possible obstacles they encountered. Within their projects, students had to integrate Arduino with sensors of different kind, extract data from sensors and perform some operations on them, such as analytics or store them in a database for further processing. Information science and technology includes several software technologies but with the widespread of the Internet of Things, it is possible to collect data of several kind from the every object equipped with sensors. One of the goals was to let the young researchers understand the vast amount of data that is possible to gather using sensors embedded in the Arduino board.

The first two projects presented in this chapter integrate Arduino with temperature sensors, a LCD and a button that gives the option to switch among the different information the system reads from its

sensors (temperature, humidity level, date and time). Data read from the sensors are stored using NoSQL approach (we have adopted Spark) and ready for visualization and quick analytics.

One more project has been focused on a security appliance to be used in houses: a photocell detects a light with certain intensity. If the intensity is greater (lower) than a fixed threshold, a relay is activated to turn on (off) an electric appliance. A shift register has been used to both leave free some pins of the Arduino board and to modularize the project. Two push buttons with a rotary encoder have also been adopted to easily change the threshold levels. Read values can be stored in a database.

A fourth project exploits Arduino's flexibility to create a joystick game controller within a case similar to the old fashion coin-operated entertainment machines typically installed in restaurants, bars and amusement arcades. The joystick is provided with USB connector and plug-and-play capabilities so that it can be recognized on the fly by a normal pc. Similarly, another project integrates Arduino with an analogic joystick game controller and 8 different led lights. Each different movement of the joystick turns on one of the lights. The rationale behind this project is to replace led lights with smart appliances in a house so that them can be controlled with a joystick.

A sixth project uses Arduino for domotics. It allows an electric appliance to be turn on or off through a web interface.

A final project represents a sound intensity detector that can be embedded in any system where it is critical to perform any action after a certain sound intensity has been produced.

For all the projects it is straightforward to embed a module to store the read data from the sensors in a database for further processing, and analytics (e.g. through data mining techniques).

More info about the background, design, building process, usage and application of the developed smart prototypes will be detailed in the next remaining sections of the chapter.

Following the open source best practices, documentation and codes of these projects have been made online for free downloading and sharing in order to further contribute to the advancement and widespread usage of the Arduino platform. In some cases, videos have been taken so that the reader can have a deeper insight of the underlying project[2].

BACKGROUND

Arduino was born in Italy in 2004 when a Colombian student created the development platform Wiring as his Master's thesis project whose goal was to create a low cost tool for a wide range of users for digital projects.

The first Arduino was introduced in 2005 with the goal of providing an easy way, innovative and low-cost for a wide range of users for developing devices that could interact with their environment (such as robots, thermostats, motion detectors, etc.). In 2011 over 300 thousand official Arduinos were produced and in 2013 over 700 thousand official boards were at disposal of users.

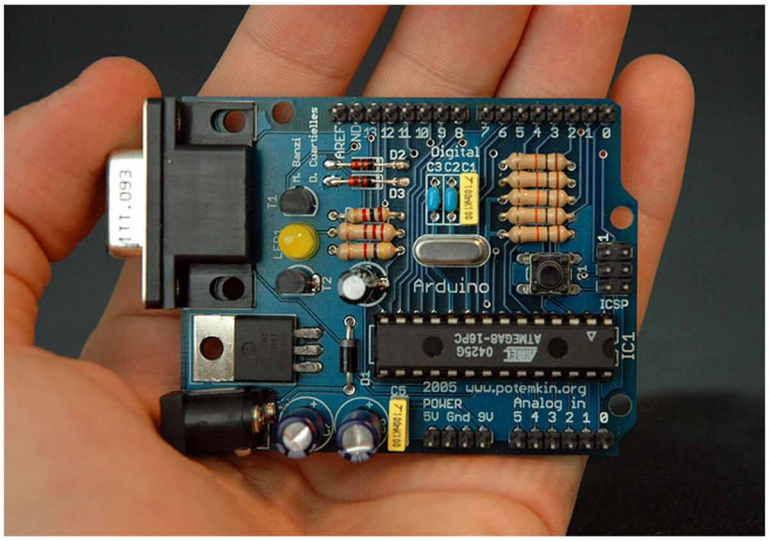
The Arduino board is provided with an Atmel 8, 16 or 32 bit AVR microcontroller with other components for the integration in other circuits. Arduino's connectors allow the connection between the CPU board to a variety of add-on modules called shields. One handy feature of Arduino's microcontroller is the boot loader it is provided that simplifies the upload of programs on the chip flash memory. Figure 1 shows an Arduino board. As far as the software is concerned, the Arduino Integrated Development Environment (IDE) supports the programming languages C and C++. Every Arduino program consists of two functions that are compiled and linked into an executable cyclic program, setup() and loop().

The setup function is used for initialization and runs once at the start of the program whereas the loop function is called continuously until the board is turned off.

Arduino is employed in a number of projects within several disciplines and it is often used and mentioned in research papers.

One domain that is experiencing to a quick widespread of the utilization of the Arduino framework is the home control and automation. Authors in Piyare, R., (2013) presented a novel architecture for low cost and flexible home control and monitoring system using Arduino. RESTful based web services have been used for the communication between the user and the home devices. The system allows any Android based smart phone with WiFi, 3G or 4G to access the system. To note that the proposed system does not require a dedicated server PC as many other current systems but it is hosted within Arduino itself and offers a novel communication protocol. One of the directions that the authors of the mentioned paper wanted to head was the Internet of Things (IoT). It is defined as a global network that links physical objects using network communications, web applications and cloud computing technologies. Within the IoT, devices can communicate, access, store and retrieve information from/to the Internet, interact with users and create smart and pervasive environment. Arduino can easily read data from all kinds of sensors and is well suited for IoT for its simplicity and extensibility. Authors in Doukas, C., (2012) provided details and information needed to design and create IoT applications using the Arduino platform. They described cloud computing concepts, open platforms used to store sensor data on the cloud, how to connect Arduino with an Android phone and store/retrieve data through the Internet, and how to reprogram the Arduino microcontroller remotely through the cloud. One more example of adoption of the Arduino platform for home automation is represented by the work in David, N., A. Chima, A. Ugochukwu, & E. Obinna, (2015) where the authors presented a flexible home control and environmental monitoring system. A micro web server is hosted with the Arduino and Bluetooth technology is used for the communication between the remote user and the home devices. A similar work related to Arduino for home

Figure 1. An Arduino board with an RS-232 serial communication interface (upper left) and an Atmel ATmega8 microcontroller (black, lower right)[3]



automation that takes into account security of the home providing a safeguard from possible intruders is represented by Chattoraj, S., (2015) where several sensors (temperature, humidity, smoke) are used and controlled by Arduino that acts as a master controller.

Another domain where the adoption of Arduino is rapidly increasing is the robotics. Authors in Warren, J., J. Adams, & H. Molle, (2011) describe Arduino to control a variety of different robots and provide detailed instructions on how to build them (e.g. GPA-enabled robot, robotic lawn mower, fighting bot, etc.). They mention and show different motors used in robotics and interfaced with Arduino.

More recently, authors in Araujo, A., D. Portugal, M. S. Couceiro, & R. P. Rocha, (2013) presented a full integration of compact educational mobile robotic platforms built around Arduino controller board in the Robotic Operating System (ROS). Even though most of robotic platforms provide open source software, there are important constraints the limit their diffusion and wide spread along the utilizers: (i) they require a slow learning curve and (ii) the hardware has limited capabilities. This was the rationale behind the development of a new robotic platform on top of Arduino. One more example within the robotic domain is represented by Broccia, G., M. Livesu, & R. Scateni, (2011). Here the authors proposed a cost-effective four-wheeled surveillance robot built using Arduino and a smartphone running Android. The hardware of the smartphone has been used for the robot purposes through the API offered by Android (e.g. GPS, video-camera, etc.). The robot could be remotely controlled with a PC connected to Internet.

Arduino has also been used in Jena, S. P., S. Aman, & R. Das, (2015) for data acquisition of green house environment. Multiple sensors were used (to measure things such as temperature, humidity, CO2 gas, soil moisture), connected to the Arduino with the goal of achieving an enhancement of growth in green house.

Arduino has been employed to develop game devices and video games as well. One pretty common example is represented by the famous Pong videogame that has been designed using the Arduino board. There are different versions of it Alberti, D., (2013), Arduino. TFT Pong. A different and more ambitious project is Arduboy. Arduboy (2015) is a game system powered by Arduino that had enormous success to raise funds in Kickstarter. Arduboy is a miniature open-source game 8-bit computer that contains all of the instructions, graphics, and sound to produce the game played on the device. Users can reprogram the Arduboy and change the games on it.

DEVELOPED PROTOTYPES

In this section we will describe in detail each information system prototype developed by each group of students for computer architecture, class held at the first year of the degree of computer science at the University of Cagliari. It is impressive to note that thanks to the simplicity and flexibility of the Arduino platform, freshmen were able to design and create systems that can easily be installed in an environment to collect data of several kinds. They might even get commercialized and/or exploited for further opportunities.

Measuring Light Intensity, Temperature and Humidity With Arduino

Two systems have been built working with these sensors. The first includes a display showing the values of light intensity, temperature and humidity. It also uses the following components:

- Arduino board UNO,
- 16x9 LCD display,
- Humidity and temperature sensor DHT11,
- RTC module for data and time, and
- A potentiometer.

Figure 2 shows the schema of the system for all the connections. Software has been divided into three parts: (i) initialization of Arduino and inclusion of all the needed libraries; (ii) check of each component when they are on; (iii) print of information on the LCD display.

The other related project does not use the LCD display but sends the value read out of the sensors to a Web server that stores them in a NoSQL database and shows the results online in a dedicated web page. For such a project we have used:

- Arduino Uno,
- Arduino Ethernet Shield,
- DHT11 sensor,
- A resistor of 10 kΩ,
- A photo-resistor,
- An Ethernet cable.

As shown in Figure 3, and as already discussed previously, digital and analogical inputs of Arduino have been connected with the sensors. Light intensity has been shown as a 10 bits number (value between 0 and 1023). For the temperature and humidity we have adopted a digital DHT11 sensor. An Ethernet board compatible with Arduino has been used in order to send read data to a PHP page that processes GET requests and stores results in a remote database.

Figure 2. Connections of LCD display, DHT11 sensor, potentiometer, RTC module, and Arduino UNO board using Fritzing

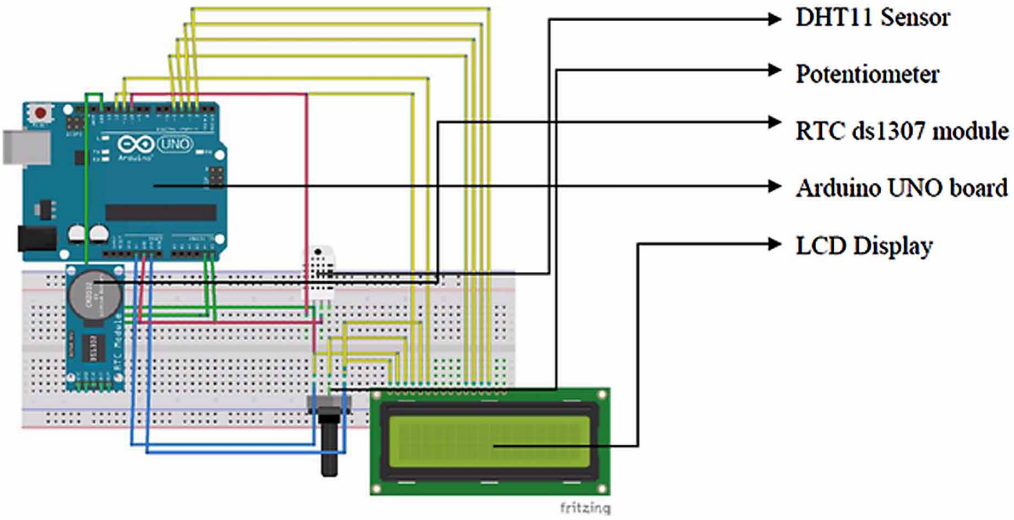
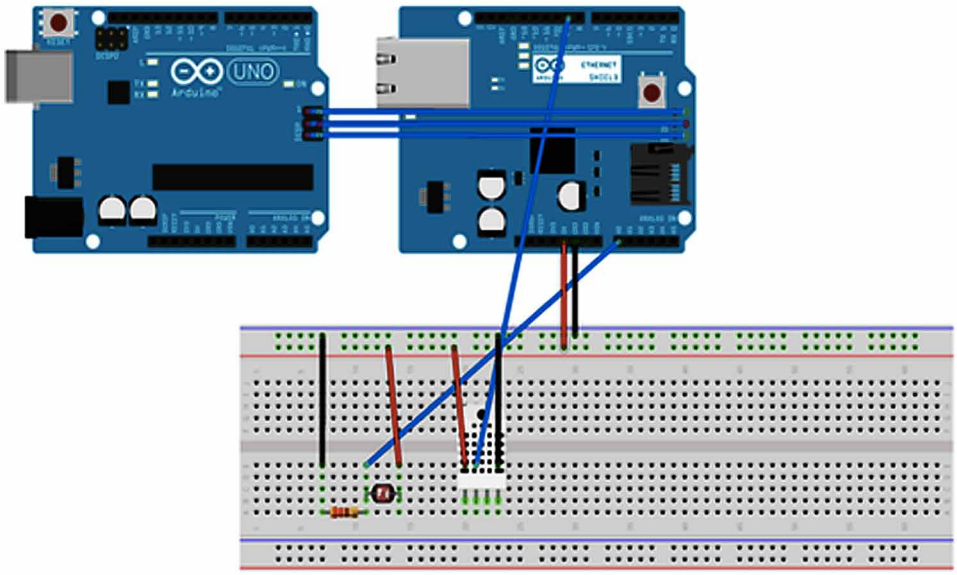


Figure 3. The schema of the light intensity, temperature and humidity sensors linked to Arduino and the Arduino Ethernet board using Fritzing



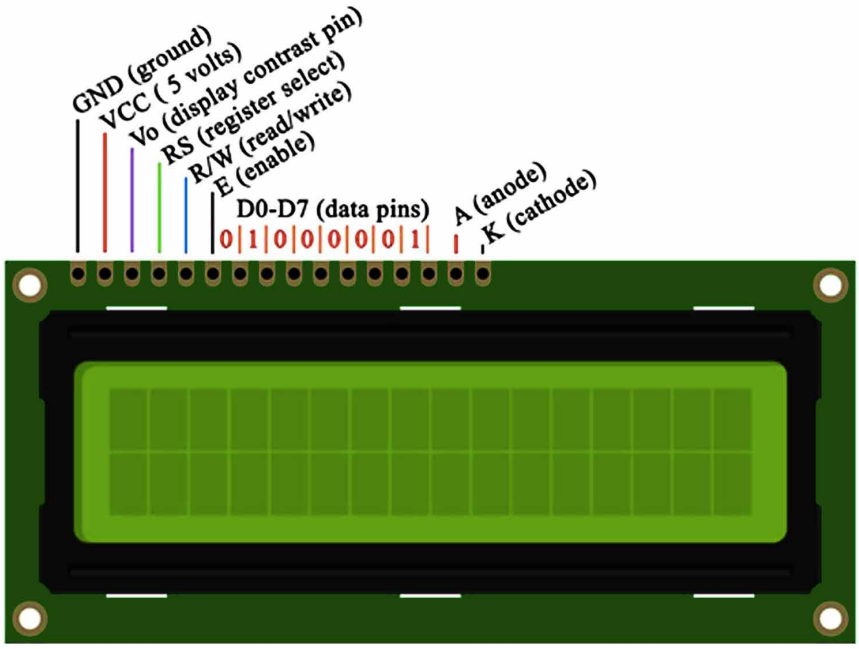
Smart Management of Electric Appliances Using LCD Display

Components that have been used for the construction of this prototype are the following:

- Arduino Uno;
- 74HC595 Shift register;
- 16x2 LCD display, wired through the use of:
  - One NPN transistor;
  - A trimmer;
- Photo resistor;
- Relay;
- 2x Pushbuttons;

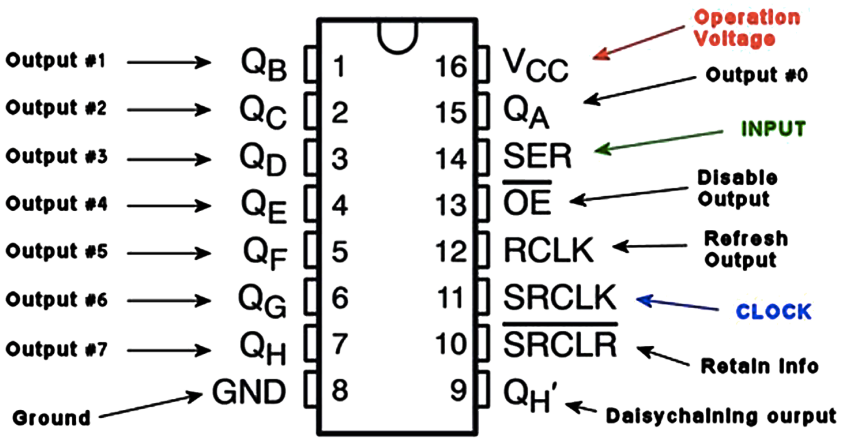
Arduino sends data to be visualized on the LCD display to the shift register through the pins INPUT (14), CLOCK (11) and REFRESH OUTPUT (12). The shift register performs a translation from serial to parallel and sends data through four of the eight pins of the LCD display. Moreover, it uses one pin of the NPN transistor to securely control the backlight of the LCD display. The reader is invited to check Figure 4 for the schema of the LCD display. Pins directly used by the shift register to send data to the LCD display are: RS, E, R/W. D4-D7, and K for controlling the backlight. The shift register is not essential but it has been employed to reduce the number of pins directly used on the Arduino. Without it, the Arduino would have been connected directly to the LCD using eight pins (as mentioned above). After describing the procedure how the data are sent and shown on the LCD display, let us move on with the other components. Figure 5 shows the schema of the used shift register.

Figure 4. The 16x2 LCD display and its pins employed for the prototype



The photo resistor is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. It is connected to the analogic pin of Arduino with a push down resistor. Arduino reads through the pin connected to the photo resistor a value ranging from 0 to 1023, which indicates the intensity of the light in the environment. A value closer to 0 means absence of light whereas a value closer to 1023 indicates the highest intensity. A value between 600 and 800 indicates acceptable indoor light. Just to get an idea on real settings, solar light has a value closer to 950. A default value of 650 is used as threshold of the system. When the light has an intensity value greater or equal than the threshold the system is activated, otherwise it is turned off.

Figure 5. 595 Shift register and its schema



The two push buttons are connected in a pull down configuration to two interrupt pins of the Arduino board. They start two interrupt routines whose purpose is to increase or decrease the threshold value for the intensity of light that enables the system.

Finally, a 5V relay is connected to a digital pin of Arduino and it is enabled when the intensity of light is below the threshold. The relay is connected to a lamp or any other electric appliance having a power in compliance with that supported by the relay.

As far as the software is concerned, the LiquidCrystal595 Arduino Library has been employed for driving the LCD instead of the classic LiquidCrystal because of the presence of the Shift Register, this library also permits to manage the backlight of the LCD without any additional configuration.

Figure 6 shows the assembled prototype.

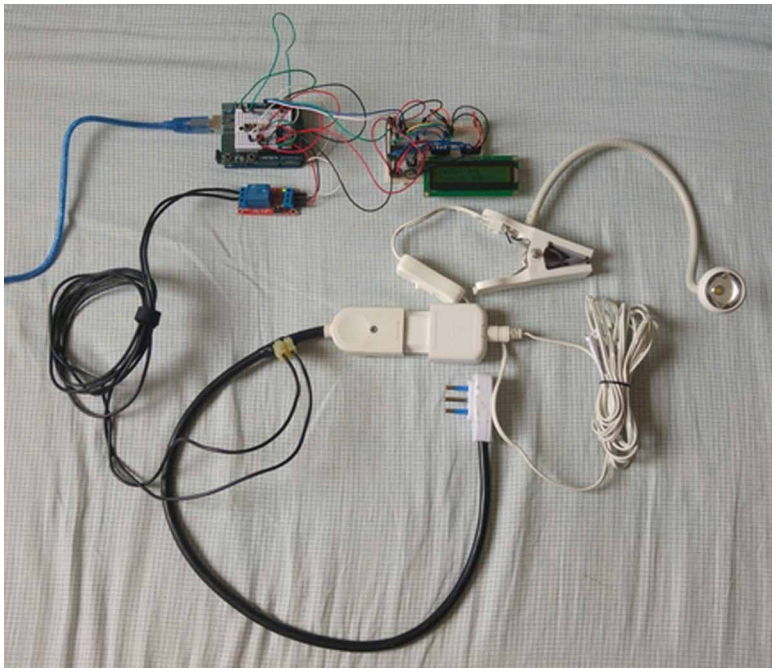
It is important to note that the schema presented in this subsection does not change at all if we replace the photo resistor with any other sensor (e.g. temperature, humidity, etc.) in order to control the electric appliance connected to the relay according to the temperature or humidity of the environment.

An Arcade Game Controller

The second prototype we describe consists in an arcade game controller developed to play video games in any PC. Components that we have employed for the design process were the following:

- Arduino Leonardo Microcontroller;
- Components from the Arduino Starter Kit;
- BreadBoard;

Figure 6. The assembled prototype for smart management of electric appliances



- 4 semi-transparent arcade game buttons with mechanical switch (bought on eBay);
- 4 leds (2 red from the Arduino Starter Kit and 2 white bought separately);
- A home-made wooden case we built.

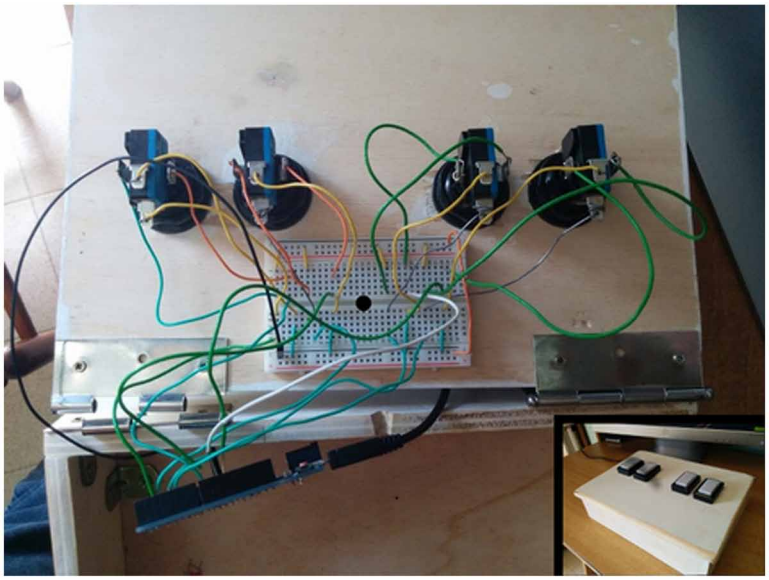
The core of the game controller lies on Arduino itself. The raw input signals are acquired from the buttons and sent to the Arduino board, then translated into keyboard signals and sent to the pc through the USB cable.

Each of the 4 buttons has 2 connectors for the switch and 2 connectors to light up the led inside each button. Whenever a button is pressed, its led is turned on. Each button is connected to the breadboard to allow a more precise circuit mapping. No additional resistors are necessary, only the built-in pull-up resistors inside the breadboard.

The Arduino board has been programmed to emulate a common plug & play USB keyboard. We have leveraged the keyboard.h library, in order to be compatible with every computer and OS (we have tested it on a Windows, Linux and Mac machine). We made sure the ghosting effect[4] does not occur, and therefore all the 4 buttons can be pressed and recognized at the same time without any issues.

The code initializes (in the setup function) the status of the 4 pins related to the four buttons, setting them as inputs and 4 pins as output to light up the led lights. The loop function is executed every few milliseconds to accurately acquire any push of each button. This function checks at every loop if a button is pressed; if this happens, the main board sends to the PC the corresponding keyboard signal. In the meantime the main board also sets to "high" the status of the pin associated with the button, lighting up the led inside the corresponding button. As long as the button is pressed the board continues to send the same signal, and keeps the led on. Figure 7 shows the case and the assembled components.

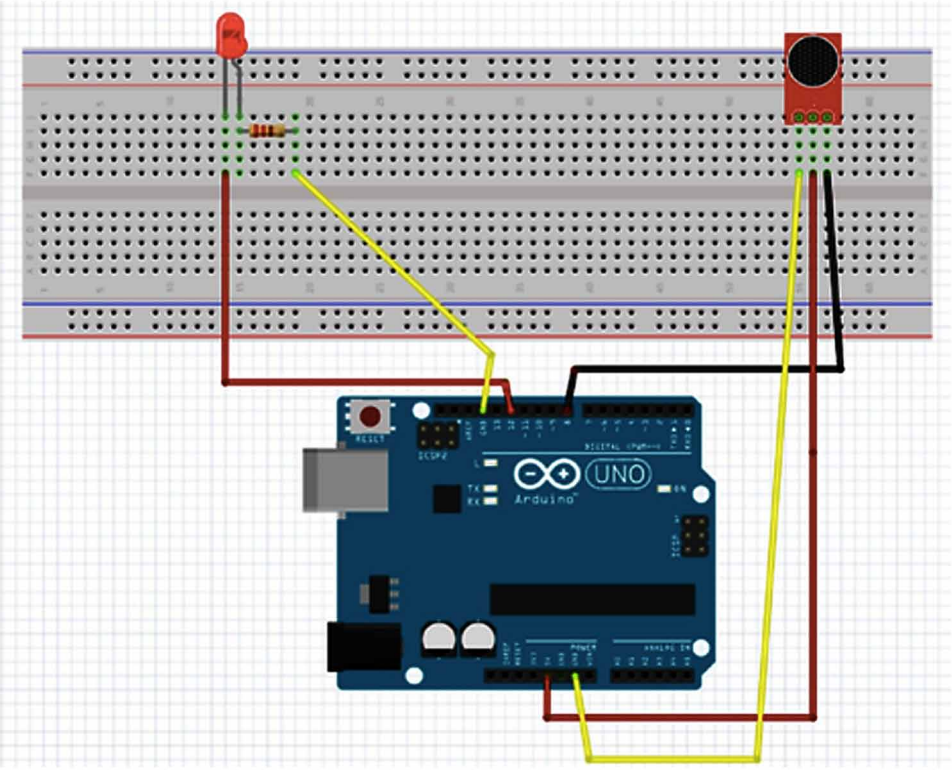
Figure 7. The case (bottom right) and the assembled components of the arcade game controller prototype



A Sound Intensity Detector

In this third prototype, Arduino has been connected with an acoustic sensor to detect sounds whose intensity is higher than a chosen threshold. If it is then a led is turned on. There are several applications of such a schema to be used in homes: e.g. baby crying detector, dog bark detector, etc. The adopted acoustic sensor has a microphone, seven resistors (one of them is variable), a LM939 module and two led lights. It is possible to set the sound intensity level to detect by tightening a screw of the embedded potentiometer. When the microphone detects a sound intensity value higher than the threshold level, a HIGH signal will be produced on the DO pin. Otherwise, a LOW signal will be propagated. Figure 8 shows the schema of the prototype (Arduino's connections with the acoustic sensor, the LED, and the resistor). More in detail, the acoustic sensor is connected to Arduino through three pins: DO, digital exit, to the pin 8. Vcc and GND connected, respectively, to the 5V and GND pins. Once the system is connected to either USB or to a power supply it is active and ready to listen. If a sound with intensity greater than the threshold is detected, the LED is turned on for a second. For the next five seconds, the system is in pause and, right after, it comes back to active and ready to listen.

Figure 8. The schema of the sound intensity detector using Fritzing[5]



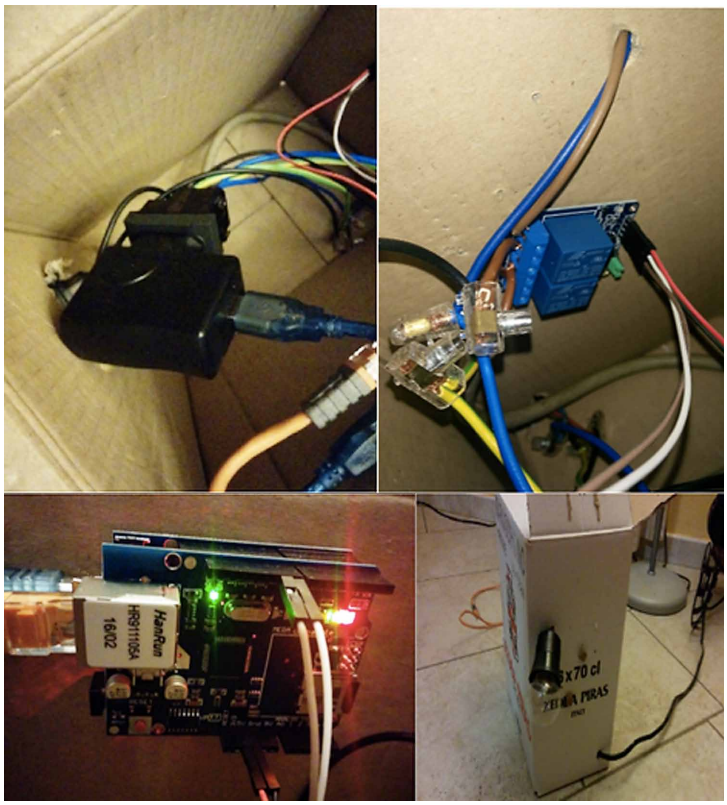
Management of Electric Appliances Through Web Services

This project aims at turning on and off electric appliances through a simple web interface. The extra modules we have used are: Arduino Ethernet Shield and the Relay module. The former allows linking an Arduino board with a PC or an Internet router therefore creating a web server in order to manage all the digital ports of Arduino. The latter includes two relays connected to a digital port of Arduino that will command to turn on or off the electrical appliances connected to one endpoints of the relay. Other tools we have used are:

- 512MB MicroSD,
- Ethernet cable,
- 2 x relay,
- lamp,
- paper box.

A web page has been developed within the microSD of the Ethernet Shield board and other code for the Arduino main functions lets the web server wait the requests on the IP address indicated in the configuration. Figure 9 shows the components used for such a project.

Figure 9. Components used for the project



Analog Stick With Arduino

Components we have used for such a prototype are:

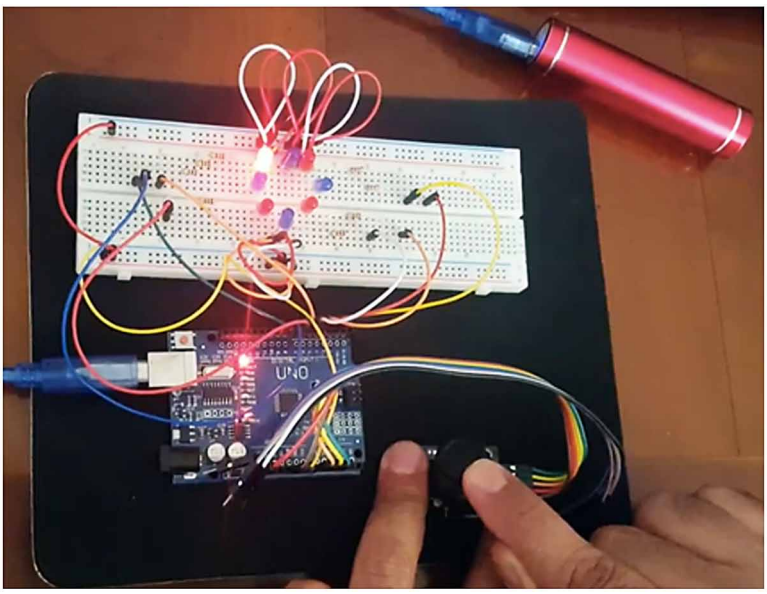
- Arduino UNO board,
- Breadboard,
- Analog stick,
- Eight 220 Ω resistors,
- Eight led lights (4 red and 4 blue), and
- A power bank as power supply.

The rationale of the software developed on top of Arduino is to detect the x-y position of the analog stick and turning on the correspondent led light. Instead of the led lights, electric appliances might be connected and turned on or off using the stick. Figure 10 shows the connections of all the components used for this prototype where the reader may observe the top left red led light on when the user moves the stick toward the corresponding direction.

FUTURE RESEARCH DIRECTIONS

There are plenty of ideas to be implemented that stimulate us. For example, there are several smart components that can be designed, programmed and used in homes and connected with Internet and managed through smart phone applications whose data can be gathered for plenty of analysis. Definitely, the most stimulating of them is within the robotics domain. In fact, as future directions where we are

Figure 10. Breadboard and all the components for the analog stick built with Arduino



headed we would like to develop on top of Arduino a robotic platform provided with several sensors (temperature, camera, humidity, acoustic), wheels to move on a flat surface, arms to pick up objects, move and perform general. One advanced version will have a humanoid shape and will be provided of legs instead of the wheels. We want to also provide the robot with a basic artificial intelligence so that it can perform basic actions depending on the context. Last but not least, we want to come up with a set of API to access to all the sensors and functionalities of the robot so that everyone can build the same robot (we will publish the manual and data sheets of each component we will be using) and program software that can interface with all the robot capabilities. We would like to keep the project open source and follow its best practices.

CONCLUSION

Arduino is a platform that easily allows the development and integration of hardware in any domain. It can be used to easily collect data and information from any sensor and store them in cluster for further (big data) processing. In this chapter we have described a set of applications and prototypes developed on top of Arduino for different domains where data can be extracted and analyzed for further processing. The ease of design and development of so many sensors and opportunity to extract data paves the way for start-up/spin-off opportunity creation that sell as business core products developed with Arduino or even consulting and training for the use of Arduino and its tools. We aim at creating such a start-up with skills in creating and positioning sensors, extract and store data in databases and perform analytics on them.

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KEY TERMS AND DEFINITIONS

Arduboy: A credit card sized game system developed using Arduino whose cost is $39. The original project was funded through Kickstarter.

Arduino Board: Open source board provided with Atmel 8, 16 or 32 bit AVR microcontroller with other components used to program for development and embedding in other systems.

Breadboard: It is a solderless device for prototyping of electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connect the holes on the top of the board.

Fritzing: Open source hardware initiative that makes electronics accessible as creative material for everyone.

Ghosting: Effect appearing in some models of keyboards when some key combinations pressed together cause some keypresses to disappear, although they are physically pressed.

Internet of Things: A development of the Internet where common objects have network connection and send and receive data.

Kickstarter: The world's largest crowdfunding platform for creative projects developed by an American corporation based in Brooklyn, New York.

NoSQL Approaches: Provide a mechanism for storage and retrieval of data without using a predefined schema as that present in relational databases. NoSQL indicates non relational.

Restful Web Services: Software architectural style of the World Wide Web that specifies constraints that if applied to a web service induce desirable properties. Data and functionality are resources accessed using Uniform Resource Identifiers.

ENDNOTES

1 https://www.kickstarter.com/

2 Prototypes, their descriptions and video showing how they work can be found online.

3 Taken from Wikipedia, http://www.wikipedia.com

4 https://www.microsoft.com/appliedsciences/antighostingexplained.mspx

5 http://fritzing.org/home/

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Chapter 9
Educational Serious Games Design

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ABSTRACT

Serious games are defined as games in which learning has priority over entertainment. While the entertainment industry is characterized by an established game design paradigm, the foregrounding of learning in serious games creates new demands. The design of effective serious games requires the pooling of expertise from both game design professionals and learning sciences professionals. One of the main problems the field of serious game design faces concerns the disconnect between game design and learning design. Several serious game design models have been proposed to bridge this gap. As these models have not been systematically reviewed, their contribution is not known. The chapter presents the state of the art for the field of serious game design and outlines five principal challenges. Next, 11 serious game design models are briefly introduced and reviewed. It is concluded that the degree to which the models meet the five challenges varies and that the field of serious game design is in a pre-paradigm state.

INTRODUCTION

Initially, digital games targeted mainly entertainment. The idea of combining fun and learning led to edutainment, the pairing of entertainment with education. The latest trend, serious games, marginalize entertainment and brings education into the spotlight. Serious games are games not exclusively designed for fun, serving non-entertainment goals in many diverse fields such as military, government, corporate, health-care, and education (Michael & Chen, 2006).

Digital games have become a defining phenomenon of contemporary culture. Over the last two decades, the educational interest in digital games has skyrocketed. This interest has taken two main forms. First, game-based learning that is entertainment-driven. This trend involves the use of commercial games for learning. Second, education-driven game-based learning that is currently manifested in trends such as gamification and serious games. The former refers to the application of game design elements to educational settings (Deterding, Khaled, Nacke, & Dixon, 2011; Kapp, 2012). The latter refers to the ad

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hoc development of games that bring education in the spotlight without excluding entertainment. Serious games are games not exclusively designed for fun, serving non-entertainment goals in many diverse fields such as military, government, corporate, health-care, and education (Michael & Chen, 2006).

Game design is an inherently interdisciplinary endeavor, involving experts from various disciplines such as graphic, audio, product, and interaction design, programming, animation, writing, and content area expertise (Salen, 2007). The game industry has developed highly sophisticated narrative, artistic, and technical methodologies for creating engaging and immersive games (e.g. Salen & Zimmerman, 2004; Schell, 2014; Adams, 2010). Currently, the field of digital game design is mature, being in a paradigm state (Kuhn, 1996).

As the emphasis has gradually shifted to serious games, however, new requirements emerged. Compared to traditional digital game design, the main complication that emerges in the case of Serious Game Design (SGD) is that learning has priority over entertainment. Consequently, in addition to all other types of expertise required for digital game design, SGD necessitates professionals whose expertise is related to learning. Such professionals include educators, content experts, and learning sciences professionals in general. To design effective serious games, game design professionals would need to collaborate with learning sciences professionals (Charsky, 2010; Lim et al., 2014; El Mawas, 2014). Such a collaboration, however, might not be directly possible because a common vocabulary is missing (Arnab et al., 2014). As it has been stressed, the main limitation characterizing the field of serious game design pertains to the disconnect between established game development models and the design of learning (Arnab et al, 2014; Bellotti, Berta, De Gloria, D'ursi & Fiore, 2012; Van Staalduinen & de Freitas, 2011). To address this limitation, Moreno-Ger et al., (2014) argued that serious game development methodologies are needed that will eventually help systematize the creation of games. To bridge the game design - educational design gap, a number of serious game design models have been advanced over the past few years. To date, there has been no systematic review of such SGD models. Consequently, the extent to which these models address the major challenges the field of SGD faces is unknown. The present work has two main objectives. First, it presents the state of the art in SGD by briefly introducing 13 models. Second, it acknowledges contribution these models make and identifies 5 principal challenges that remain open for the field of SGD. The chapter is concluded with an examination of the extent to which every model meets the design challenges and an outline of the road map ahead.

BACKGROUND: SERIOUS GAME DESIGN MODELS – STATE OF THE ART

In this section 13 SGD models that have been advanced in recent years are briefly introduced. An overview of the models is given in table 1.

While all models aim at SGD, they have different origins and constitute different solutions to the problem of design. For convenience, the SGD models are presented in chronological order.

Kiili, (2005) proposed the Experiential Gaming Model (EGM) for designing SGs. The EGM is based on on Kolb's experiential learning cycle and the corresponding four stages of experiential learning. The starting point for the development of this model was the observation that the creation of educational games often fails because the emphasis on educational dimensions of games has displaced fun, resulting in unengaging games. The main idea underlying the EGM is that the link of gameplay with experiential learning will facilitate the state of flow and, eventually, lead to learning.

Table 1. An overview of SGD models

Model	Sources	Features
Experiential Gaming Model (EGM)	Kiili (2005)	experiential learning influence; links gameplay with experiential learning
4 Dimensional Framework (4DF)	De Freitas & Oliver (2006); De Freitas & Jarvis (2009)	provides 4 dimensions for game design: learner, pedagogy, representation, and context
Game Object Model (GOM), GOM II	Amory & Seagram (2003); Amory (2007)	object-oriented programming influence; game components are described in terms of abstract (pedagogical) and concrete (design) interfaces
Document-Oriented Design and Development for Experiential Learning (DODDEL)	McMahon (2009)	extension of a generic ADDIE model comprising of the following stages: situation analysis, design proposal, design documentation, production documentation, prototype, development, and implementation
Is	Annetta (2010)	encapsulated model comprised of 6 elements: identity, immersion, interactivity, increasing complexity, informed teaching, and instructional
Game-Based Learning framework (GBLF)	Van Staalduinen & de Freitas (2011)	4DF extension with 25 game elements that improve memory and learning
Design Patterns Framework (DPF)	Kelle, Klemke & Specht (2011)	4 step procedure for mapping game design patterns on teaching and learning functions
Game Discourse Analysis (GDA)	Wouters, Oostendorp, Boonekamp & Spek (2011)	uses (a) information flow (resources needed in the game) and (b) game discourse (presentation of resources in the game) to inform game design
Six Facets Framework (SFF)	Marne, Wisdom, Huynh-Kim-Bang & Labat (2012)	6 design elements: pedagogical objectives, domain simulation, interactions with the simulation, problems and progression, decorum, conditions of use
Architecture for Representations, Games, Interactions, and Learning among Experts (ARGILE)	El Mawas (2014)	design methodology that employs Web 2.0 practices for SGs
Learning Mechanics – Game Mechanics (LM-GM)	Arnab et al., (2014); Lim et al., (2013); Lim et al., (2014)	associates ludic elements (game mechanics) with pedagogy (learning mechanics)
Cognitive Behavioral Game Design Model (CBGD)	Starks (2014)	Social Cogitive theory and Flow theory influences; combines (a) social cognitive elements and (b) multiple intelligences elements to promote flow
Activity Theory-based Model of Serious Games (ATMSG)	(Carvalho et al., 2015)	Activity Theory influence; extension of the GM-LM model that distinguishes 3 types of activity: (a) learning, (b) gaming, and (c) instructional; each activity type is further represented in terms of actions

De Freitas & Oliver (2006) (also de Freitas & Jarvis, 2009) advanced the 4 Dimentional Framework (4DF) for the design of SGs. The framework comprises 4 main dimensions which can be employed to guide game design: learner, pedagogy, representation, and context. While this framework was initially conceptualized for classifying educational games, the authors have eventually adapted it for game design.

The Game Object Model (GOM) for SG design was proposed by Amory & Seagram (2003). The GOM attempts to describe the relationship between game elements and pedagogical dimensions of learning. The model draws on object-oriented programming (OOP) concepts such as classes, encapsulation, and inheritance. GOM II (Amory, 2007) is the updated version, aimed to enrich the initial GOM. The GOM considers educational games as consisting of components (objects) each of which is described in terms of abstract and concrete interfaces. Abstract interfaces refer to pedagogical and theoretical constructs (conceptualization phase) while concrete interfaces refer to design elements (design phase).

McMahon (2009) introduced the Document-Oriented Design and Development for Experiential Learning (DODDEL) model. DODDEL was developed for the purposes of an undergraduate course on game design and is an extension of the generic ADDIE model (i.e. Analyse, Design, Develop, Implement, and Evaluate – ADDIE). The DODDEL comprises several discrete design and development stages: situation analysis, design proposal, design documentation, production documentation, prototype, development, and implementation.

Annetta (2010) proposed Is, a framework for serious educational game design that comprises six elements: identity, immersion, interactivity, increasing complexity, informed teaching, and instructional (all start with an I). In this framework the elements are nested, so the top element (instructional) encapsulates all others down the stack.

The Design Patterns framework (DPF) has been advanced by Kelle, Klemke & Specht (2011). This work constitutes more of a framework rather than a concrete development model. The DPF emerged in response to the need of mapping game design patterns onto educational methods. The authors draw on the idea of Design Patterns as the building blocks of a game and propose a 4 step procedure for mapping design patterns on teaching and learning functions.

The Game-Based Learning framework (GBLF) (Van Staalduinen & de Freitas, 2011) was conceptualized as an extension of the aforementioned 4DF. The authors reviewed the literature and identified 25 game elements that improve memory and learning. They have then integrated these game elements into the four dimensions of the 4DF. The resulting framework explicitly incorporates learning, instruction, and assessment as core elements.

Wouters, Oostendorp, Boonekamp & Spek (2011) introduced the Game Discourse Analysis model (GDA). The authors introduce the concepts of information flow and game discourse. The former describes the information resources needed in a game while the latter pertains to how the resources can be presented in the game. The GDA model is proposed as a method for supporting designers in the game making process with respect to information flow and game discourse. The model comprises 3 main components that center on the information flow: (a) building blocks, which describe the information resources required to materialize a task in the game, (b) standardized description of the information flow, and (c) manipulation, which denotes the creation of a game discourse through the information flow. This model utilizes constructs from cognitive psychology, such as cognitive task analysis (CTA), to explicitly inform game design.

Marne et al., (2012) developed the Six Facet Framework (SFF), a conceptual framework that allows all game design stakeholders (game experts and pedagogical experts) to speak a common language and work together in designing games. The main drive behind this framework is the communication problem between the two types of experts that are involved in SG design. The framework includes the following elements (facets) of design: (a) pedagogical objectives, (b) domain simulation, (c) interactions with the simulation, (d) problems and progression, (e) decorum, and (f) conditions of use. The authors developed a design pattern library consisting of 42 design patterns within the SFF. This model represents a systematic attempt to bridge formal game design and pedagogy design. While it is principally conceived as a means to foster interdisciplinary collaboration, the SFF is also helpful as a general purpose design guide due to the comprehensive library of design patterns.

The ARGILE model (Architecture for Representations, Games, Interactions, and Learning among Experts) (El Mawas, 2014) is mainly a methodology for the design of participatory and knowledge-intensive SGs. ARGILE constitutes a participatory architecture for the co-design of games by designers, experts, and players. This model attempts to extend Web 2.0 practices to game design practices through co-design.

The Learning Mechanics-Game Mechanics Model (LM-GM) for SG design has been described in a number of recent publications by a large international team (Arnab et al., 2014; Lim et al., 2013). The model was explicitly conceptualized so as to bridge the most challenging gap in the field: the SG design and educational design gap. The LM-GM model provides a means to relate pedagogy to ludic elements. The core elements of the LM-GM model are Serious Game Mechanics (SGMs) and the Mechanics of Learning (LM). The LM-GM model maps game mechanics onto learning mechanics in considerable detail. Interestingly, Lim et al., (2014) have extended the LM-GM model by integrating narrative elements through Narrative Serious Game Mechanics (NSGM).

Starks (2014) introduced the Cognitive Behavioral Game Design Model (CBGD). The main argument behind CBGD is that game design should make more systematic use of established psychological theory. Consequently, CBGD draws on (a) Bandura's Social Cognitive Theory (SCT), (b) Gardner's Theory of Multiple Intelligences (MI) and (c) the enjoyment process. The CBGD model involves the use of social cognitive elements (i.e. knowledge, goals, outcomes, encouragement, and barriers) through the mechanisms of multiple intelligences elements (e.g. graphics, narrative, space, sound etc), so as to promote enjoyment in terms of engagement, challenge, flow, persistence, and mastery.

Lastly, The Activity Theory-based Model of Serious Games (ATMSG) (Carvalho et al., 2015) is an extension of the GM-LM model. It targets the problem of how concrete game components need to be structured to foster learning. Based on Activity Theory, the model adopts the concept of activity and its hierarchical structure and organization. Consequently, the model proposes 3 main types of activity: (a) gaming activity, (b) learning activity, and (c) instructional activity. Each activity type consists of separate actions. As Carvalho et al., (2015) argue, actions can be represented as triangles, each depicting how a subject achieves a goal using a tool. Game components are defined as actions forming subject-tool-goal triangles. Drawing upon this definition, the authors introduce a serious games taxonomy made up of three types of components: gaming, learning, and instructional ones.

FURTHER RESEARCH DIRECTIONS: PRINCIPAL CHALLENGES FOR SERIOUS GAME DESIGN

Overall, these models are clear evidence of the solid progress made over the last decade in terms of conceptualizing SGD. While each model has it own unique merits, all the SGD models make important contributions to the field. As a whole, the models represent a rich and diverse set of solutions to the problem of SGD, helping piece the whole puzzle together. Despite progress, however, important issues remain unresolved. The core problem is how to bring two different professional communities together. More specifically, to design effective serious games, the expertise of educators, content experts, and learning experts will need to be utilized on the top of all other experts who are typically involved in game design. To advance as a field, SGD will need to facilitate the collaboration among experts from different disciplines. In practical terms, this involves bridging the gap between game design and learning design. Considering the state of the art in SGD as reflected in the models, we argue that the road map for advancing the field requires the community to address the five principal challenges outlined in Table 2.

The first challenge is how to integrate content into games. Learning is about academic content, so the design of serious games requires ways to integrate content into the games. Academic content cannot be embedded into games in the ways it is done in textbooks, i.e. in expository form. Content needs to be adapted, and embedded in the game in specific ways. Preserving fun while promoting learning seam-

Table 2. Principal design challenges for the SGD field

N	Design Challenges
1	Integrate content
2	Address student ideas
3	Engineer instruction
4	Engineer learning
5	Conceptualize learning

lessly, requires intrinsic content integration into the game (Sanchez, 2011; Malone, 1981). The seamless content integration into games entails that distinguishing the learning from the fun becomes difficult (Charsky, 2010). Preliminary evidence suggests that intrinsic integration into content might be essential for learning from games (Habgood & Ainsworth, 2011; Dickey, 2011)

The second major challenge is how to take into consideration students' ideas and conceptions of content when adapting and integrating content into serious games. For instance, as the Science education literature suggests, students have intuitive ideas about most physical phenomena (Driver, Asoko, Leach, Scott, & Mortimer, 1994; Smith, Disessa, & Roschelle 1994). Such ideas are often not in agreement with the established scientific viewpoint. As research has indicated, such intuitive conceptions influence learning and cannot be ignored (Duit, Treagust, 2003; Vosniadou, Ioannides, Dimitrakopoulou, Papademetriou, 2001).

The third challenge involves determining how to utilize instructional design theory to inform SGD. Mayer (2011) argues that to design serious games, we need to combine two fields: the science of instruction and the science of learning. As he puts it, the challenge is to find the proper mix between game and instructional features. One of the requirements mentioned is a science of instruction. The genuine challenge, however, is to translate the principles outlined in Mayer (2011; 2014) into actual game design methods since a direct translation might not be possible.

The fourth challenge is to examine how people learn (e.g. Bransford, Brown & Cocking, 2000) and utilize this body of knowledge for the purposes of SGD. Engineering learning as opposed to engineering entertainment is what differentiates games for entertainment from serious games. Therefore, learning theory and research will need to be translated into ludic approaches so as to be effectively integrated into games. Inversely, ludic approaches will need to be combined with learning theory and research. While it has been illustrated that game designers intuitively employ learning principles when creating games (Gee, 2003), a more systematic approach will have to be followed.

As an extension of the previous one, the final challenge is related to the conceptualization of learning per se. While some SGD models have turned to instructional design theory for solutions, it should be noted that instruction is merely a means to an end. The end goal of all instruction is learning: instruction should simply be instrumental in facilitating it. As opposed to looking at the field of instructional design for inspiration, learning will need to be approached in a more principled way. We argue that effective SGD calls for both an empirically and theoretically grounded conceptualization of learning. Regarding the former, SGD needs to be founded on solid principles of learning. Mayer (2011) stressed the need for a science of learning for game design, specifically advocating the use of Multimedia Learning Theory (MLT) principles for informing SGD. We would extend this argument to include empirical

research from the learning sciences at large. Regarding the latter, what is required is a concrete, coherent, and comprehensive conceptualization of learning for the purposes of SGD. Such an all-encompassing conceptualization will need to account for learning in terms of content, context, social interaction, and mediational artifacts. We argue that such a conceptualization will provide a much-needed framework for bridging traditional game elements with learning theory.

The extent to which the SGD models meet each of the 5 principal design challenges is presented in Table 3.

Several interesting conclusions can be drawn from the table. First, none of the models addresses all 5 challenges. However, six models (4DF, GBLF, SFF, LM-GM, CBGD, and ATMSG) appear to be more comprehensive than others considering that they simultaneously meet several challenges. Second, the degree to which each SGD model addresses a specific challenge varies considerably: some of the models might fully address a challenge while others only tangentially. For instance, both the EGM and the ATMSG models adopt certain notions of learning but the latter approaches learning in a more principled manner. Third, no uniformity should be implied in how the different SGD models approach the same design problem. The models overcome a specific design challenge in different ways depending on their origin, goal, and overall approach. Models such as the EGM approach the issue of academic content integration in different terms compared to the LM-GM model. Fourth, the majority of the models draw rely heavily on psychology (for learning) and education (for instruction). Finally, the SGD models examined have placed virtually no importance on student ideas (2nd challenge) and conceptualization of learning (5th challenge). None of the models explicitly approaches the issue of previous student knowledge and how it might facilitate or hinder learning from the game. Similarly, all models fall short in terms of adopting a concrete, coherent, and comprehensive conceptualization of learning for ludic purposes.

Table 3. How SGD models meet the design challenges

Design Challenge Met	Serious Games Design Models
4	**Experiential Gaming Model** (EGM)
1, 3, 4	**4 Dimensional Framework** (4DF)
3, 4	**Game Object Model** (GOM), GOM II
1, 4	**Document-Oriented Design and Development for Experiential Learning** (DODDEL)
3, 4	**Is**
1, 3, 4	**Game-Based Learning framework** (GBLF)
3, 4	**Design Patterns Framework** (DPF)
3, 4	**Game Discourse Analysis** (GDA)
1, 3, 4	**Six Facets Framework** (SFF)
3, 4	**Architecture for Representations, Games, Interactions, and Learning among Experts** (ARGILE)
1, 3, 4	**Learning Mechanics – Game Mechanics** (LM-GM)
1, 3, 4	**Cognitive Behavioral Game Design Model** (CBGD)
1, 3, 4	**Activity Theory-based Model of Serious Games** (ATMSG)

CONCLUSION

As noted in the introductory section, the field of game design is in a paradigm state. A decade ago Gunter, Kenny and Vick, (2006) argued that a new game design paradigm is required for the field of SGD. Despite the considerable progress made, this conclusion still holds as the field of SGD is currently in a pre-paradigm state (Kuhn, 1996). It is imperative that the game design and the learning sciences communities join forces to bridge the game design and learning design gap. To advance the field to a paradigm state, the two communities will have to rise up to the five principal design challenges.

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KEY TERMS AND DEFINITIONS

Digital Game: A game whose system is (partly or wholly) implemented in a digital device such as a game console, a personal computer, a smart-phone or tablet.

Game: A system in which participants compete to achieve a clearly identifiable result. The system is made up of interrelated components whose relations are rule-governed.

Game Design: The art and science involved in making all the necessary decisions for creating a game.

Ludic Elements: Game components that refer to player engagement and represent the entertainment dimension of a game.

Pedagogical Elements: Game components refer to the curricular, instructional and learning dimensions of a serious game.

Serious Game: A game that is not exclusively designed for fun, serving primarily non-entertainment goals in various fields such as education, health-care, corporate etc.

Serious Game Design: The art and science of making all the necessary decisions for creating a game that does not foreground entertainment.

Serious Game Design Models: Conceptualizations that aim to inform the decision-making processes involved in creating a serious game.

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Chapter 10
Exposure to Video Games and Decision Making

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ABSTRACT

In the last years, it is ever more frequent to read popular press stories about the effects of video and/or computer games on the brain and on the behavior. In some cases, we can read something claiming that video games "damage the brain," while in others these activities can "boost brain power," and such conflicting proclamation create confusion about the real or potential effects of this activity on human beings. Thus, it is very interesting to deeply understand the effect that exposure to video games (VGs) can have on cognitive processes, with particular attention to decision making. Only a few studies have been carried out on this issue: the main aim of this contribution is to clarify these aspects, critically reviewing the existing scientific literature. Particular attention has been dedicated to normal and pathological players, different types of VGs, and moral aspects of decision making vulnerable to VGs. It has been concluded that research in this area is still in its early days, and this short review aims at discussing several issues and challenges that should be addressed to forward this research field.

INTRODUCTION

In the last decade, the playing of video games (VGs) has become very popular among people. Video games represent a pervasive leisure activity beginning in middle childhood and continuing through adulthood (Gentile et al., 2004; Kubitzki, 2005). Population based surveys indicate that average gaming time ranges between 7 and 13 hs per week in both children and adolescents (Gentile and Anderson, 2003), and this value may underestimate the prevalence of use in some population segments. This high level of VGs consumption highlights the relevance for a clearer understanding of the potential influences of video game experience on human behaviour and cognition (Bioulac et al., 2008; Green and Bavelier, 2006).

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Indeed, after several dramatic and murderous shoot-outs happened mainly in schools and colleges, game research focused mostly on the impact of aggressive shooter games on aggression-related cognitions, affects, and behaviors (Anderson and Bushman, 2001). The studies present in the literature showed different risks of excessive exposure to VGs: increase in aggression (Anderson et al., 2010), emergence of attention problem (Swing et al., 2010) and hyperactivity (Gupta et al., 1994), poor academic performance (Rideout et al., 2007), possible addiction (King et al., 2011), mood troubles as depression and anxiety (Mentzoni et al., 2011), reduction of empathy (Bartholomew et al., 2005), impairment of social behavior (Gentile et al., 2011), reduction of sleep time, quality and efficiency (Weaver et al., 2010; King et al., 2013).

However, exposure to VGs can not be regarded only as a negative experience. A great body of literature has revealed that action video game players, compared to non video game players, can develop broader cognitive benefits from extensive playing. These benefits include visual acuity (Green and Bavelier, 2007; Wu and Spance, 2013; Granic et al., 2014), attention flexibility (Green and Bavelier, 2003; Cain et al., 2012), stimulus-response mapping (Clark et al.,1987; Castel et al., 2005), encoding speed (Wilms et al., 2013), and executive functioning (Strobach et al., 2012). Extensive experience playing action VGs can even affect memory for the stimuli presented in a very short period (e.g., iconic memory and visual working memory), resulting in better accuracy (Boot et al., 2008; Blacker and Curby, 2013), higher precision (Sungur and Boduroglu, 2012) and more efficient strategy in retrieving information (Clark et al., 2011).

At the present, only a few studies have investigated the potential effects of video game exposure on decision making. The aim of the present chapter is to describe this relation, reviewing published studies and discussing possible implications for future research.

BACKGROUND

1. Exposure to Video Game and Decision Making

The study of the VGs effects on decision-making is a new research field in psychology, with a limited number of published studies; nevertheless, it can offer important clues for understanding risks and potentialities.

Past research has demonstrated that VGs experience can influence cognition and emotion (West and Bailey, 2013). More specifically, the prolonged exposition to VG is associated with decreased use of proactive cognitive control (Kronenberger et al., 2005; Mathews et al., 2005; Bailey et al., 2010), changes in feeling and expressing both positive and negative affects (Bartholow et al., 2006; Kirsh and Mounts, 2007; Bailey et al., 2011). Since it is well known that the efficacy of decision making is modulated by emotion, executive/cognitive control, and by presence of chemical and behavioural addiction (Weber and Johnson, 2009; Figner and Weber, 2011), one could expect that VGs experience could have a detrimental effect on the efficacy of this complex process.

It has been demonstrated that exposure to racing VGs can influence real-world decision making related to driving behavior (Fischer et al., 2009; Beullens et al., 2011). There is evidence, however, that certain types of VGs may have differential effects on cognitive control, a set of abilities that allow the individual to maintain goal-directed information processing (Basak et al., 2008; Bailey et al., 2010). For example, in a study focused on individual differences (Bailey et al., 2010) it has been reported that experience with First Person Shooter (FPS) video games was correlated with a reduction in proactive control (ac-

tive, sustained maintenance of goal-relevant information) and was not correlated with reactive control (just-in-time mobilization of control after the conflict is detected; Braver, 2012). Furthermore, Swing (2012) demonstrated that 10 hs of FPS experience resulted in a reduction in the use of proactive control in a training study. These findings may indicate that FPS gamers may be more likely to make their decisions immediately rather than after thoughtful deliberation, a tendency that could indicate a preference for immediate rewards rather than long-term assessment of the risks and benefits (Bailey et al., 2013).

In contrast to FPS games, strategy VGs may promote an increase in careful planning and executive control of behavior. Basak and coworkers (2008) demonstrated that more than 23 hs of training with strategy VGs improved task-switching and working memory abilities, that are cognitive processes relevant for the efficacy of decision making.

A study proposed by Bailey and colleagues (2013) examined the relationship between two of the most popular genres of video games (FPS and strategy) and decision making. The main purpose was to provide a more comprehensive understanding of how VGs experience is related to risky decision making. By measuring both behavioral and self-reported impulsivity, it emerged that pathological gaming and playing FPS games were positively associated with a greater impulsivity. This association sounds very interesting, supporting the evidence that this form of gaming is also associated with a reduction in the use of proactive cognitive control (Bailey, 2009; Bailey et al., 2010; Swing, 2012). Taken together these results may indicate that playing FPS games and pathological gaming are associated with an increase in impulsive behavior that results from a decrease in the use of proactive cognitive control of behavior (Bailey et al., 2013). Also, the association between gaming and risky decisions was sensitive to game genre: the number of hours spent to playing VGs and to be a FPS gamer negatively correlated with the tendency to select low risk options. These findings provide a clear evidence that gaming time, pathology, and game genre (i.e., FPS) influence the individual' selection of risky options, and that such a behavior continues in spite of its detrimental effect on performance.

In contrast to FPS type, strategy VGs were not strongly related to increased risk-taking. One explanation for the differential influence of game genre is that there could be social repercussions for making impulsive decisions in a strategy game, where a successful performance requires cooperation within a team (Bailey et al., 2013). It is important to note, in fact, that both strategy and FPS games are associated with pathological gaming, but the consequences of impulsivity and risk-taking are not the same for the two genres. This may be due to the structure of the gaming environment or to player' goals within the different genres.

It has also provided an preliminary evidence of a negative association between playing violent VGs and prosocial behavior (Anderson & Bushman, 2001; Ballard & Lineberger, 1999; Wiegman & VanSchie, 1998). According to the General Aggression Model (GAM; Anderson & Bushman, 2002), pro- and antisocial behaviors may be affected by the activation of aggression-related patterns that are stored in memory after exposure to VGs. Such patterns can alter the way in which subsequent information is processed, so that even neutral or ambiguous cues may be interpreted as threatening or aggressive. Consequently, the activation of aggression-related patterns may alter appraisal and decision-making processes, ultimately leading to more antisocial (and, conversely, fewer prosocial) behaviors. Based on this idea, Sheese and Graziano (2005) carried out an experiment aiming at investigating the effect of VGs violence on cooperative decision making. Participants were divided in pair and randomly assigned to play either a violent or a nonviolent version of a famous VG. Following the VG exposure, participants were separated and had the opportunity to choose to cooperate with their partner for mutual gain, withdraw from the interaction, or exploit their partner for their own benefit. Results showed that playing violent VGs affects subsequent

decisions to cooperate or compete with other individuals in high-stakes situations, undermining prosocial and altruistic motivation by promoting competitive behavior in deliberate decision making (Sheese and Graziano, 2005). More specifically, participants to the violent condition were significantly more likely to choose to exploit their partners compared to those of the non-violent condition. Moreover, they were more convinced that their partners would exploit or distrust them. Instead, participants in both conditions generally expected that their partners would trust them and cooperate with them. However, participants in the violent condition were more likely to exploit than trust and choose to defect compared to those in the non-violent condition. These findings suggest that playing violent VGs may undermine prosocial motivation and promote exploitive behavior in social interactions.

Recent studies examined the influence of VG on self-perception, a process termed *identity simulation* (Fischer et al., 2010; Hull et al., 2012). In these studies, it was investigated how adoption of moral frameworks through identity simulation can impact on subsequent behaviors. By means of the *identity simulation*, players embrace the characters' decisions and behaviors as their own and a game player can adopt the traits' and attitudes of the controlled character, and this happens also outside virtual reality (Kaufman et al., 2012). Thus, moral decisions made while videogaming, could influence players' views of themselves and their morality, and this self-perception could impact real moral behaviors. The study of Ellithorpe and coworkers (2015), examined how people make and interpret moral behaviors in VGs, and how gaming behaviors influence real-world behavior. Participants made a moral decision in a VG, followed by two behavioral tasks. They were instructed to take on a deontological (save as many lives as possible) or utilitarian (win against the enemy, at any cost) mind-set during gameplay. The game asked participants to choose between saving one person or allowing him to suffer for the greater good, in this case, aiding the war effort. Immediately after, they played a game with another participant (actually a computer, in a task called Noise Blast; Bartholow et al., 2006; Bushman, 1995): whoever was faster would be rewarded with money, whoever was slower would hear an uncomfortable blast of noise. Participants set the noise and reward levels for their ''partner,'' and their ''partner'' set levels for them. In the post-test participants indicated the decision they perceived as more moral. Results showed that players tended to see the deontological option as the more "moral". More specifically, participants who had implemented the deontological choice in the game may have felt more strongly that they had the moral high ground, so they were more likely to retaliate against another participant who had blasted them with noise by reducing the reward the other participant received. On the other hand, participants who had implemented the utilitarian choice shifted their view of this behavior to be slightly more moral, these participants were less likely to retaliate by reducing reward levels. Although it is believed that participants internalized the moral mind-set from the game, participants may have felt the need to justify their in game actions. Importantly, either explanation involves the character's behavior being internalized, and the participant acting in a manner that is consistent with moral license.

These results indicate that people may see identity simulation through moral behavior in video games as a sufficient way to fulfill their moral quota (Ellithorpe et al., 2015). If mediated behavior acts as a sufficient substitute for actual behavior, then moral license processes may occur more frequently than previously expected. Thus, the adoption of different mind-sets can impact players' real-world behavior. These changes provide evidence for moral license (Mikhail, 2007) as a theoretically important perspective in VG and moral behavior research, with identity simulation as one possible mechanism (Fischer et al., 2010; Hull et al., 2012). The effects of violent VG with simulation of moral behaviors is therefore not cut-and-dried, but instead a complex process the outcomes of which depend on gameplay experiences and perceptions.

2. Pathological Gaming and Decision Making

Pathological gaming in adolescents and young adults is an emerging problem in developed societies, being a direct consequence of the rapid escalation of technological advances.

Some studies have shown that pathological gaming might overlap other behavioural and substance addictions. In fact, in healthy volunteers playing to VGs is usually associated with greater ventral striatal presynaptic dopamine release, suggesting that videogaming is potentially rewarding or motivating in itself (Koepp et al., 1998). Adolescents that can be described as frequent VGs players present greater volume in left striatal grey matter, a region that also had greater activity during loss feedback and that negatively correlate with deliberation time at the Cambridge Gamble Task (Kuhn et al., 2011). Following a 6 week extended gaming exposure of healthy volunteers, an increased orbitofrontal and anterior cingulate activity has been observed, suggesting that VGs playing can act as a reinforce and associated cues can become conditioned reinforces (Han et al., 2010). Similarly, subjects with pathological gaming have a greater cognitive bias and cue reactivity towards game-related images, with greater medial prefrontal and anterior cingulated cortex activity (van Holst et al., 2012; Zhou et al., 2012; Lorenz et al., 2013). Pathological gaming is also associated with greater impulsivity on the Barratt's Impulsiveness Scale and greater perseveration on the Wisconsin Card Sorting Test along with increased volume in thalamus and inferior temporal and occipital gyrus (Han et al., 2012). Moreover, pathological gamers further demonstrated an impaired motor response inhibition as assessed by Go/No Go tasks, along with decreased error-related negativity (Littel et al., 2012). These results reveal that some mechanisms of behavioral and substances addiction are common to both addiction and gambling.

Another feature that we can observe in both substance/behavioural addictions and game dependence is the impulsivity, that can be differentiated into decision and motor impulsivity (Robbins et al., 2012; Perry and Carrol, 2008). Decision impulsivity includes impulsive choice (a preference for an immediate smaller reward over a larger delayed reward; Kirby et al., 1999) and reflection impulsivity (the tendency to gather and appraise information prior to making a decision; Clark et al., 2006). Motor impulsivity includes motor response inhibition (Aron et al., 2003) and premature responding, or also anticipatory responding (Voon et al., 2013).

On the basis of these evidences, Irvine and colleagues (2013) investigated the different subtypes of decisional and motor impulsivity in a well-defined pathological gaming cohort, hypothesizing that VGs would be associated with greater decision impulsivity, both in terms of delay discounting and reflection impulsivity (Irvine et al., 2013). Results showed that pathological gaming is actually associated with greater decision impulsivity, with less evidence sampled prior to a decision and greater impulsive choice. Increased reflection impulsivity (e.g. sampling less evidence or opening fewer boxes prior to making a decision) had negative consequences with pathological gamers obtaining significantly fewer points, possibly mediated via the numeric increase in number of sampling errors (Irvine et al., 2013). From these results, it could be concluded that pathological gamers might be less sensitive to the introduction of cost or penalties or may be more impaired in the integration of decision cost in optimizing final outcomes; this suggests that pathological gamers may be more likely to respond to instrumental reward feedback and less to negative costs in decision making (Irvine et al., 2013).

Also, according to some researchers, pathological gambling players might suffer from more discrete cognitive biases of probability estimation and choices that are not specific to pathological gambling, but are exacerbated by the disorder. In fact, cognitive biases influence decision-making, resulting in an increased risk willingness when winning probabilities are seen as high, and in risk aversion when win-

ning probabilities are seen as low. Goodie (2003, 2005) and Lakey and coworkers (2006, 2007) observed that pathological gamblers were more confident in their decisions about a general knowledge task, even though they had no greater competence or performance level than non-gambling controls. Problem and pathological gamblers were also more likely to accept lower probability gamblers, which suggests a higher degree of cognitive bias.

However it would appear that the condition is not created in experienced poker players which have a significantly lower bias in estimating the winning probability of hands and played hands with a significantly higher average winning probability compared with inexperienced players (Linnet et al. 2010). Linnet and colleagues (2012) reported that pathological gambling poker players had a larger error margin of probability estimation, played hands with lower winning probability, and had poorer differentiation of winning probability between played and folded hands compared to experienced poker players. Pathological gambling poker players and inexperienced poker players did not differ on these measures. These results suggest that cognitive biases in pathological gambling poker players cannot simply be explained as a problem of decision-making, that pathological gambling poker players have intact probability estimation, but are drawn toward risky gambles (Linnet et al., 2012).

FUTURE RESEARCH DIRECTION

On the basis of this brief analysis of the limited existing literature, we could say that the exposure to VGs may results in changes of individuals' decision making.

The results reported and discussed in this chapter necessarily require further investigation, studying these topics in more detail and with greater and balanced sample.

A well known limit, indeed, is related to the fact that almost all investigation have been carried out on men. Moreover, it would also be appropriate to conduct longitudinal studies, in order to verify if the observed results can be intended as permanent or if they are only acute and limited in time. Furthermore, this field of research would strongly gain from new investigations aimed at clarifying whether decision making is equally influenced in pathological gamblers and "healthy" VGs players. Also, additional research should be oriented on possible differential effects of different genres of VGs on decision making: it is, in fact, arguable that action and non-action VGs might differentially affect cognitive processes, an interesting issue not still directly tested. As a possible improvement, also differential effects between different kinds of games (strategy, sport, life simulation, etc) merit to be investigated.

In conclusion, this brief review underlines the relevance of new research to better understand how VGs in general and gambling in particular can influence decision making and for clarifying the mechanisms underlying such changes.

CONCLUSION

The study of the VGs exposure on decision making is a new field of research, currently characterized by few investigations. With this mini-review, we aimed at providing different considerations about the role of VGs on this higher order cognitive process.

Video games seem to influence impulsive decisions, both in subject with pathological gambling (Bailey et al., 2013) and healthy sample (Irvine et al., 2013). Experienced or pathological players tend to decide more impulsively, prefer smaller and immediate rewards and spend less time to analyze elements available before making a choice. Gamblers showed a lower sensitivity to negative reward or punishment (Bailey et al., 2013) that should discourage these behaviors.

Bailey and colleagues (2013) were the first to make a distinction between FPS and strategic video games, showing that strategic video game players are led likely to take risky decision and are more susceptible to negative feedback compared FPS players. These results, together with other studies (Fischer et al., 2009; Beullens et al., 2011) have highlighted the need to begin to distinguish various types of video games and focus on different effects that they can induce.

Several studies have shown that VGs have an important role in the moral decision, in particular the work by Ellithorpe and colleagues (2013) showed that players can identify themselves with the character's choices who plays in the VGs and that this choice influence the subject' behaviour out of the virtual world as a result of moral license (Merritt et al., 2010; Monin e Miller; 2001). This is an important result because prove that decisions taken in virtual context can modify the choice that we will take in the everyday life, well outside the game.

Finally, regarding the influence of violent VGs on competitive or cooperative behavior it has been seen that violent content can evoke the same type of behaviour towards a partner and lead to the decision to compete instead cooperate though without affecting the trust and the relationship that the subject puts in partner (Sheese e Graziano, 2005).

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KEY TERMS AND DEFINITIONS

Adolescence: The transitional period between puberty and adulthood in human development, terminating legally when the age of majority is reached.

Behavior: The actions by which an organism interacts with surrounding environment.

Cognition: The mental process of knowing, including several aspects as, for example, awareness, perception, reasoning, memory and judgment.

Decision-Making: The thought process of selecting a logical choice from the available options.

Executive Control: A set of cognitive processes (as attentional control, or working memory) that are necessary for the cognitive control of behavior.

Gambling: Recreational activity that consist in gamble or bet money on the outcome of a game. Gambling can became an addictive habit.

Pathological Gambling: Persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress, as indicated by the individual itself or by friends and relatives.

Video Game: Electronic device that allows to interact with the projected images on an screen. This apparatus allows to simulate real or unreal situations, on which the players intervenes using a keyboard or a joystick.

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Chapter 11
Learning With Games and Digital Stories in Visual Programming

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ABSTRACT

This chapter traces the recent development and the use of games and digital stories for engaging students in learning in visual programming environments. It reports on the application of game development-based learning and educational digital storytelling to engage students in learning in visual programming environments. The empirical findings support the positive effects of these two learning approaches on a range of student learning outcomes. Because many available visual programming tools are free of charge and provide a low-floor, high-ceiling learning environment, teachers should encourage students to venture into the programming world with these tools. Such practice is beneficial to student learning both within the computer science discipline and across disciplines.

INTRODUCTION

This paper traces the recent development and the use of games and digital stories for engaging students in learning in visual programming environments (Lau & Yuen, 2015).

Games have long been used to arouse and sustain students' learning interest. Wu and Wang (2012) contended that as students modify or develop a game by using a game development framework (GDF), they can learn different skills and concepts in computer science (CS) and software engineering (SE). They labeled this learning experience as game development-based learning (GDBL), and showed that it consisted of "four elements (course aim, pedagogical theory support, GDF resource pool, and impact factor), two methods (learning by creating and learning by modifying games), and six steps in the teaching process and two subjects (students and teachers)" (p. 16). More recently, Wang and Wu (2015) reviewed 66 articles related to game development and CS/SE education published between 2004 and 2012 and found that the number of articles published on this topic had increased steadily from 2004 to 2009. On

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average, 12 articles were published each year from 2009 to 2012. Game development was mainly used in colleges and universities (81%) but also in high schools (9%) and middle schools (9%). In CS, game development was adopted primarily to teach introductory courses and programming (77%).

Psomos and Kordaki (2012a, 2012b) advocated the practice of educational digital storytelling (EDS), which denotes the intersection of education, storytelling, and digital technology, to help students achieve the six cognitive objectives of the revised Bloom's taxonomy (Bloom, Mesia, & Krathwohl, 1964) and acquire various literacy skills (Robin, 2006). McWilliam (2009) surveyed 300 online digital storytelling programs and found that 123 were provided by educational institutions. Of these 123 programs, 55 were hosted in K–12 schools; 42 in universities; and 26 in colleges or institutes. In schools, digital storytelling was mainly used to engage students in learning and to enhance student print and media literacy, whereas in universities and colleges, it was either embedded in student-teacher training programs or formed part of multimedia and design courses. A recent review by Gregori-Signes (2014) showed that EDS has been used extensively in different subjects and contexts at the primary, secondary, and tertiary levels as well as for teacher prepration programs.

In the following sections, I first discuss the theoretical basis and educational benefits of GDBL and EDS in general. I then present empirical evidence to support the positive effects of these two pedagogical approaches on student learning outcomes. Subsequently, I provide insights into future research directions regarding learning with games and digital stories in visual programming and then conclude the paper.

BACKGROUND

According to Dempsey, Lucassen, Haynes, and Casey (1996), computer games are rule-guided, artificial, and technologically rendered scenarios that involve one or more players and have specific goals, constraints, payoffs, and consequences. Many people are enthusiastic about playing games and express high hopes for its positive impacts on learning. Connolly, Boyle, MacArthur, Hainey, and Boyle (2012) concluded that playing computer games, in general, was associated with numerous perceptual, cognitive, behavioral, affective, and motivational impacts and outcomes. In particular, the most prominent effects were found in knowledge acquisition/content understanding and affective and motivational outcomes. McClarty et al. (2012) identified five potential benefits of using digital games in education: 1. Games are built on sound learning principles. 2. Games provide personalized learning opportunities. 3. Games provide more engagement for learners. 4. Games teach 21st century skills. 5. Games provide an environment for authentic and relevant assessment (pp. 6–7).

Furthermore, Werner, Denner, and Campe (2014) argued that designing and programming a game can be regarded as an ill-structured design problem (Jonassen, 2000) that requires students to define the goal, decide how to reach that goal, and evaluate the solution. Because most games involve problem-solving tasks that are dynamic, time dependent, and complex, game development is often understood as a complex problem-solving process that draws on an individual's abilities to formulate complex problems, design systems, and understand human behavior (Denner, Werner, Campe, & Ortiz, 2014). Thus, it is anticipated that such a practice can help improve student problem-solving skills and higher-order thinking abilities.

Digital storytelling refers to "the art of combining narrative with digital media such as images, sound, and video to create a short story" (Dreon, Kerper, & Landis, 2011). The Center for Digital Storytelling in Berkeley, California, identified seven crucial elements of digital storytelling: point of view, a dramatic question, emotional content, the gift of your voice, the power of the soundtrack, economy, and pacing

(http://digitalstorytelling.coe.uh.edu/page.cfm?id=27&cid=27&sublinkid=31). Robin (2008) asserted that digital storytelling enables users to combine the traditional processes of creative story writing with various types of multimedia, which results in an electronic artifact that is accessible through both local computers and the Internet. Constructionism and the narrative paradigm are the two basic theories that support the use of digital storytelling in education (Wang & Zhan, 2010). In constructionism, students create external and sharable objects (learning by making) through active interaction and engagement in the learning process. The narrative paradigm posits that meaningful learning occurs as students attempt to interpret actions, words, and deeds from a story into something relevant to their experiences.

Digital storytelling benefits student learning in numerous ways. Using digital storytelling in the classroom helps both general education students and those with learning difficulties become more motivated to practice traditional writing. Digital storytelling can be an effective method for engaging students, from kindergarten through college, in student-centered activities mediated by technology. Digital storytelling empowers students to express themselves through multimodal communication techniques and to develop multiliteracies such as digital, global, technology, visual, and information literacy (Robin, 2008). It helps students to understand more clearly the subject matter and to improve their literacy skills.

Porter (2005) found several advantages of practicing digital storytelling: helping students to improve their multiple literacy skills, increasing their content learning, engaging students in learning across the curriculum in schools, fostering their mastery of many 21st century skills, and meeting technology standards. Digital storytelling can be integrated across a range of subject areas to enhance student learning outcomes. Curriculum integration enables students to establish connections across content areas and to communicate their experiences to a wider audience.

EMPIRICAL EVALUATION

Hwang, Hung, and Chen (2014) found that a peer assessment-based game development approach enhanced students' learning achievement, learning motivation, problem-solving skills, and their perceptions of the use of educational computer games compared with those who were instructed with a conventional game development approach. The peer assessment-based approach also helped students engage in deep learning. Akcaoglu and Koehler (2014) showed that students attending the Game-Design and Learning program outperformed their counterparts who did not attend the program in several problem-solving tasks including system analysis and design, decision making, and troubleshooting. This provides empirical evidence that the program can improve student problem-solving abilities. In their review, Wang and Wu (2015) also reported the positive effects of using game development to improve student motivation and engagement.

However, Chu and Hung (2015) indicated that although the game-based development approach was effective in promoting student problem-solving skills, students learning with this approach showed no difference in academic achievement or motivation from others who learned by playing a digital game. This calls for further research to determine the contextual factors that influence the success and effectiveness of this learning approach.

Burke and Kafai (2012) demonstrated the efficacy of a 7-week writing workshop in helping students to learn the basics of both programming and storytelling, which was reflected in the digital stories they produced (products), the debugging and revising they performed (processes), and their overall perceptions of the workshop at its end. Students also realized that programming and writing were interrelated

composition processes. Fields, Kafai, Strommer, Wolf, and Seiner (2014) explored the effects of collaborative and interactive storytelling activities in a Scratch online community on youth learning of computer programming in two aspects: (1) how this learning experience supports creative expression in collaborative digital stories in both media and code; and (2) how feedback from commentators influences the artistic and computational qualities of stories undergoing revision. They found that the participants could make story designs that were more creative and develop code that was more sophisticated for their final submission after receiving constructive feedback from the Scratch online community.

FUTURE RESEARCH DIRECTIONS

It is believed that GDBL and EDS will remain frequently used approaches through which students learn computer programming in visual environments. Future research may continue to investigate how computational thinking (CT) is developed in visual programming languages. According to Brennan and Resnick (2012), CT involves problem solving by using CS concepts and entails three key dimensions: computational concepts, computational practices, and computational perspectives. Some empirical evidence suggests that visual programming helps increase K–12 student performance in the three dimensions of CT (Lye & Koh, 2014). In addition, Chang (2014) showed the effectiveness of using Alice and Scratch in corrective instruction, raising university students' playfulness and enjoyment levels, and improving their learning performance.

Another research direction concerns the viability of using visual programming to enhance CT, which may promote science, technology, engineering, and mathematics (STEM) learning among K–12 students. CT has been identified as the core component in all STEM disciplines (Grover & Pea, 2013) and there has been an ongoing effort to integrate CT into STEM curricula. For example, Weintrop et al. (2014) proposed a CT-STEM skills taxonomy framework that consists of four major categories of relevant skills: data and information skills, modeling and simulation skills, computational problem-solving skills, and systems thinking skills. However, little is known about how CT can be taught in STEM subjects in practice and, more important, whether and how visual programming may affect STEM learing through the development of CT. Additional studies exploring these issues are necessary.

CONCLUSION

This paper reports on recent development of using GDBL and EDS to engage students in learning in visual programming environments. The empirical findings support the positive effects of these two learning approaches on a range of student learning outcomes. Because many available visual programming tools are free of charge and provide a low-floor, high-ceiling learning environment, teachers should encourage students to venture into the programming world with these tools. Such practice is beneficial to student learning both within the CS discipline and across disciplines. In particular, more research should be devoted to investigating how visual programming may enhance student CT and STEM learning.

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KEY TERMS AND DEFINITIONS

Computational Thinking: It involves solving problems by employing concepts fundamental to computer science.

Game Development-Based Learning: This learning approach requires students to modify or develop a game on the basis of a game development framework. Students are expected to acquire different computer science and software engineering skills and concepts in the learning process.

Game Development Framework: It encompasses the toolkits used to develop or modify games such as the game engine, game editors, simulation platforms, or any integrated development environment.

Digital Storytelling: It refers to the combination of a narrative with multimedia elements such as text, images, sound, and video for creating a short story.

Educational Digital Storytelling: A blend of education with digital storytelling, educational digital storytelling aims to help students to attain the six cognitive objectives of the revised Bloom's taxonomy and develop various literacy skills.

Science, Technology, Engineering, and Mathematics: It is increasingly important for any government to improve STEM education in order to maintain its competitiveness in science and technology development.

Visual Programming Environments: They are computer software that support the use of visual expressions such as graphics, drawings, animations, and icons in the programming process.

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Chapter 12
The Process Model of Gameplay to Understand Digital Gaming Outcomes

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ABSTRACT

Common conceptions of digital gaming often allude to its role in promoting aggression, yet little is understood about its function as enjoyable leisure. This alternative lens permits a more comprehensive account of the way in which gaming may hold equivalent benefits to that of other leisure. In developing a rationale for this solution, this chapter evaluates theoretical models explaining the processes through which digital game violence can translate into aggressive behavior. Here, there is a suggestion that these models are too restrictive in accounting for diverse gaming outcomes, suggesting that theoretical frameworks need to be sufficiently complex to account for a wider set of influences. Leisure theory is presented as a framework for understanding diverse gameplay experiences and their impact on gaming outcomes. This framework presents an alternative to the traditional focus of much research by suggesting that differential outcomes of gaming occur as a result of interactions between personal and contextual factors, as well as the dynamic process of gameplay itself.

INTRODUCTION

Digital games have been the focus of psychological research for a number of decades, yet there remains substantial concern and debate about the potentially harmful effects of violent digital games on children and young people (DeLisi, Vaughn, Gentile, Anderson & Shook, 2013). These concerns primarily relate to the amount of violent content in particular types of digital games, given that evidence has suggested exposure to violent content in games is related to increases in aggressive attitudes and behaviour (Anderson et al., 2010), and reduced sensitivity to real life violence (Bartholow, Bushman, & Sestir, 2006).

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While some researchers claim that there is conclusive evidence of a link between violent game exposure and aggressive cognition, affect and behaviour (Anderson et al., 2010), others have criticised the theoretical and methodological basis of such claims (Adachi & Willoughby, 2011a; Elson & Ferguson, 2014; Ferguson, 2007). This suggests a need to reconsider the way in which outcomes of (violent) gaming are studied. This is the key focus of the current chapter. This includes a critical consideration of the socio-cognitive models which are typically used within this area, and questions the extent to which they can effectively represent the range of potential outcomes of playing digital games. Following this, other key factors are reviewed, and presented as a reason to reconsider the theoretical underpinnings of this research field. Here, a Process Model of Gameplay is presented as a solution to further understand these issues. Specifically, this model aims to provide a framework through which to understand a variety of factors and the diversity of gaming experiences, and their combined role on gaming outcomes. In a practical sense, this can inform future psychological research to adopt a more holistic approach when measuring digital gaming outcomes, particularly in controlling for the extent of factors which are influential in this regard.

Background: Existing Theoretical Models

Existing theoretical models explaining the influence of violent game content on aggression outcomes include the General Aggression Model (GAM: Anderson & Bushman, 2002; Anderson & Huesmann, 2003), and the General Learning Model (GLM: Buckley & Anderson, 2006). These consolidate existing socio-cognitive models to explain the effects of media violence on aggression-related outcomes. The underlying principle of these models is that engaging with violent digital games interacts with an individual's internal state, trait and situational factors to influence appraisal and subsequent behaviour (DeWall & Anderson, 2011). The long-term effects of such processes are said to occur through the development of knowledge structures via learning processes which create a repeated pattern of responses, increasing the accessibility of violent "scripts" over time (Barlett & Anderson, 2013). Beyond this, the GLM more specifically explains how exposure to *any* media content can "teach" a behavioural response. This includes the role of prosocial media content on teaching prosocial behaviours (Greitemeyer & Osswald, 2009), suggesting digital games can be effective "teachers" when exposing participants to specific types of content (Gentile & Gentile, 2008), and thus highlighting their use within educational contexts (Prensky, 2001). However, given that many games include violent content, this has caused substantial concern in particular academic communities, and prompted much research to investigate the way in which repeated exposure to game violence may be harmful through the way in which aggressive scripts are learnt and applied in the real world.

Although some studies have provided support for these models, other studies have not. Specifically, some researchers have criticised the restrictive nature of these models (e.g., Ferguson, 2009). One such criticism is that they imply "passive modelling" in which individuals exposed to violent media will be more likely to engage in real world violent behaviour, regardless of other key influential factors (e.g., family violence, trait aggression) (Ferguson, 2009). Relevant evidence here is the modelling which has been shown through objectification of females within many digital games (Burgess, Stermer & Burgess, 2007), and the consequences this has on real-world prejudices and beliefs towards women (Beck, Boys, Rose & Beck, 2012; Dill & Thrill, 2007). Similarly, particularly in relation to aggressive effects, existing models exclude the role of genetic predispositions and innate motivational systems towards violent behaviour which are believed to explain a substantial proportion of the variance in real-life violent be-

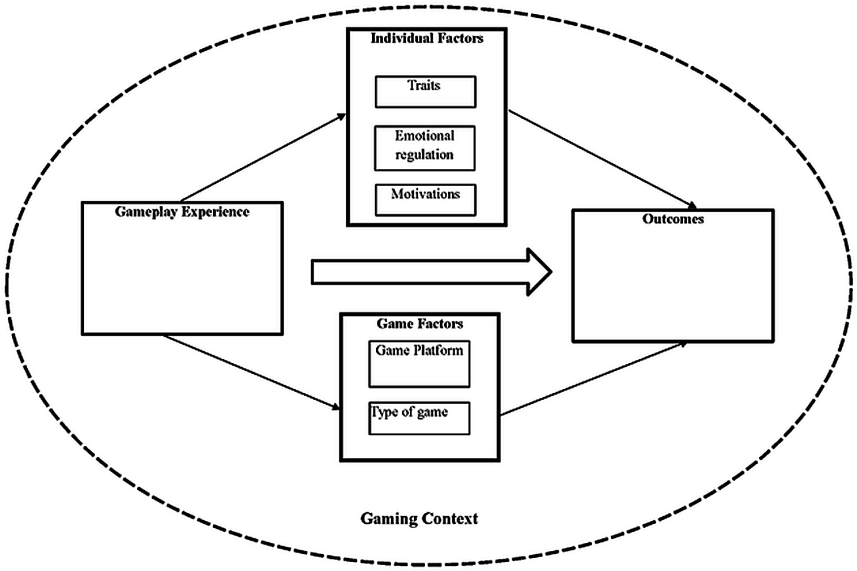
haviour (Eley, Lichtenstein, & Moffitt, 2003; Ferguson, Rueda, Cruz, Ferguson, Ritz, & Smith, 2008). Thus, greater specificity is needed within theory on how such factors function in this process (Ferguson & Dyck, 2012).

Additionally, existing models are not entirely clear in their capacity to test the influence of a range of other factors which have also been suggested to interact upon gaming outcomes (Krahé & Möller, 2004; Markey & Scherer, 2009). For example, emotional regulation has been found as a mediator of the of violent gaming——aggression link (Unsworth, Devilly, & Ward, 2007). This suggests that gaming may serve a mood management function for some individuals (Unsworth et al., 2007). Indeed, mood management theory (Zillman, 1988) suggests that players may be motivated to play as a means of maximising exposure to positive stimuli, as a way of enhancing mood (Bowman & Tamborini, 2015). Conversely, this can result in games being successful in alleviating negative states (Ferguson & Rueda, 2010). This suggests a positive function of (violent) gameplay which existing theoretical models are unable to address. Understanding gaming processes are therefore key, highlighting the importance of understanding *changes* in experiences through gaming in order to fully examine the influence of gameplay processes on the outcomes of the activity. In response to this, the Process Model of Gameplay is presented (see Figure 1). This acknowledges the influence of the dynamic and varied nature of gaming processes upon the range of outcomes of the activity.

Future Research Directions: The Process Model

The Process Model can provide a basis through which to underpin research which aims to explore the various outcomes of gaming, particularly in how the factors identified here are influential in this regard. The merit of this model is that it highlights the range of factors and potential interactions which underpin the dynamic and varied nature of gaming experiences. This can therefore provide a basis from which to research a variety of different mechanisms which underpin gaming outcomes. The following

Figure 1.



sections identify key themes which are integrated within this process-based model to understanding digital gaming outcomes.

Type of Games and Platforms

In addition to individual factors (e.g., traits, emotional regulation) previously outlined, potential variations in gaming experiences may also depend on factors such as game genre and platform (Limperos, Schmierbach, Kegerise & Dardis, 2011). For example, previous studies have identified reduced physiological and emotional responses when playing games on handheld compared to TV-based consoles (Ivory & Magee, 2009). Additionally, enhanced responses to violent content has been found when playing on immersive games technology compared to traditional platforms (Persky & Blascovich, 2007, 2008). This suggests that different gaming consoles have a role in determining the outcomes of the activity. Different game genres have also been found to have differential physiological effects, with greater arousal being identified when playing driving games compared to first-person shooter games (Goodson & Pearson, 2009). This suggests the importance of integrating these factors into models of gaming outcomes. Games are structurally complex, and consist of a range of different dimensions (Bryce & Kaye, 2011). Indeed, previous research shows how specific game dimensions (e.g., identification with game characters, pace of action) are influential upon the derived experiences of the activity (Elson, Breuer, Van Looy, Kneer, & Quandt, 2015). Therefore, understanding the complexities of digital games and acknowledging this within the theoretical underpinnings of digital game research is a key requirement. Unfortunately, theories such as GAM or GLM fail to account for the way in which variables and experiential factors may be influential in the way in which individuals respond to games, and how these may vary as a result of the interaction of the individual and the games technology (Nacke et al., 2009). In light of this, the Process Model includes these as factors underpinning digital gaming outcomes. Here, "game platform" and "type of game" are two identified sub-factors included within the model, in an attempt to provide a more interactionalist perspective for modelling gaming outcomes.

Knowledge and Engagement

Another issue with previous models is the lack of acknowledgement of the knowledge of players, and their experiences associated with moral engagement with virtual violence. Specifically in relation to player knowledge, evidence shows differences between players and non-players in cognitive defence mechanism responses to shooter games (Kneer, Munko, Glock & Bente, 2012). Additionally, other research demonstrates differences between individuals in their gaming experiences (Cotton, Mayes, Jentsch & Sims, 2001; Cox, Cairns, Shah & Carroll, 2012), and responses to priming of aggression-related concepts (Glock & Kneer, 2009). In respect of moral engagement in violence, research shows these individual differences to be influential to the emotional responses associated with gameplay (Young & Whitty, 2010, 2011). The ability of some games to offer opportunities for players to engage in violent acts and violate real-world social norms in the virtual world can provide intense positive emotional experiences (Bertozzi, 2008; Hartmann & Vorderer, 2010), suggesting that the consequences of violent gameplay are not necessarily solely and exclusively negative in nature. In light of this, the Process Model acknowledges "player traits" in respect of the individual variations in responses to specific game content, and how these hold a combined influence on the nature of gaming outcomes. In this way, the Process Model can

provide a more holistic perspective of gaming outcomes, in respect of player experience—game context interactions, which previous models fail to include.

Contextual Factors

A further key limitation of existing theoretical models is their inability to account for the variety of social contexts in which games are experienced. That is, existing models do not account for differences in experiences between immediate gaming contexts in which gamers may be playing alone, compared to with others, and whether or not this in the physical presence of others or via online gameplay. Evidence suggests that different social contexts of gameplay result in differential experiences (de Kort, IJsselsteijn, Poels, 2007). For example, social opportunities with others can enhance emotional gaming experiences (Kaye & Bryce, 2012), and result in enhanced positive mood following gameplay (Kaye & Bryce, 2014). Other research has compared levels of arousal, engagement and mood between different gameplay contexts and found that outcomes are more strongly enhanced in the physical presence of others during gameplay relative to virtual presence (Gajadhar, de Kort & IJsselsteijn, 2009). Similarly, different types of gameplay (i.e., competitive versus cooperative play) do not hold equivalent outcomes (Lim & Lee, 2009), resulting in limitations of existing models which cannot account for these distinctions. The importance of acknowledging social contexts of gaming is particularly pertinent given the increasing popularity of social gaming (Information Solutions Group, 2011). It makes conceptual sense therefore to integrate these constructs into frameworks designed to theorise on gaming impacts.

As well as immediate gameplay contexts, there are wider socio-cultural contexts of interest here. That is, values of social systems may be largely determined by cultural conception and transformation of social representations (Moscovici, 2000). Social representation of identity (e.g., gamer identity) for example is one factor which has been found to be related to different psychological outcomes of digital gaming (Kaye, 2015), suggesting these wider social contexts and constructs play a role in this process. Similarly, when considering gaming within the context of gamers' everyday lives, it is possible to see how it operates as a part of gamers' social identity formation (Kaye, 2014). This highlights the importance of understanding these socio-contextual influences on gaming outcomes. Thus, the Process Model addresses the limitations of existing theoretical gaming models by acknowledging gaming context (in respect of immediate and wider socio-cultural context) within this framework. Specifically, this framework models the player——game experience interaction through a contextual lens, given that the outcomes associated with these interactions are expected to vary considerably as a result of contextual variations.

A Leisure Framework

The fact that gaming is a highly popular leisure activity suggests that it facilitates a range of positive experiences and outcomes for players. Most people engage in leisure to experience enjoyment and freedom from everyday life (Harper, 1986). Specifically in relation to gaming, the derived enjoyment is a key intrinsic motivation for continued engagement (Ryan, Rigby & Przbylski, 2006), in similar ways to that of other leisure (Harper, 1986). That is, gaming provides opportunities for psychological need satisfaction, through enhancing perceptions of efficacy, skill growth and relatedness with others (Przybylski, Deci, Rigby & Ryan, 2014; Reinecke, Klatt & Kramer, 2011; Ryan & Deci, 2000).

A leisure perspective presents a useful approach through which to examine the motivational and experiential processes associated with gaming. In turn, this explains the potential psychological benefits, including; enhanced well-being (Ryan et al., 2006), positive mood (Hull, 1990), and recovery (Collins & Cox, 2014; Reinecke, 2009). Therefore, when viewing gaming through the lens of enjoyable leisure, it should hold similar benefits as other leisure activities, highlighting the utility of this framework for theorising on the more positive outcomes of gaming. Specifically, this perspective assumes a broader role of the activity itself; a key feature underpinning the Process Model presented here. That is, it can provide a way of examining the *processes* involved in gameplay, to better understand how these experiences operate for promoting a range of (positive) gaming outcomes. This extends the focus from solely concerning the content of games, and instead suggests them to operate in equivalent ways to that of other leisure. This can extend beyond the realms of immediate and short-term effects, and can offer insight into the more enduring, broader outcomes of this activity (Mayra, 2007).

An operational example of the Process Model relates to flow theory (Csikszentmihalyi, 1975). This theory proposes that individuals experience enjoyment during an intrinsically motivated activity, characterised by total concentration and lack of self-awareness (Csikszentmihalyi, 1975). Flow, in the context of gaming can provide an insight into motivations for participation, the associated positive experiences, and their combined influence on the nature of gaming outcomes. This is supported by research highlighting the importance of understanding player experiences, particularly in relation to the goal-directed nature of play, and how this might provide a more useful framework than a focus on game content, as in previous models (Oswald, Prorock & Murphy, 2014). As outlined in the Process Model, enjoyable and intrinsically motivated gaming experiences, are likely to largely result in positive emotional outcomes.

Considering gaming as enjoyable leisure provides a useful framework through which to examine the impact of experiential aspects of the activity, which may better account for a more diverse range of outcomes. Specifically in relation to flow for example, the Process Model can underpin its function in explaining continued motivation for specific types of games, highlighting the way in which gaming motivations and experiences are best understood in combination, as an effective way of predicting gaming outcomes. Therefore, the possibilities of future research avenues are fruitful, particularly in relation to examining the impacts which occur as a result of the *processes* of gameplay. On a practical level, research findings within this perspective can offer game industry representatives better scope for applying these approaches to player testing protocols, and indeed an informed evidence-base through which to effectively market their games in light of positive player experiences.

Although existing theory has largely focused on the role of violent game content on aggression-related outcomes, this represents only a small part of the overall gaming experience. Games are complex, providing diverse and variable experiences, indicating the utility of the Process Model in better capturing the dynamic and idiosyncratic nature of the player——game interaction. It is intended that the Process Model may initiate a research agenda which acknowledges the complexities of digital games, and the processes afforded to the activity itself, in order to expand beyond the "negative effects perspective".

CONCLUSION

This chapter has provided a critical review of the theoretical underpinnings of digital gaming research. It has highlighted the limitations, and presented the Process Model of Gameplay as a more holistic framework for these issues. Specifically, this model presents a dynamic process framework for better examining

digital gaming outcomes, through a more comprehensive interactionalist account of the relevant factors. In this way, this model may serve as a vehicle for modelling further research approaches. Although initial support is available for the range of influences included within the Process Model of Gameplay, future research is required which examines the validity and efficacy of the proposed framework. In particular, additional work which accounts for the dynamic process of gaming and how this impacts upon diverse gaming outcomes is greatly warranted. Such a focus would entail a move towards methods such as Experience Sampling Methodology, to gain players' accounts of their "real-world" gaming experiences (Kaye, Monk & Hamlin, in press). Indeed, this calls for research in this area to shift from the traditional "global, broad" perspective, towards a more idiographic one, if a more comprehensive understanding of the range and diversity of outcomes is to be established. This would provide a valuable contribution to the theoretical underpinnings for explaining how and why different individuals respond differently to particular digital games.

Overall, this chapter has argued for a greater focus on understanding the dynamics of gameplay as the direction for future research in this area, and presented a Process Model in response to this. Although a large body of research has examined the influence of violent game content on aggression-related outcomes, this constitutes only one aspect of the overall digital gaming experience. Understanding the complexity of digital games, gaming process and associated outcomes can only be achieved by adopting a more holistic approach to the study of the activity. In this way, it is hoped that the Process Model of Gameplay may be a suitable starting point, through which to initiate this research agenda.

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KEY TERMS AND DEFINITIONS

Digital Games: Used here as a generic term to include all electronic games which can be played in arcades, on game consoles, hand-held consoles, PCs, and over the Internet.

Emotional Regulation: One's ability to utilise emotional stability.

Genetic Predisposition: The extent to which an individual is biologically determined to think or behave in a certain way.

Intrinsic Motivation: Undertaking a task or activity for an internal or inherent sense of reward rather than an external reward (e.g., money).

Social Identity: The extent to which an individual defines themselves by their affiliation to a social group (e.g., gamer).

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Chapter 13
Serious Games Advancing the Technology of Engaging Information

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ABSTRACT

Game researchers are now moving from exploring if games can teach to how games teach. The caveat is that not all games teach but that all good games teach. Leaving a simple truth, it is hard to make a good game, no less a good game that is also educational. The real challenge is getting the people with the right design abilities to make these types of games and establish best practices and quantify what actually makes games as educational systems work. Efforts to move in that direction must begin with establishing terms and defining a framework for what goes into games for learning as formal systems.

INTRODUCTION

The term Serious Games is an umbrella term that refers to any games that have goals other than pure entertainment. The term grew in popularity in the early 2000s when the Foresight and Governance Project at the Woodrow Wilson International Center for Scholars founded the Serious Games Initiative (SGI). The SGI was founded to pursue the goal of helping to organize and accelerate the adoption of computer games for non-entertainment purposes. This included exploring new applications for games in education, training, recruitment, and beyond. At this time many researchers were beginning to understand that games could have positive effects outside of pure entertainment. In Raph Koster's book, A Theory of Fun for Game Design (Koster, 2005) he described the motivating factor of fun in all games as the act of learning. James Paul Gee a well respected games researcher best known for his book, "What video games have to teach us about learning and literacy," focuses on the idea that all good video games exhibit thirty-six learning principles supported by literature in learning science and cognition research (Gee,

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2007). While Serious Games are not based solely on the idea that games can teach, the principles behind good game design actually support learning. As a result, the research has shown that Serious Games are not just another media for learning through a passive act of absorbing material, but are a technology for engaging with information.

Games researchers are now moving from exploring if games can teach to how games teach. The caveat is that not all games teach but that all good games teach. Leaving a simple truth, it is hard to make a good game, no less a good game that is also educational. The real challenge is getting the people with the right design abilities to make these types of games and establish best practices and quantify what actually makes games as educational systems work. Efforts to move in that direction must begin with establishing terms and defining a framework for what goes into games for learning as formal systems.

BACKGROUND

Before the more modern notion of Serious Games took hold, the military made many attempts at using video games for training. The earliest being in 1980 when the Army commissioned Atari to build the Atari Bradley Trainer (P. Smith, In Press). This game was a modified version of the popular vector graphics based game Battlezone, also published in 1980. Only 2 Atari Bradley Trainers were ever built and shown at a trade show. It is unknown why the Army never deployed the game, but it was never actually used by soldiers.

Another military project was started by 1984, this time by the Navy, to use a video game to teach Morse Code (Driskell & Dwyer, 1984). This project also only made it through the prototyping phase. The military's view of games at the time was that they were not serious enough for military training, though the problem seemed to be one of vocabulary only. This is illustrated by the Marines common use of games under the name, Tactical Decision-making Simulations (TDS) since development of the game Marine Doom in 1996 (P. Smith, 2005). Marine Doom is a modification (mod) of the popular first person shooter game Doom, and was created by the Marine Corps Modeling and Simulation Management Office (MCMSMO) developed for the training of Marine fire teams.

This prejudice against video games didn't carry over to the common practice of table top War Gaming, or the use of Flight Simulator Software on PC's, which were sold as games to the rest of the world. The military did not seem completely ready to embrace games for training until after DARPA created DARWARS Ambush, a mod to the game Operation Flashpoint, which was followed up by the Army creating TRADOC Capabilities Manager for Gaming (TCM Gaming) and deploying Virtual Battle Space 2 (VBS2) as one of many official Army Games in 2008. However this prejudice persisted after Serious Games were well established outside of the department of defense. (R. Smith, 2009)

Paralleling the emergence of games in the military is the development of the ill fated Edutainment market. In the early 1980s Edutainment games became an incredibly popular trend. These games, such as "Where in the World is Carmen Sandiego," "The Oregon Trail," "Reader Rabbit," "Math blaster," among many others flooded the market with games that contained some level of educational content. Mizuko Ito described it as a time where the developers were empowered with a "sense that they were creating possibilities for learning that freed it from the institutional constraints of schooling." (Ito, 2006).

Edutainment games succeeded in capturing an audience, and establishing itself as an accepted part of the games industry, however, they never quite got established as a credible form of education. Ito, suggests that the reason behind this is that, "edutainment embodies the challenges which reformers face

in creating new genres of representation and practice…" (Ito, 2006). However, the answer is much simpler. In general the games did not achieve the dual goals of being good educational platforms while also being good games. Edutainment, along with many of the other past attempts to develop learning games, have largely been deemed failures. A sentiment best stated by Michael Zyda, the Director of the Game Pipe Lab at USC, "The game industry has already witnessed the failure of edutainment, an awkward combination of educational software lightly sprinkled with game-like interfaces and cute dialog. This failure shows that story must come first and that research must focus on combining instruction with story creation and the game development process." (Zyda, 2005)

Clark C Apt's book, Serious Games, was published in 1970 and represents the first recorded use of the term Serious Games (Apt, 1970). The term Serious Games was not, however, an instant success. In the 30 years that followed, serious games had a few false starts on the road to becoming a main stream part of the non-entertainment world, the most dramatic of these being in both the education and training arenas.

Clark C. Apt defined Serious Games as games that "have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement" (Apt, 1970). Apt wrote these words over thirty years before the founding of the SGI but his words are still relevant and extremely close to the current definition that most game scholars adhere to for serious games. The one inconsistency of his definition is that serious games have evolved to include more applications than just education. Serious games are commonly defined as some derivation of a game designed for a primary purpose other than pure entertainment. This definition is purposefully open ended in order to allow for the diverse backgrounds of various serious game practitioners.

Mike Zyda, the Director of GamePipe at USC, defined serious games as: "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, 2005). His particular definition met his vision of what a serious game could be, but others whose application of serious games do not fit into the categories defined were still searching for a definition. Further still, many industries utilize gaming technology but do not explicitly create games with the technology, yet have aligned themselves with the serious games movement.

In an effort to move towards a more open ended understanding of Serious Games, the term became an umbrella term that encompassed the efforts underway, bringing all the groups working on Serious Games under one unified vision. The Taxonomy of Serious Games (Table 1.) was presented at the Serious Games Summit (SGS) held at the 2008 Game Developers Conference (GDC). It defines the current categories of games that have been developed by the Serious Games industry including, Games for Health, Advergames, Games for Training, Games for Education, Games for Science and Research, Games for Production, and Games as Work. It further cross references them with the industries that currently use Serious Games. Further slides show the amount of development in each category, illustrating that most of the work in the Serious Games Space was being done for education and training in both schools and the military. (Sawyer, Smith, P., 2008)

The success of the Taxonomy as a reference for where the market had evolved did not, unfortunately, meet the needs of everyone in the community. Debate on the appropriate categories continues. While criticisms can be made of final categorization, the model persisted and it is commonly understood that Serious Games cannot be defined as a single type of game or a particular field.

Table 1. The Taxonomy of Serious Games

	Games for Health	Adver-Games	Games for Training	Games for Education	Games for Science Research	Production	Games as Work
Government & NGO	Public Health Education & Mass Casualty Response	Political Games	Employee Training	Inform Public	Data Collection / Planning	Strategic & Policy Planning	Public Diplomacy, Opinion Research
Defense	Rehabilitation & Wellness	Recruitment & Propaganda	Soldier/ Support Training	School House Education	Wargames / planning	War planning & weapons research	Command & Control
Healthcare	Cybertherapy / Exergaming	Public Health Policy & Social Awareness Campaigns	Training Games for Health Professionals	Games for Patient Education and Disease Management	Visualization & Epidemiology	Biotech manufacturing & design	Public Health Response Planning & Logistics
Marketing & Communication	Advertising Treatment	Advertising, marketing with games, product placement	Product Use	Product Information	Opinion Research	Machinima	Opinion Research
Education	Inform about diseases/risks	Social Issue Games	Train teachers / Train workforce skills	Learning	Computer Science & Recruitment	P2P Learning Constructivism Documentary?	Teaching Distance Learning
Corporate	Employee Health Information & Wellness	Customer Education & Awareness	Employee Training	Continuing Education & Certification	Advertising / visualization	Strategic Planning	Command & Control
Industry	Occupational Safety	Sales & Recruitment	Employee Training	Workforce Education	Process Optimization Simulation	Nano/Bio-tech Design	Command & Control

UNDERSTANDING SERIOUS GAMES THROUGH UNDERSTANDING GAMES

Despite the strides Serious Games have taken in recent years they are considered subpar as games by many due to the lack of an established design methodology, general development guidelines, and underprepared designers. Jacob Habgood of The University of Nottingham's Learning Science Research Institute labeled them to be "Chocolate-Covered Broccoli" due to their poor marriage of games and learning (Habgood, 2005). His suggestion to solve this is a tighter integration between game mechanics and the learning content or what he terms as Intrinsic Integration (Habgood, Ainsworth, & Benford, 2005). This is a sentiment shared by NavAir's Dr. Robert Hays in his game based research literature review (Hays, 2005).

Both Habgood and Hays understood that for good learning outcomes to occur gaming characteristics or features needed to support instructional objectives completely. This of course means that learning games need to go beyond the "lightly sprinkled… game-like interfaces and cute dialog" Zyda (2005) used as a charge against edutainment. They need game mechanics that support both gameplay and learning at the same time. Game mechanics are, "mechanisms through which players make meaningful choices and arrive at a meaningful play experience" (Salen & Zimmerman, 2004). In a book written by Adams and Dormans (2012), mechanics are referred to as feedback loops and some are specifically used to design the internal economy of games to make them challenging. These economies are a basic exchange of resources between player and system and can create deadlocks and mutual dependencies.

In order to map these mechanics to learning outcomes it is important to understand what features of games support what types of mechanics. Further in order to insure those games support learning it is important to have an understanding of what features of games support what learning outcomes. By mapping these features against each other, an understanding of how game mechanics map to learning outcomes can be gained.

Features of Entertainment Games

Before being able to determine the features of games that lead to better learning, it is important to first identify the features that fundamentally define a game. Unfortunately, there isn't one agreed upon definition that everyone in the game industry uses. Further, the definitions that are used seem to vary widely.

Many definitions are far too simple to describe all games well. One of the most oft mentioned definitions is Sid Meier's declaration that, "A game is a series of interesting decisions." (Bateman, 2008). While this might be true of good strategy games, the type of games Meier is known for, this does not include simple twitch or rhythm games, where the player is tasked with maintaining good timing but is limited by the decisions they can make. The definition cited by Jane McGonigal, a well-known proponent of gamification, in her book, Reality is Broken, is one by the philosopher Bernard Suits. He stated, "Playing a game is the voluntary attempt to overcome unnecessary obstacles," (McGonigal, 2011; Suits, 1978). This definition, while open ended enough to justify gamification as a legitimate type of game, does not provide enough details to even meet the features McGonigal suggests in her book, which include: goals, rules, feedback, and voluntary participation (McGonigal, 2011). Though this set of features is already flawed as many educational games are compulsory to courses.

The game designer whose games are most often cited when the question of what makes a game versus a simulation is Will Wright. His games include SimCity, The Sims, and Spore, but he doesn't consider them games; he describes them as toys. "People call me a game designer, but I really like to think of these things more as toys," (Wright, 2007).

One of the earliest game scholars, Johan Huizinga, defined games in his book, Homo Ludins, as "…a free activity standing quite consciously outside ordinary life as being not serious, but at the same time absorbing the player intensely and utterly… according to fixed rules and in an orderly manner," (Huizinga, 1949). Jesper Juul provided a definition that attempted to encompass the various views one could take on games. In doing so, he categorized definition in the categories of: the game as a formal system, the player and the game, the game and the rest of the world, and other (Juul, 2003).

A good definition for those interested in Serious Games would consider a game as a formal system that can be applied to learning. As such, the definition of games used moving forward here will be Katie Salen and Eric Zimmerman's definition provided in their book Rules of Play. Salen and Zimmerman, like many other game researchers, developed their definition through a thorough analysis of various definitions. In particular, they used a total of eight leading definitions that were suitably feature rich. Three of these definitions have already been discussed; all of them are by leading games researchers or designers themselves. By carefully comparing these definitions and analyzing their meaning, they settled upon their definition and in doing so they have provided a workable framework for the features that make a game. (Salen & Zimmerman, 2004)

Using this framework as a guide, Salen and Zimmerman defined a game as: "A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome." (Salen & Zimmerman, 2004). Using this definition, a game can be broken up into the following set of core features: System, Players, Conflict, Rules/Goals, Outcomes, and the Artificial.

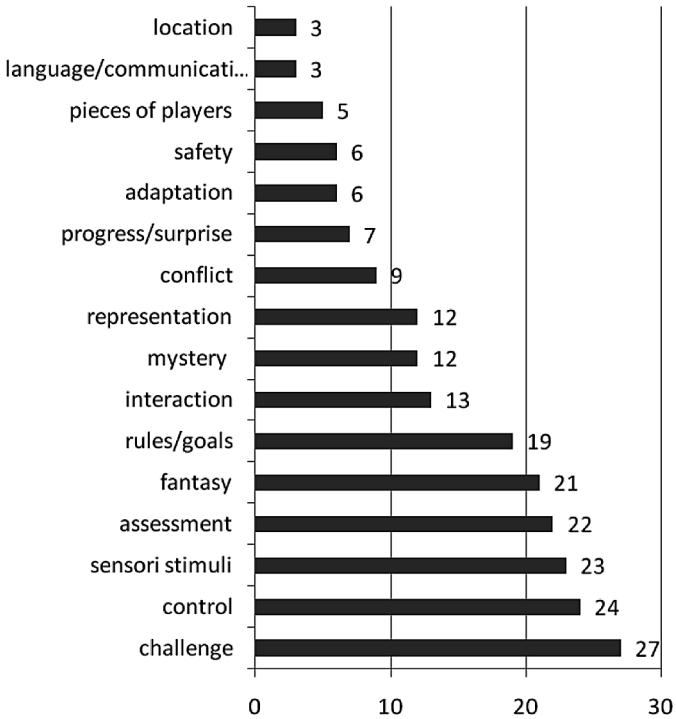
Features of Serious Games

Learning games at their core can and should be considered games, and as games they should exhibit the same features of games that define games themselves. Therefore determining a list of features that defines learning games is a redundant process. The interesting task is in determining the features of games that support learning.

In a comprehensive review of over 41 papers performed in 2009, researchers identified over a dozen features of games that would support learning (Wilson et al., 2009). Upon closer inspection of the data provided, some features overlap with each other. Others are along considered features of games by a miniscule fraction of the 41 researchers. As seen in Figure 1, over 27 researchers found challenge to be an important feature for learning in games, while only 3 suggest location is important. For this research, only features agreed upon by 10 or more researchers will be considered agreed upon features. Further, overlapping features will be combined.

In particular, the feature of interaction, or the ability for the player to interact with the game, will be combined with control. Control is the ability for the player to maintain control of the flow of the game, an activity accomplished through interaction.

Figure 1. A Comparison of Game Features Supporting Learning



Another overarching feature of games is their aesthetic feel. This feature is represented by mystery, fantasy, representation, and sensory stimuli. The Aesthetics determine if a game provides a mystery to unravel, if the game is fantasy-based or based in realistic representation of reality, and they are responsible for the type and form of sensory stimuli provided to the player. Once repeated features are consolidated and fringe features are removed we are left with the following list: Interaction, Challenge, Rules/Goals, Assessment, and Aesthetics.

Complementary Features

The list of features that game designers have determined to define games share a remarkable level of overlap with the list of features learning games researchers determined support learning.

Interaction / Players

Interaction is a key feature of games. Games are to be played by players, not observed or reported on. Interaction is sometimes defined by the players themselves, "Players interact with the system of a game in order to experience the play of the game" (Salen & Zimmerman, 2004). Other times it is defined through the type of hardware, such as a game controller, or mouse and keyboard combinations. Interaction can occur in many ways, and through many mechanisms. The interaction and control of a game is often dependent on the core game mechanic of physics where it is "used to test the player's dexterity, timing and accuracy," (Adams and Dormans, 2012). Thus, the most efficient controller to use would be one with the fastest and most reliable feedback between player and game objects.

Challenge / Conflict

"All games embody a contest of powers. The contest can take many forms, from cooperation to competition, from solo conflict with a game system to multiplayer social conflict. Conflict is central to games" (Salen & Zimmerman, 2004). While Salen & Zimmerman prefer to call it conflict, they have captured the essence of what this research will refer to as challenge. Challenge can be cooperative, competitive, or individualistic. It can also be a combination of any of the three. For example team versus team challenge has competition with inter team competition. Highly competitive E-sports are prime examples of how games can implement the concept of competition.

Rules/Goals / Rules

Wilson coupled the terms rules and goals into a single feature, while Salen & Zimmerman refer to only rules. "Rules provide the structure out of which play emerges, by delimiting what the player can and cannot do" (Salen & Zimmerman, 2004). They instead associate goals with outcomes. Goals in particular are difficult to separate from other features, and are possibly their own feature.

Assessment / Outcomes

"Games have a quantifiable goal or outcome. At the conclusion of a game, a player has either won, lost, or received some kind of numerical score" (Salen & Zimmerman, 2004). Games must provide feedback

to the player in the form of an assessment or outcome. While the assessment might not be explicit to the player in all games, the game must provide the appropriate outcome based on the performance of the player in the game.

Aesthetics / Artificial

"Games maintain a boundary from so-called "real life" in both time and space" (Salen & Zimmerman, 2004). Games provide aesthetics to the player. This might be fantasy or reality based. It might mean a deep storyline filled with interesting plot twists or it might mean a simple song and falling blocks. While the Aesthetic is important, it can vary widely between games and can be manipulated using different gaming mediums, such as 2D vs. 3D, and Virtual Reality

Disparate Features

All five of the core features identified by learning games researchers have direct definitional overlap with features that game designers identified. The one feature game designers identified that learning games researchers did not is the concept of a system.

Salen & Zimmerman use a definition of system that is taken from Stephen W. Littlejohn, and include 4 defining elements. They are objects, attributes, internal relationships, and environment (Littlejohn & Foss, 2007; Salen & Zimmerman, 2004). Using this definition, Salen & Zimmerman further define systems as simulations (2004). The system is the core structure of a game. It determines how the environment works and what types of objects can operate within it. When other features are applied to it the game becomes fully formed. This is important when considering the game versus simulation debate. It is easy to imagine that a game is a simulation with others gaming features added to it. This, however, is not the case.

In his 2010 keynote address to the GameTech Conference, Will Wright defined his particular types of games as toys. These toys, SimCity, The Sims, Spore, among others, are commonly used to frame the argument between what is a game and what is a simulation. Will Wright further stated that his toys exist as a constrainment of freeform play, and if they were constrained more they could be considered games. He did not want to constrain them with preformed goals, outcomes, or challenges (Wright, 2010). Taking a similar approach to the space of modeling and simulation one could consider a constructive simulation as a constrainment of the space, but a simulation still provides a level of freeform use that makes it similar to how Will Wright refers to toys in the space of play. Simulations need a facilitator to add goals, outcomes, and challenges to the exercise. Further constraining a simulation by introducing gaming features may in fact result in a Serious Game.

FUTURE RESEARCH DIRECTIONS

Future research in Serious Games should focus on how the design of Serious Games can be used to improve learning outcomes. While research has focused on various features of Serious Games new developers have emerged that are building very personal and informational games that combine the power of well-designed good games and a personal passion for the topic that the game covers. These games are often made for entertainment purposes and happen to be very effective serious games. These

include Dys4ia, That Dragon Cancer, Tampon Run, and countless others, that cover incredibly complex and sensitive topics in new ways. The future of Serious Games may be found in the design of personal stories that explore both education and game design from much more personal view.

CONCLUSION

Current research in Serious Games has focused on exploring how the features of Serious Games effect learning outcomes. Serious Games have been found to outshine other forms of educational technology in engagement, motivation, goal orientation, and many other categories, but only when properly designed. It is important to determine if narrative can improve learning outcomes, or time on task, and this work is happening. With an understanding of how gaming features work, serious game developers can build best practices and develop even more effective and engaging games. More importantly more game designers are exploring the power of Serious Games and more great examples exist every day.

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KEY TERMS AND DEFINITIONS

Edutainment: A name given to games developed during a briefly successful attempt to popularize educational games in the 80s.

Game: A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (Salen & Zimmerman, 2004).

Game Feature: An underlying component that defines what a game is.

Games For Change: Games with the primary goal of social change.

Learning Games: Games with the primary goal of education or training.

Serious Games: An umbrella term referring to any game developed for a non-entertainment based purpose.

Tactical Decision-Making Simulation: A term used by the marines to denote a Serious Game.

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Chapter 14
Towards Modelling Effective Educational Games Using Multi-Domain Framework

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ABSTRACT

Game-based learning (GBL) has dominantly become an emerging teaching industry in 21st century. To provide an effective development of educational games (EG) with assurance of effectiveness, modelling and design methods are highlighted. To model EG, game developers must understand existing elements' interaction and relationships. The elements of EG have been documented in literature; however, the relationships are not well documented. Hence, this research has established these relationships by conducting a literature survey and identifying the relationships between different elements. Consequently, they are validated by eight game-based learning experts via qualitative methods and the validation results are interpreted using the hermeneutics method of the interpretivism paradigm. In this chapter, the authors present the relationships that they found most crucial to validate since they have the least literature evidence. With the relationships identified and documented, game developers will have better understanding of the interaction between each element and can produce better models of EG.

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INTRODUCTION

The use of game-based learning (GBL) as a common medium for educational deliverance, as opposed to pure entertainment, has gained immense popularity in recent years. Main attention has recently been diverted towards the impact of gaining knowledge, engaging, and motivating learners through playing educational games (Azadegan et al., 2014; Romero, 2015). Game-based learning (GBL) is an act of appropriate game mechanics, scenario recreation, and problem oriented learning processes to ensure learning objective is accomplished (Poulsen, 2011). Designers and developers need to enhance the educational tools by integrating game domains and elements to maximize the tools' effectiveness, hence, increase learning outcomes, level of engagement and motivation. To understand the link between multiple domains and elements of GBL, there is a need to fit multiple widely known instructional approaches with experts such as game designers, developers, educators, and software engineers.

For GBL development process to be effective and reliable, it is vital to provide emphasis on involving theoretical foundations with game rules, and fun with authentic learning for leaners, thus, providing an precise base for learners to gain knowledge (Hays, 2005; Kebritchi & Hirumi, 2008). The innovative learning approach derived from EG possess educational values or even different kinds of software applications that compiles into knowledgeable aspects such as teaching enhancement, assessments and evaluation of learners (Tang & Hanneghan, 2010). Nevertheless, game technologies are specifically used for accessibility of simulated and modelling environments and visualization.

Educational games are designed through a process of modelling, depending on diverse criteria such as how one element can relate to another element or types of domains used in EG. When the game developers initiate the development of EG, challenges occurs in terms of planning from gathered requirements, verifying, and cross-check to ensure several possibilities occurrence. This is due to a mixture of pedagogical, educational, and fun elements needed to be collaborated accurately. Furthermore, an effectually designed pre-model unfolding the relationships amongst game elements, and their domains is highly recommended. Therefore, a modelling technique is needed to conceptualise the elements/components in the EG and provide a holistic idea based on how domains and their related components can be modelled to provide a promising modelling and developing process.

The objective of this chapter is to study the relationships among EG elements in order to provide game developers, software engineers, and game designers; a medium of understanding connections, interrelations, and interactions between game elements and game domains. Furthermore, they should be able to map the relationships to model out an effective educational games during developing process.

BACKGROUND

This section mainly explains how the evaluation and modelling strategies adopted or proposed in designing of EG to provide a unified modelling techniques during development process of EG.

EG Evaluation and Modelling Languages

GBL evaluation is carried out to ensure design quality (Di Loreto & Gouaïch, 2010), identify usage(Djelil, Sanchez, Albouy-Kissi, Lavest, & Albouy-Kissi, 2014), and verify instructional outcomes(Casey, Baghaei, & Nand, 2014). However, the complex nature of GBL is not well-structured (Djelil et al., 2014).

Certainly, the evaluation has to undergo a definitive number of steps to measure variables and provide appropriate analysis of these variables. Although not all evaluations provide coherent results (Annetta et al., 2013; Von Wangenheim, Thiry, & Kochanski, 2009), a few existing methods for data collection and analysis have proven their efficiency and reliability in practice. Even though, the evaluation of EG is time consuming and complex; it is the only reliable aspect to verify the goals and detect malfunctions throughout the EG. Therefore, a learning game ought to be evaluated prior to being used as a learning material (Djelil et al., 2014). A recent study implements a six-phase methodology, HEXA-GBL, for designing and evaluating GBL activities from learner centered perspective (Romero, 2015). The phases are: 1) game design activity, 2) learning objectives definition, 3) the learner-centered need analysis, and the definition of the game modalities, 4) mechanics and rules, 5) the play activity evaluation from the learning outcomes, assessment and feedback, and 6) learners' gaming and learning experience during the GBL activity. While overcoming the barriers of GBL costs and focusing on game mechanics, HEXA-GBL also prioritized the educators to operationalize with adapting processes.

Modelling processes can be a powerful 'tool' to boost student's perceptive activities, hence, refining their scientific conceptual minds (de Jong & van Joolingen, 2008). A recent and a wide range of discussion of a potential value using model-driven engineering (MDE) approaches for EG has been recorded(Dormans, 2012; France & Rumpe, 2007). Furthermore, UML-based game specifications such as Statecharts(Sauer & Engels, 2001); offer a rigorous state machine foundation, which may be difficult to use for some stakeholders (e.g., game designers). With respect to GBL, MDE can provide an environment for domain experts to produce EG via modelling without upsetting the sophistication of game development process. Moreover, it provides an increased productivity value, portability among different platforms, an easier software maintenance, reliability of mapping from model to code, and minimized modelling error (Kelly & Tolvanen, 2008).

Game designers experienced in using Storyboards prefer using tabular Use Case (UC) method (MDE) due to the similarity of presentation (Truong, Hayes, & Abowd, 2006); as it is understood, well-established, maintainable, and straightforward to define. A recent research used MDE to integrate elements of game design, pedagogical content, and software engineering methodologies to provide a storyboard with textual description of the learning objectives and game play to user interfaces. Due to iterative development process, it transforms the model into UML UC model (visual and tabular based specifications (Stevens, 2002)), then, it converts it into formal model which can then be executable (Cooper, Nasr, & Longstreet, 2014). Although Cooper et.al, provides various modelling techniques are used in this approach, the need of a complete new solution is not evident.

In game development field, the use of software frameworks and tools are usual practice among professional (commercial) game developers. Another modelling technique, namely, Model Driven Architecture (MDA)(Miller & Mukerji, 2001), has also been implemented in Domain-Driven Software Development Framework (Agrawal, Karsai, & Lédeczi, 2003) and Modelling Turnpike (Wada, Suzuki, & Oba, 2005). These frameworks aid software architects to develop their own MDE to suit a particular domain (security, content repurposing, software testing, and pervasive computing). Although current tools improve the productivity of the development team while providing maximum control and flexibility to artistically craft the game software, the production pipeline is still very reliant on specialist artists and programmers. This therefore presents a practical solution to assist non-technical domain experts in the production of serious games.

Educational Game Design Frameworks and Models

There has been quite a number of models and frameworks proposed by researchers in developing, modelling and designing EG. Game Object Model II (GOM II) describes relationships containing various elements of EG interfaces by using Object Oriented Programming to provide a constructive way of achieving theoretical and pedagogical goals in designing EG (Amory, 2007). However, GOM II does not represent how the relationship between game elements develops over time, and its diagram can become complex and difficult to understand. Another model, Mechanics-Game Mechanics (LM-GM) model provides a graphical representation of game flow to establish relationships among components which translates pedagogical learning mechanics into game mechanics (Arnab et al., 2015). Although it identifies abstract patterns and predefined elements to be replicated across EG, it does not expose the connection with the educational objectives to allow sustainable mechanics.

A recent model proposed with seven steps to identify attributes with specific roles and steps to each expert including cognitive and pedagogical experts, storyboard writers, artistic directors, actors, graphic designers, sound managers, etc. (Marfisi-Schottman, George, & Tarpin-Bernard, 2010). However, it is sequential based and they do not easily fit into an iterative design. Another game-based learning framework works as an evaluation tool for designers by adopting instructional and cognitive approaches in designing process to map out existing games (van Staalduinen & de Freitas, 2010). This approach is beneficial for repurposing game content and providing scalable immersive game content, however, more work is needed to assess the validating of game-design strategies such as links between components and consistency.

When model-driven approaches (MDA) are used in developing process of EG, there are benefits and challenges at all aspects (Sauer & Engels, 2001). A Model-Driven Game Development Approach (Reyno & Cubel, 2008) introduces a framework which uses the selection of UML diagrams to gather requirements into Class Diagrams which is then extended to model the relationships between different game entities and their behavior through the game actions. Another framework based on MDA (Altunbay, Metin, & Çetinkaya, 2009) uses UML Class Diagrams as the modelling language to represent the game model with the combination of languages such as Meta-model with UML Class Diagram and Domain-specific language. All the three frameworks based on MDA have similarities in terms of modelling but they differ in terms of how non-technical domain expert can deal with the modelling languages used. With regards to that concern, MDA based framework (Tang & Hanneghan, 2010) designed to help non-technical domain experts in producing EG. Although the gap of non-technical experts is covered and the creation of game models can be represented, a challenge of having defined and explicit model while maintaining the consistency is an overlapping issue.

Another way to design EG is by providing a language using Design Patterns based on the Six Facets of Serious Game Design, namely, pedagogical objectives, domain simulations, interactions with the simulation, problems and progressions, decorum, and conditions of use (Marne, Wisdom, Huynh-Kim-Bang, & Labat, 2012). This way, the game designers and teachers can easily relate to join the purpose of developing EG as they will communicate their ideas thoroughly. In contrast, the Educational Computer Game Design Model was proposed with game design components as Learn and Play, so that a balanced integration can construct good EG design (Osman & Bakar, 2012). Another author provided a conceptual framework for adapting collaborative multiplayer games by adopting the concept of multiplayer games and gameplay design principles (Sinkewicz, 2015). First, it is built on an existing model of players to provide insights of the audience, then, it develops a typology of gameplay themes to help designers

with conceptualizing actions on the screen. Finally, it provides a framework with five main game design components, namely, learning objectives, story, 3D world, gameplay, and evaluation.

Recently, a framework is proposed for a blended learning environment to enhance learning outcomes and to provide a valuable strategy to facilitate both lecturers and students to obtain better educational knowledge (Jing, Yue, & Murugesan, 2015). Although it has proven a positive learning outcome, there is a need of more research work that can validate the learning-driven game design strategy. In contrast, an Activity Theory-based Model of Serious Games is proposed to provide a way to reason about the relationships between serious game components and the educational goals of the game it includes gaming activity, learning activity, and the instructional activity (Arnab et al., 2015). The model explicitly accounts for the distinction between designer and instructor, therefore, the clarification of the role of the teacher/instructor in the game is needed. The game sequence representation follows the unified modeling language (UML) activity diagrams notation, which uses the shapes connected by arrows to represent the flow of the activities(Kühn, 2015).

MAIN FOCUS OF THE CHAPTER

Issues, Controversies, Problems

The gap between game design and educational design has become evident that to optimize the learning from serious games, pedagogical experts should be actively involved in the development process (Arnab et al., 2015). The experts involved in a development process is highlighted many times. It is a challenged and substantial to ensure that collaboration between game-based learning experts, theoretical experts, game designers teachers, learners, developers, and non-technical domain experts occurs. The sophistication in terms of popularity and budged of creating EG by scratch demands high level of production process is also challenging to researchers and game developers. Due to lack of infrastructure capabilities including hardware and software requirements, theoretical aspects in terms of pedagogical and instructional aspects are also very crucial in designing and development process. The game industry needs to insure that integrating an instructor in an EG can provide a useful feedback to users at a runtime significance(Sinkewicz, 2015).

Modelling and developing effective EG needs to have a clear understanding of what the desired learning outcomes are and to establish a transparent mapping amongst (Hainey, Connolly, Stansfield, & Boyle, 2011). To understand that, research methods and statistics are broad-ranging, complex, and interconnected with logical and scientific reasoning, understanding different representations of data, data analysis, interpretation of results and evaluation skills (Boyle et al., 2014). It is barely the case where domains such as game play, game environment, subject-matter, and learning theories interaction has been discussed in order to provide a holistic view of a particular game element. Mostly, the literature uses vaguely spread game elements that cover large number of relationships and domains.

The GBL and its diverse dimensions and characteristics makes it difficult to evaluate and model. However, evaluation remains the only way to verify if the educational targets are being achieved and to detect any functional vulnerability inside the learning game. If the gaps between EG community and industry, and between academia and industry is bridged, the game development efforts could benefit all communities, including industry (Arnab et al., 2015; Azadegan et al., 2014). Although evaluation

process can be costly, there should be a pre-modelling strategy which can allow developer or designer to model out the elements and related elements, as well as domains that should be involved in EG actively.

SOLUTIONS AND RECOMMENDATIONS

Initially, a multi-domain framework was proposed as a result of systematic literature review (SLR) (Ahmad, Ab Rahim, Arshad, & Mehat, 2016). In SLR, there were fifteen (15) existing frameworks and models, game design elements/components, domains, learning theories and subject-matter aspects were understood(Ahmad, Rahim, & Arshad, 2015). Systematic literature review (SLR) is a method adopted for characterizing frameworks; hence, five (5) steps proposed by (Khan, Kunz, Kleijnen, & Antes, 2003) has assisted in proposing the multi-domain framework are briefly shown in Figure 1. Figure 2 shows the multi-domain framework, which is composed of four major domains: (1) Game environment (GE), (2) Game play (GP), (3) Learning Theories (LT), and (4) Subject-matter (SM). Each domain is composed of game components categorized according to the domain's definition.

With reference to the proposed framework, this paper discusses implicit relationships which are not supported by literature and they are not explicitly mentioned. Therefore, the selected twenty-seven (27) relationships are mapped upon the four domains to be validated by game-based learning experts. The Table 1 shows the implicit twenty-seven (27) relationships statements with highlighted game components from framework.

The extraction of relationships was obtained by using the NVIVO software to 'code' the text in literature that contain the EG elements and domains. Using the coding technique through the paragraphs analyzed; provided discern sentences that explain the implicit relationships between elements and domains.

In validation process, the authors conducted eight (8) qualitative interviews with game-based learning experts (GBLe) who are highly experienced with this area of study. The interviews were transcribed and coded into NVIVO software to understand the emergence of new "nodes" in each relationship. This article discusses all four (4) domains as the major themes and its relationships as sub-themes. Each relationship has its components and those components are the existing "nodes" (highlighted as **bold**).

Each relationship is discussed by applying interpretive hermeneutic approach of qualitative study. Interpretive hermeneutic method is associated to interpretivism philosophical perspective of qualitative study, allowing understanding of in-depth experience of experts and self-reflexive for a constructive interpretation (Kafle, 2011).

Figure 1. Five major steps to provide an effective systematic literature review

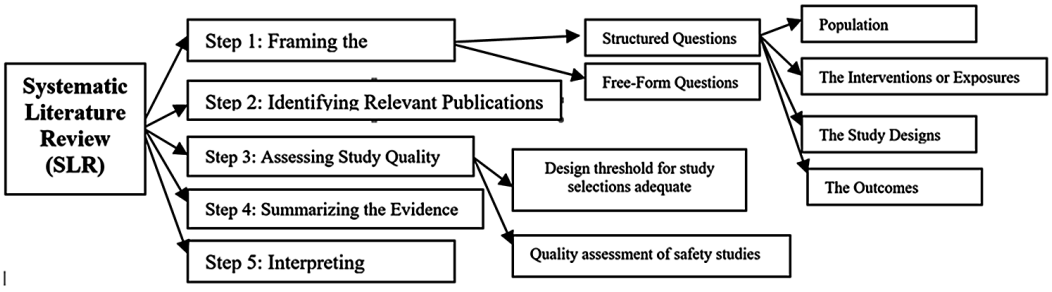
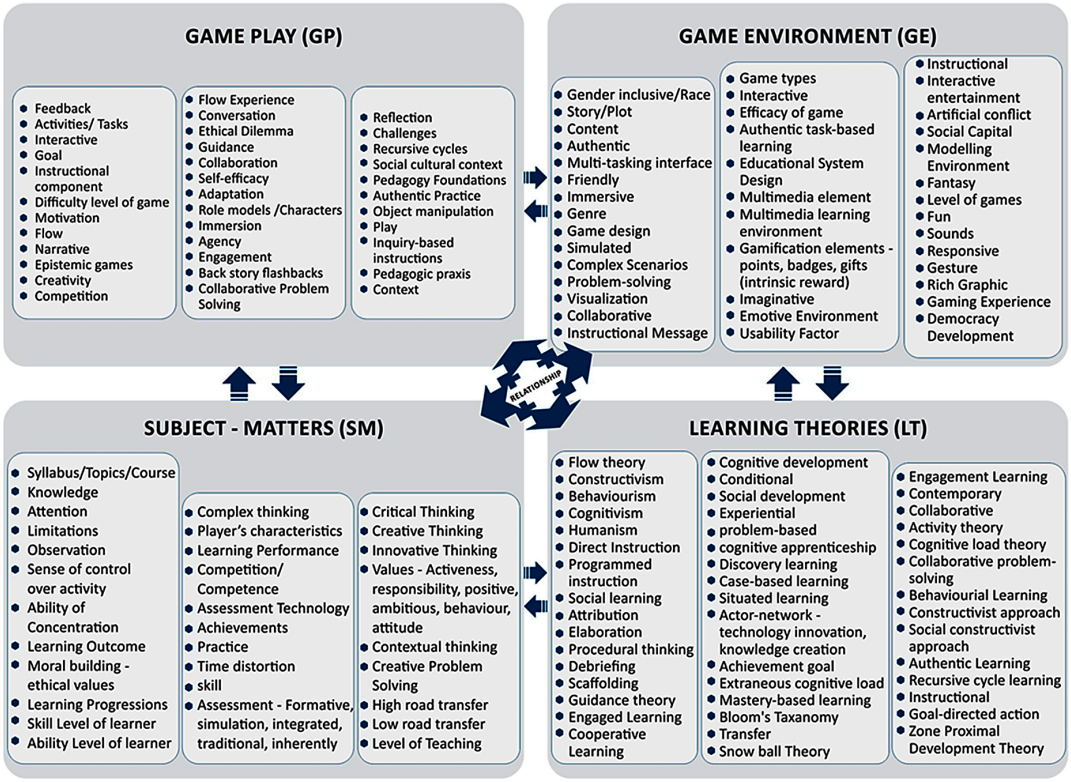


Figure 2. The Multi-domain framework for modelling educational games



Results and Discussions

There were 216 feedbacks collected from eight GBLe during the interview session. The interpretations are presented with interpretive paradigm expectation, combining components suggested by GBLe and author's understanding towards the relevancy with domains of framework. Hence, this self-reflection aspect is the goal of hermeneutic method and interpretivism paradigm approach. Due to limitation of word count, the authors have discussed three relationships to provide the reader with an understanding of interpretations.

- **Relationship: 16.** GBLe highly agreed that interactive learning environment should have the components, namely, instructional messages, pedagogy and story, and less load towards learner's memory. Furthermore, multimedia environment elements such as sound, graphics and animation should also be integrated. When this occurs, there are fifteen (15) learning theories suggested to be integrated within this environment, i.e. motivational learning (behaviorism, collaborative learning, cooperative learning, guidance theory, intrinsically rewarded, social constructivism), cognitive, cognitive apprenticeship, constructivist learning, contextual thinking, experiential learning, problem solving, bloom's taxonomy, creative thinking, innovating thinking, and critical thinking. Since it plays a role in cognitive, the player's thinking and memory is also related to this concept. Moreover, it involves cognitive (knowledge), affective (attitudinal) and psychomotor

Table 1. The explicit relationships on the four domains and their elements.

#	Relationship Statement
1.	**Flow Experience** includes **sense of control over activity**, **time distortion**, **increase learning**, **increased exploratory behavior**, **positive effect**, and **acceptance of technology**.
2.	**Players** can be allowed to change **game play** to improve their **performance** and reach **goals**.
3.	Combining **game play** and **narrative context** provides **cognitive resources**, **immersion**, **engagement**, and **perception patterns of narrative**.
4.	If the **difficulty level** of a **task** in a game increases **step-wise**, the player forms **knowledge** and **strategies**, hence, **reduces frustration**.
5.	**Restorative narrative** structure include **story realistic environment**, **sounds**, and **back story flashbacks** where **character** or **player** talks to game directly.
6.	A **game** should have **pedagogical foundations** and proven educational **practices** such as **fun** and **engagement** to meet expectations of producers and consumers.
7.	**Well-designed games** expose learners to **complex tasks**, **predesigned narrative content**, **story** and has the **ability to interact** with others.
8.	**Educational games** have new **concepts** and logical **learning progressions** to provide **set of skills** and **knowledge**.
9.	**Social capital** has structural dimensions which has the patterns of **social interactions between actors**. **Social learning** involves **observation**, **imitation**, and **modeling**.
10.	The **content** of the games **reflects the problem**. **Content** transfer outside the games tends to be limited and low level.
11.	**Educational games** have **explicit knowledge** and **conversation** for learners.
12.	**Simulated environments** are integral part of learning, supports **intellectual development**, and it has **recursive cycle learning**.
13.	**Multi-player role playing games** support **problem-based learning** and **visualization** of their actions to solve the **challenges**.
14.	**Games** should have **emotive environment**, **role models** and **challenges**.
15.	**Educational games** should be **gender-inclusive.**
16.	**Interactive learning environment** can be evolves **instructional messages**, **pedagogy** and **story** to minimize chance of **overloading the learner's cognitive system**.
17.	**Cognitive apprenticeship** involves **authentic practices**. **Authentic practice** is a combination of **activity** and **social interaction**.
18.	**Learner's construct learning** in EG with the aid of **visual and verbal representation** occurring parallel to their **memory**.
19.	**Behaviorism** allows the change in **behavior of player** and change in **environmen**t shape to **encourage learners** in understanding concepts. **Attribution theory** allows **observing** and **explaining** the **cause of event** changed.
20.	**Social constructivist approach** in **multi-player games** involves **interaction** between **players** and **social construction of knowledge**.
21.	**Cognitive load theory** guides the **design** of **multimedia learning environment** and it has **instructional messages** embedded to help avoid **overloading memory** of learning.
22	**Cognitive load optimization** can be achieved with less irrelevant **multimedia elements**.
23.	**Learners** experiencing bad **usability in task flow**, eventually sacrifice **attention** and **cognitive activity** due to limitation of working **memory capacity**.
24.	**Scaffolding** can be combined with **graphical presentations** to lower player's **cognitive load**.
25.	**Problem solving skill** is also known as **discovery learning**, increases in and across **games** but it is difficult to use it outside the game.
26.	To ensure the **player's behavior** does not change in the gaming world, **adaptive features** should be transparent.
27.	**Game play**, **game environment**, **subject-matter** and **learning theories** are important in **educational games**.

(skills) domains in taxonomy, which works concurrently with respect to learner's playing games. Finally, this relationship is not amended and it involves components from GE, and GP domain.

- **Relationship: 25.** GBLe greatly supported with new suggestions to it. The problem-solving methods are implemented in EG as assignments or activities; which can be applied in real life as the learners adapt innovative approaches, logical situations, and appropriate knowledge selection to overcome the problem outside. Two emerging nodes were the way the knowledge is transferred inside and outside of EG. 'Transfer' is defined as the process of knowledge/skills acquired in one context in a new or varied context. Transfer is divided into a few types in which the knowledge context can be changed. Low road transfer (also known as reflexive transfer), involves the triggering of well-designed routines by stimulus conditions similar to learning context. High road transfer (mindful transfer) involves a deliberate amount of effortful abstraction and searches for connections. Moreover, another expert mentions about CPS factors (Creative Problem Solving); a mental state, problem reframing, multiple idea facilitation, and inducing change of perspective. The relationship is not amended and it involves the components from SM and LT domain.

Verifying the framework domain selection, one question involved all four domains. To ensure correct adoption of those domains, validation was scaled from 1 to 10 (1 as lowest and 10 as highest). The importance to collaborate game plays (GP), game environment (GE), subject-matter (SM) and learning theories (LT) in educational games.

Relationship statement: 27. *"I would give 10, because this is what makes an ordinary game different as compared to the educational game. Because in EG, we have certain learning outcomes that we need to achieve and in order to achieve the learning outcomes, we need to make sure that the learning environment has been taken care of in such a way. For example, the interactive natures of the game and also certain learning theories have been inserted in the game. And then, of course we need to have the expertise of subject-matter expert because we need to tailor the game, you know, for each and every subject. Okay, therefore I think this is very important all together and this must be considered in the educational games." (Game-based Learning Expert's Opinion)*

FUTURE RESEARCH DIRECTIONS

Modeling language for the behaviors of educational game is to our knowledge not available. Another field that may be of benefit to educational game development is model-based testing (MBT). MBT is a method to improve the testing process of software by referring to the models for guidance (Hemmati, Arcuri, & Briand, 2013; Timmer, Brinksma, & Stoelinga, 2011). Verifying effectiveness of the game has been explored many times (Omar & Jaafar, 2010) and the most common method is a combination of acceptance testing and quantitative/qualitative research methods. Other methods such as unit testing, white-box testing and verification using models are yet to be well known.

Further research can also be performed on using Model-Driven Engineering (MDE) (Tang & Hanneghan, 2011) in development of EGs; where, 1) modelling languages can be used at different level of modelling from requirements to detailed design, 2) model for traceability from requirements to code, and 3) verification of educational games effectiveness from models.

CONCLUSION

This chapter has discussed various types of existing frameworks and models which aid in developing EGs. Due to lack in explicit relationships amongst game components and vaguely spread elements, it is difficult to examine the importance and relevancy with other game domains. Therefore, this chapter proposes a multi-domain framework and twenty-seven explicit relationships involving four major domains, game play, game environment, subject-matter, and learning theories. To verify those relationships, interviews with game-based learning experts were collected. Due to their expertise in areas of teaching, game play, environments, and theoretical aspects of EG, it was an informative data collection. The interviews were interpreted using interpretivism paradigm and hermeneutics method is used to illustrate each relationship in context with the four domains. Finally, this chapters provides an insight on how the modelling of an existing EG or a new EG can be done by understanding different elements and their relations with other elements and domains of game to thoroughly understand the theoretical and practical concepts of EG before implementation.

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KEY TERMS AND DEFINITIONS

Bloom's Taxonomy: it is known as a multi-tiered model of classifying thinking according to six cognitive levels of complexity.

Game Environment: A dimension which collaborates game rules, objectives, subject, and theoretical aspects together as a whole to provide an interactive flow of activity.

Game Play: This is where the rules and regulations of EG.

Hermeneutic Circle: The iterative process of interpretation, reflective writing, and reading to provide the details of the whole phenomenon discussed.

Hermeneutics Method: An interpretive and concentrated research on historical meanings of experience and their developmental and cumulative effects on individual and social levels. Iteratively taking parts of interdependent meaning and the whole of their formation to achieve understanding.

Interpretivism: The belief in multiple observations of reality, subjective and socially constructed through language, consciousness and shared meaning.

Model-Driven Engineering: A software development approach, focusing on creation of models that represents the system-under-study (SUS) and subsequent generation of fully-working software artefacts from these models.

Subject-Matter: The teacher/learner and the subject embedded in the EG.

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Section 3
Language Studies

Chapter 15
Mobile Testing System for Developing Language Skills

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ABSTRACT

This chapter investigates the pedagogical impact of both the mobile testing system PeLe and enquiry-based approach on language skills development in the context of mobile-assisted language learning. The study aims to work out a methodological framework for PeLe implementation into language classroom through immediate feedback and formative assessment. The framework was developed and pilot tested in a joint research project MobiLL by EFL teachers at Lomonosov Moscow State University (Russia) and University College HiST (Norway). The analysis based on quantitative research data demonstrated that PeLe-supported language classes resulted in language skill gains. The qualitative data analysis highlighted the positive effect of mobile formative assessment and of post-test activities on learner motivation and collaboration skills. This study suggests that the use of technology was effective in engaging students in enquiry-based tasks to cultivate collaboration.

INTRODUCTION

Recent research demonstrated that language skills can be enhanced through mobile technologies that transformed drastically foreign language learning/teaching experience offering immediate diagnosis of learning problems and design of new assessment models (Cooney & Keogh, 2007); creating mobile networking collaboration (Lan, Sung & Chang, 2007; Pemberton, Winter & Fallahkhair, 2010), enhancing autonomy (Murphy, Bollen & Langdon, 2012); providing instant feedback and a personalized learning experience (Voelkel & Bennett, 2013; Oberg & Daniels, 2013); enabling teachers to create new formats of problem-solving tasks based on augmented reality (Cook, 2010; Driver, 2012).

But in spite of the plethora of research in the area of mobile learning, it challenges instructors to examine how the pedagogical potential provided by mobile technologies relates to their teaching aims, methods, and subject matter because there is not yet consistent MALL methodology. There is a need for a new educational framework for mobile testing apps implementation aimed at developing learner skills

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rather than just assessing learner knowledge. The hypothesis to guide the framework of this research includes enquiry-based learning pedagogy and educational opportunities provided by ubiquitous devices such as interactivity and immediate feedback. This study supported by both current m-learning theory and enquiry-based approach focuses on working out a methodological framework for mobile testing system implementation into the language classroom.

BACKGROUND

Today teachers who would like to meet the expectations of a new generation of mobile natives need to follow a transformational approach (Puentedura, 2011) to the development of language skills based on creative use of mobile technologies within the learner-oriented environment. The main prerequisite of this environment functioning is collaborative peer-learning approach. The social framework, learners' expertise, and cultural practices are gaining importance, the role of the devices is becoming less important. Mobility is no longer defined through the devices, but through "the learners' abilities to act flexibly in ever changing and self-constructed learning contexts" (Seipold, 2011, p.32). Seipold argues that only if teachers provide spaces to learners to act according to their interests, agency, and cultural practices, innovative use of the devices can be discovered by learners (2011).

The research framework is also based on Mishra and Koehler's model for implementing new technologies into teaching - Technological Pedagogical Content Knowledge (TPCK)(2006). This approach suggests teachers should be aiming to reach a point where their traditional content and pedagogical knowledge is enhanced by technological knowledge. According to TPCK framework, a new tool complements teachers' knowledge and skills. This theoretical perspective suggests that learning is affected and modified by the tools employed for it and that reciprocally these tools are adjusted in the way they are used for learning. As Stockwell and Hubbard argue: "Let the language learning task fit the technology and environment, and let the technology and environment fit the task" (2013, p.9). The Substitution Augmentation Modification Redefinition model developed by Puentedura (2011) can be used as a complement to TPCK. According to this model the use of new tech tools in education may lead either to the enhancement of education (augmentation and substitution phases) or to the real transformation (redefinition and modification phases). Redefinition is the highest transformation phase which allows for a completely new format of tasks and activities that were previously impossible. This approach also offers a perspective in which the pedagogical considerations shape the design of mobile learning.

Other important theories that have been influential to work out the framework of this research are enquiry-based learning and behaviorist approach. Many researchers today highlight social aspects of mobile technologies proposing complex structures of m-learning pedagogy built on Vygotsky's hypothesis about the importance of discussions in an educational context (Sharples, Taylor, & Vavoula, 2007). Enquiry-based learning is a shift away from passive methods to the problem-based methods through which students are expected to construct their own knowledge and understandings by taking part in supported processes of enquiry (Kahn & O'Rourke, 2005).

Danaher, Gururajan, and Hafeez-Baig (2009) propose the m-learning structure based on three principles: engagement, presence, and flexibility. Presence is characterized as an interaction which is sub-divided into three types: cognitive, social and teaching. Kearney, Schuck, Burden and Aubusson (2012) argue that the main constituents of m-learning pedagogy are personalization, authenticity, and collaboration. Mobile technologies enable instructors to create collaboration environment that motivates students to

learn for themselves, bringing a research-based approach to the subject. This interactive, "dialogic models of learning are similar to the processes of participation in research" (Sambell, 2010, 56).

Ubiquitous access to information via mobile devices potentially enables a paradigmatic shift in education, it changes the way classes are managed and the instructor's role (Beatty, 2004). Kahn and O'Rourke (2005) argue that enquiry-based learning encourages students to seek out new evidence for themselves and support peer learning approach. This approach implies a principal change in the paradigm of teaching due to the fact that mobile devices effectively "act as accelerators of the social discourse" (DeGani, Martin, Stead, & Wade, 2010, p.181).

THE PEDAGOGICAL POTENTIAL OF THE MOBILE TESTING SYSTEM PELE TO ENHANCE LANGUAGE LEARNING

The mobile testing system PeLe for handheld devices, developed at Sør-Trøndelag University, enables instructors to deliver a test through any mobile device, assess it and provide timely feedback to both individual students and a group of students immediately after a test. Using Pele students can respond to tests electronically and the teacher can see on the screen what is happening during the test. The technological characteristics and the pedagogical potential of PeLe are summed up in table 1.

PeLe suits perfectly to evaluate both group dynamics and individual student results, it was primarily used in our research for formative assessment or low stake assessment which serves to give learners feedback on their performance (Sambell, 2010).

METHODOLOGY

Research Objectives

Mobile Language Learning (MOBILL) was an international project involving two institutions Sør-Trøndelag University College (HiST, Norway), and Lomonosov Moscow State University (LMSU, Russia). The project was conducted during two periods from September 2013 to January 2014, and from February to May 2014. The key objective of this research was to work out sound pedagogical strategies on how to implement PeLe into the traditional language classroom (pedagogical perspective), thus introducing some improvements to the piloting tool (technological perspective). At the first period teachers from LMSU and HiST piloted PeLe and try to develop Mobile Assisted Language Learning Model (MALLM) based on enquiry-based approach and formative assessment. The following research questions were proposed:

1. What is the PeLe pedagogical potential to develop student language skills?
2. Does PeLe intervention impact assessment patterns of the traditional classroom and foster the development of learner language skills?
3. How can enquiry-based methods be effectively implemented into MALLM?
4. Does the proposed MALLM impact student motivation and to what extend?

Table 1. Technological characteristics and the pedagogical potential of PeLe

Technological Characteristics of PeLe	Pedagogical Potential
Multiple choice tests can be delivered either via PeLe or in the written form	• Teaching in technologically limited environments • No need for profound tech preparation
Instant visualization of the test results	• Group dynamics evaluation • Formative assessment approach • Enhance learner motivation
Immediate test assessment and feedback	• Timely diagnosis of teaching/learning problems • Instant feedback on learning problems • Revision of teaching strategies
Student Response System is installed	• Can be used to conduct in-class surveys • Encourage peer discussions and post-test activities
Database stores both group and individual results	• E-portfolio approach • Formative assessment approach • Evaluation of group dynamics
It returns individual feedback to students' mobile devices	• Individual approach to each student • E-Portfolio approach
Multiple-choice questions are a mixture of text and images	• Visualization of learning materials • Enhancing learner motivation
The teacher can see on his screen what is happening during the test	• Evaluation of student learning progress • Any aspect of student output is under control
Equipment necessary: one internet-enabled teacher computer and internet-enabled student mobile devices	• Teaching in technologically limited environments • No need for bulky costly equipment
Use of student own devices	• No need for tech instructions - familiar devices

THE PROJECT IMPLEMENTATION AND RESEARCH DESIGN: METHODOLOGY OF PELE INTERVENTION

The methodological framework of the MALL model based on PeLe implementation includes both enquiry-based methods such as collaborative and peer learning post-test activities, brainstorming, problem-solving activities, group discussions and mobile learning opportunities such as immediate feedback, formative assessment, and interactivity. We offered the following procedure of PeLe intervention employed in this study:

1. Setting up the Assessment Template

The teacher sets up the PeLe assessment template choosing the number of questions, alternatives, and the correct answer. In this case the teacher has three options: he can use the printed version of the test, he can show the test on the IWB or he can save the test on PeLe.

2. The Test is on.

Students take the multiple-choice test and the teacher gets the answers monitoring this process on his computer screen. When the students are picking up the correct answers using their devices the teacher

can follow the group dynamics and each student test results. At this stage the teacher can see what kind of problems students have as a group and individually.

3. Test Submission and Instant Feedback

The teacher takes some time (usually about 3-4 minutes) to analyze test results, then students are shown their group scores on each test item in the form of a diagram. The teacher chooses the items that were the most difficult ones for students. After that, the pedagogical agent selects scaffolding from the range of post-test activities: teacher explanation, a group discussion, a pair discussion or SRS-supported activity.

4. Post-Test Activities

The teacher has to pick up a post-test activity aimed at improving test results. The type of activity depends upon the group results on a test question. We offered the following activities: teacher explanation, group discussion, pair discussion. To figure out what types of post-test activities were the most effective ones we asked the teachers to fill in the grids on post-test activities used after each test.

5. Second Voting on the Tough Questions

After post-test activities, students take the second vote on the discussed questions using either SRS installed or PeLe. At this stage, the teacher can also provide immediate feedback comparing and demonstrating group results of the first and second trial.

RESEARCH PARTICIPANTS

The project target groups consisted of Norwegian and Russian learners of English, all at approximately the same language level (B1) according to the Common European Framework for Languages (see table 2). In the first period of experimentation, students enrolled in a preparatory English course at LMSU were randomly assigned to 3 experimental groups (EXG) and 1 control group (CG). Students of the experimental groups took a series of PeLe supported formative tests as volunteers using handheld devices. The control group was tested by pen and paper method.

Table 2. The project target groups

	Group Size	Male	Female	Number of Formative Tests	Entrance test MS	Entrance Test Score SD
EXG 1	12	1	10	7	81	5,97
EXG 2	8	1	7	7	64	8,75
EXG 3	9	3	6	7	66	15.09
CG	7	0	7	0	60	7,09

DATA COLLECTION

Data collection was done in 3 cycles:

1. The intervention of PeLe tests as formative assessment tools from September to December 2013 in three experimental groups. Quantitative data of the first and the second voting of PeLe tests were analyzed by mean and standard deviation, students' t-test results. The grid on post-test activities used after each test were completed by the teachers of the experimental groups.
2. Quantitative data of the final tests were gathered in control and experimental groups to compare overall performance at the end of the semester, the data were analyzed by mean and standard deviation, t-test results.
3. The post-intervention questionnaire asks students to reflect on their attitude to PeLe integration. Qualitative data were gathered to help explain quantitative findings.

RESEARCH RESULTS AND DATA DISCUSSION

Cycle 1

In the first cycle, the students of the three experimental groups took PeLe multiple-choice grammar and vocabulary tests according to PeLe methodology intervention. In the experimental groups, formative Pele tests were provided in the form of in-class grammar and vocabulary tests. Students responded with their smart phones or tablets. They had access to PeLe tests by using Wi-Fi in class. The students of the control group were taught in the traditional way, they took the placement and final tests for summative assessment, they were not supposed to take formative PeLe supported tests with immediate feedback on their results.

According to the methodology of PeLe intervention we collected the quantitative data on the results of the first voting (FV) and the results of the second voting (SV) of the experimental groups (EXG) and analyzed the results. To assess the magnitude of any significant changes following the intervention, effect sizes were calculated according to the methods of mathematical statistics - the standard deviation (SD) and mean score (MS) for each group (see table 3). Based on the calculations, we can conclude that the effectiveness of the formative tests increased after post-tests activities. These results indicated that there was a substantial improvement in group 2 and 3 where the entrance test mean scores were 64 and 66 correspondingly although there was not the so substantial improvement in group 1 where the entrance test mean result was much higher - 88. In other words, it turned out that PeLe supported approach was more beneficial in our case for the groups with lower language level: FV MS1= 56< SV MS1= 75, FV MS2 =57< SV MS2=77. Statistical differences between the first and second voting of the PeLe supported test in the experimental groups were assessed using student's t-test for independent samples, as appropriate. T-test results of the first and second voting in group 2 and group 3 statistically are quite significant: EXG2 T-test= 3,0512 EXG3 T-test=3,2342. For group 1 T-test is 0,5023, by conventional criteria, this difference is considered to be not statistically significant.

Table 3. The mean score, standard deviation, t-test of the first and second voting of the PeLe supported test in the experimental groups

	FV MS	SV MS	FV SD	SV SD	FV and SV T-Test
EXG1	85	87	7,9	8,05	0,5023
EXG2	56	75	13,11	10,17	3,0512
EXG3	57	77	14,44	8,40	3,2342

Our study demonstrated that the second voting results in the experimental groups were better than test results of the first trial. The main reasons for that could be immediate feedback on group test results and post-test activities offered by the teachers in the experimental groups. Hattie and Timperley (2007) emphasize that effective feedback needs to provide information that specifically relates to the task so that students can develop error detection strategies and use the feedback to tackle more challenging tasks.

To answer the third question of our research we tried to figure out, first, what kind of post-test activity led to any improvement in student performance so was the most efficient one, second, whether it was the correlation between the group item score and the type of activity offered by the instructor. Our grid data analysis demonstrated that on average in each group 5.125 activities were offered after each test. The most frequently used by the instructors activity was the class discussion - 48% of the activities offered, then comes teacher explanation - 32,5% of the activities offered, the least frequently used activity was group discussion activities - 19,5% of all the activities (see table 4).

Class discussions are likely to be used more frequently because for the instructors it was easier to be a class facilitator and to initiate discussions asking open-ended questions that provoke further discussion, stimulate deeper exploration and challenge student thinking, encouraging them to seek new ways to work with problems and situations. But in this case only carefully formulated questions can stimulate the generation of ideas and interest in what students have to say, providing clues as to whether students are 'on track' (Kahn & O'Rourke, 2005). Whereas peer tuition approach seems to be very time and effort consuming on the part of the teacher. Although experimental language groups were not numerous so it was quite comfortable for the learners and the instructor to have a discussion. Peer-tuition approach in language classes might also be complicated due to the fact that the language of instruction was foreign for the learners.

Table 4. Number and type of post-test activities

	Teacher Explanation		Class Discussion		Group Discussion		Total Number of Activities		The Average Number of Activities Per Group
	%	N	%	N	%	N	%	N	
EXG 1	34,4%	11	53,1%	17	12,5%	4	26%	32	5,125
EXG2	37,5%	18	43,8%	21	19,9%	9	39%	48	
EXG3	25,6%	11	48,8%	21	25,6%	11	35%	43	
All Groups	32,5%	40	48%	59	19,5%	24		123	

Our data analysis demonstrated that the most efficient post-test activity was the class discussion because the increase in the second trial test results was significant. These increases were statistically more significant for group 2 T-test=3,053, FV MS2=56<SV MS2=75, and for group 3 T-test=3,2342, FV MS3 =57< SV MS3=77. In each group 21 class discussion activities were used (see table 5). These results substantiate the value of group discussions for student understanding, confirming the significance of constructivist approach in mobile learning (Arnesen, Korpås, Hennissen, & Stav, 2013).

The next question we tried to figure out is the correlation between the group item score and the type of activity offered. Our grid data analysis demonstrated that if from 50% of the group members gave incorrect item answer the instructors preferred teacher explanation technique. If from 50 to 75% of the group members gave the correct item answer the instructors offered either pair or class discussion activities. In this case, the teacher choice depends on the two important considerations whether it is necessary to give some additional input to initiate the discussion and whether the chosen activity helped save the time assigned for the test and its discussion.

Cycle 2

The learners of both control and experimental groups were given the same placement and final tests. These tests were used for summative assessment. The overall mean scores were included to compare overall performance of the control and experimental groups after the implementation of the intervention. The data collected on the mean scores of the entrance and final tests in control and experimental groups suggest that introduction of PeLe tests helped improve academic performance in the experimental groups in mean results of final test (see table 6) whereas the control group demonstrated just a slight increase in mean scores (60>62). Statistical differences between the two tests were also assessed using Student's t-test for independent samples: t-test results in group 1 are 1.807, in group 2 - 2.6201, in group 3 - 1.2405. In the control group t-test is the lowest - 0,7025. These data suggest that the introduction of PeLe supported approach helped improve student performance in all three experimental groups.

These results support our hypothesis that collaborative enquiry-based learning and educational opportunities provided by handheld devices formative assessment led to a significantly better exam performance of the students who took PeLe quizzes, compared to those who did not. The summative part of PeLe tests ensured a high completion rate, whereas the formative part provided students with prompt feedback and gave them information on what they needed to do to improve their performance (Voelkel, 2013). The increase in the overall exam results was encouraging, but not conclusive to show that only PeLe tests were beneficial. It could also be due to timely feedback on test results, collaborative post-test activities and administration of formative tests.

Table 5. Correlation between second voting test results and the post-activities offered

	SV MS	FV and SV T-Test	Number of post- test activities		
			Teacher Explanation	Class Discussion	Group Discussion
EXG 1	87	0,5023	11	17	4
EXG 2	75	3,0512	18	21	9
EXG 3	77	3,2342	11	21	11

Table 6. Final and entrance test results in control and experimental groups

GROUPS	Entrance Test MS	Entrance Test SD	Final Test MS	Final Test SD	T-TEST
EXG1	81	5.97	87	8.23	1.8027
EXG2	64	8.75	78	14.58	2.6201
EXG3	66	15.09	73	10.30	1.2405
CG	60	7.09	62	4.88	0,7025

Cycle 3

At this cycle, an online survey was administered to elicit students' own perceptions of PeLe intervention. The quantitative data were supplemented by student feedback gained from a post-study questionnaire. The post-study questionnaire contains 11 questions aiming to get student views on the strengths and weaknesses of PeLe intervention. The questionnaire was completed by 24 students (22 female, 2 male) of the experimental groups. Responses are provided in table 7.

In response to statement 1 and statement 2 students expressed high levels of satisfaction (3,58) with PeLe supported tests undertaken on mobile devices. The majority of students commented favorably on the fact that mobile tests helped them understand the topic in focus and get ready for midterms and final with responses to the second statement averaging.

Table 7. Results of the post-study questionnaire

	Strongly Agree	Agree	Disagree	Strongly Disagree	Median Score
1. Mobile devices are the best tools to be used for language practice	17	4	3	0	3,58
2. PeLe tests helped me understand the topic in focus	16	6	2	0	3,58
3. PeLe tests helped me get ready for midterm and final a lot	16	4	2	2	3,41
4. Instant feedback after PeLe tests was very supportive and encouraging for my learning	22	2	0	0	3,91
5. Post-test activities made me better understand grammar rules	14	6	4	0	3,41
6. Post-test activities were very helpful and timely	17	5	2	0	3,62
7. Re-voting on SRS after post-test activities helped me correct my mistakes	11	6	3	4	3,00
8. Activity switching kept me engaged in class	10	8	4	2	3,08
9. The use of mobile devices and tasks based on PeLe was fun and changed my attitude to learning	10	8	4	2	3,08
10. PeLe tests were frustrating, they complicated my learning a lot	0	0	4	20	1,16
11. PeLe based tests were motivating	16	6	2	0	3,58

The largely positive reaction to statements 3, 4, 5 and 6, where the mean scores were 3,41, 3,91, 3,41 and 3,62 respectively, emphasizes that immediate feedback on test results was very supportive and encouraging for student learning. Students appreciated the prompt feedback they got on their own understanding of material. In response to statement 7, the average was 3,00. The students were very positive about the fact that re-voting after post-test activities helped them correct their mistakes and promote reflection on grammar practice. The positive reaction to statement 8, where the mean score was 3,08, indicates that activity switch approach kept the students involved. Statements 9,10 and 11 were designed to get students attitude to PeLe intervention. The majority of students claimed that the use of mobile devices was fun and changed their attitude to learning. It supports the idea that the availability of mobile devices that learners possess makes it an attractive supplement to other forms of teaching and learning a second language (Stockwell & Hubbard, 2013).

In reaction to statement 10, the majority of students disagree on the fact that PeLe tests were frustrating and complicated their learning a lot. The average for statement 11 was 3,58 proving the idea that formative assessment tests promote feedback that seeks to empower students to become motivated and committed to exercising more control over their own learning (Sambel, 2010).

Our findings suggest that students place heavy emphasis on the value of instant, timely feedback on their tests as well as on post-test activities that stood them in good stead in improving their grammar skills. Despite the overall positive responses, there was also notable ambivalence: several respondents combined positive comments with criticisms. For example, answering statement 7 four students strongly disagreed with the idea that re-voting on tough test items after post-test activities helped them correct their mistakes and promote reflection on their grammar practice. Nonetheless, our analysis demonstrates clearly that the vast majority of students found PeLe implementation to be very appealing.

FUTURE RESEARCH DIRECTIONS

We hope that our research will provide some constructs for pedagogical thinking about enhancing MALL with new mobile-assisted assessment methodology. Formative assessment practice (Black & Wiliam, 2009) lay at the heart of the project's innovative pedagogic approach, so the approach offers a practical way of embodying assessment for language learning environments. Although mobile testing system Pele holds promise but more research is needed to determine its effects upon developing not only grammar skills but also some other skills such as speaking, writing, listening.

CONCLUSION

This research indicated that mobile apps integration into language learning could be efficient, especially if combined with enquiry-based and peer learning approaches and the pedagogical potential provided by mobile testing systems. The experimental results suggest that the MALLM approach combining m-learning and enquiry-based learning theory and formative assessment is most advisable. The research results supported our hypothesis that collaborative enquiry-based learning and educational opportunities provided by handheld devices formative assessment led to a significantly better exam performance of the students who participated in formative PeLe quizzes, compared to those who did not.

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KEY TERMS AND DEFINITIONS

Enquiry-Based Approach: A learner-centered approach that emphasizes higher order thinking skills.

Formative Assessment: Monitors student learning to provide ongoing feedback that can be used by instructors to improve their teaching and by students to improve their learning.

Interactive Learning: Is a pedagogical approach that incorporates social networking into course design and delivery.

MALL: Mobile assisted language learning.

Mobile Learning: Earning methods and materials that involve the use of mobile phones or handheld devices.

Mobile Testing System: Mobile apps design specifically for testing skills and knowledge.

Summative Assessment: Evaluates student learning at the end of an instructional unit by comparing it against some standard or benchmark.

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Chapter 16
Nominalizations in Requirements Engineering Natural Language Models

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ABSTRACT

It is a usual practice to use natural language in any document intended for clients and users in the requirements engineering process of a software development. This facilitates the comprehension of the requirements engineer's proposals to clients and users. However, natural language introduces some drawbacks, such as ambiguity and incompleteness, which attempt a good comprehension of those documents. Glossaries help by reducing ambiguity, though they introduce their own linguistic weaknesses. The nominalization of verbs is one of them. There are sometimes appreciable differences between using a verb form or its nominal form, while in other cases they may be synonyms. Therefore, the requirements engineer must be aware of the precise meaning of each term used in the application domain in order to correctly define them and properly use them in every document. In this chapter, guidelines about treatment of verb nominalization are given when constructing a specific glossary called Language Extended Lexicon.

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INTRODUCTION

The first activity of the development of a software system is to define its requirements. Requirements engineer must interact mainly with clients and users among other stakeholders (Macaulay, 1993). He or she has to understand the context in which the future system will act and he or she must carefully consider the reasons that conducted to the decision of developing such system. Requirements engineer's responsibilities include establishing a fluid communication with all stakeholders to produce reliable documents that will be used later in the software development process (Leite et al., 2004). Usually the culture, knowledge and skills of clients and users are rather different from those of the software development experts. As part of the communication with clients and users, the requirements engineer must clearly show them the characteristics of the software system that he or she is conceiving to attend clients and users' issues. Requirements Engineering process has two main activities: to understand the application domain, and to correctly define the services that the future software system will provide (Leite et al., 2004). As a general practice, both activities involve the development of models that describe such domain. It is also a common practice to develop such models in natural language to enhance the communication among stakeholders (Rolland & Ben Achour, 1998; Leite et al., 2004; Seiff et al., 2009); however, this introduces some obstacles, such as ambiguity, incompleteness and poor information structuring (Zowghi & Gervasi, 2002; Berry & Kamsties, 2004; Leite et al., 2005; Doorn & Ridao, 2009; Hadad et al., 2015). All of these inconveniences come from the natural language itself. As a consequence, Requirements Engineering has become more and more involved with linguistic considerations. Furthermore, it should be kept in mind that language conveys culture and knowledge (Nettle & Romaine, 2000; Fishman, 1999). Thereby, the terminology of clients and users holds application domain knowledge. Therefore, to document and to slightly formalize the relevant words or phrases heard from clients and users or read from documents is a valuable practice. In other words, creating a glossary of such terminology helps the Requirements Engineering process in two relevant ways: it eases the understanding of the application domain and it reduces the ambiguity of the oral communication with clients and users and the ambiguity of every produced document (Hadad, Doorn, & Kaplan, 2009).

However, the glossary construction itself introduces some drawbacks. The most important of these drawbacks, not yet treated, is the presence of nominalizations, either in the clients and users' terminology or in the produced glossary. The former is a possible source of ambiguity while the latter is a hint of an adequate or inadequate creation of glossary symbols by the requirements engineer. Both may cause defects in the glossary. Nominalization refers to the construction of nouns from verbs or adjectives. Linguistic authors have largely studied nominalization in many languages such as English, French, German, Russian, Spanish, etc. (Alexiadou, 2001; Bisetto & Melloni, 2005; Grimshaw, 1990; Rothmayr, 2009; Rozwadowska, 1997). The simplest way to describe verb nominalization is by means of the phrase *action of and effect of*. In some cases, nominalization occurs only by *action of*; while in others only occurs by *effect of*.

In this chapter, the influence of nominalization on the quality of Requirements Engineering documents is analyzed. The requirements engineer should be aware of the substantial differences in meaning, that sometimes arise when using the nominal mode of a verb or its verbal mode, since the action and the effect of a verb nominalization may produce synonyms or even homonyms.

BACKGROUND

The work presented in this chapter is based on the lessons learned in several research projects where many study cases were created using Scenarios and Language Extended Lexicon (LEL) models (Leite et al., 1997; Leite et al., 2000; Leite et al., 2004). LEL is a glossary proposed by Leite and Franco (1993). Scenarios are structured natural language descriptions of situations that occur in the application domain (Leite et al., 2000).

The LEL is itself a glossary with roles and structure different from the usual ones. It is composed by a set of symbols, which are words or phrases peculiar and frequently used in the application domain. Each symbol is identified by a name or names. An acronym or an abbreviation may be also a name of a term, only if present in the application domain. In case of synonyms the more relevant name is used as the main key entry. Every symbol has two types of descriptions; this particular structure makes the difference with other glossaries. The first type, called Notion, is the usual one and describes the denotation of the word or phrase, that is, it defines what the symbol is. The second, called Behavioral Response, describes the connotation of the word or phrase, that is, it describes how the symbol acts in the application domain; this description is not usually present in other glossaries and enriches the knowledge about the symbol and the context at hand. LEL symbols contain hypertext links pointing to directly related entries.

When the denotation of the term acquires several meanings, it indicates the existence of homonyms, which forces the creation of more than one entry in the lexicon. The absence of any behavioral response indicates that the symbol does not belong to the LEL.

LEL entries are classified in four types according to its general use in the application domain. The types are: Subject, Object, Verb and State. Table 1 shows the LEL model.

Symbols of type object, verb and state may be affected by a linguistic transformation, called nominalization, which may hide the type of the symbol and may produce confusions between verbs and objects, or between verbs and states. Nominalization is a source of ambiguities, especially in behavioral responses. It has not received the necessary attention in the Requirements Engineering literature (Berry & Kamsties, 2004; Kovitz, 1998). This chapter is devoted to analyze and control the influence of nominalization on the quality of Requirements Engineering documents. Proposals to reduce the possible negative influence of nominalization are described.

Table 1. Language EXTENDED LEXICON model

LEL: representation of the symbols in the application domain language. Syntax: $\{Symbol\}_1^N$
Symbol: entry of the lexicon that has a special meaning in the application domain. Syntax: $\{Name\}_1^N + \{Notion\}_1^N + \{Behavioral\ Response\}_1^N$
Name: identification of the symbol. More than one represents synonyms. Syntax: Word | Phrase
Notion: denotation of the symbol. Syntax: Sentence
Behavioral Response: connotation of the symbol. Syntax: Sentence

Source: (Leite et al., 2000)

The scenario model is a structure composed of the entities: title, goal, context, resources, actors, episodes, exceptions and the attribute constraint (see Table 2). Actors and resources are an enumeration. Title, goal, context and exceptions are declarative sentences while episodes are a set of sentences expressed in a simple language that give an operational description of behavior. A scenario must satisfy a goal that is reached by performing its episodes. Episodes represent the main course of action but they include also variations or possible alternatives. While performing episodes an exception may arise, signaling an obstacle to goal achievement. The treatment of the exception may or may not satisfy the original goal. All descriptions in the Scenario must maximize the use of LEL symbols, as a way to reduce ambiguity. This is another reason that strengthens the necessity of a high quality LEL creation.

VERB NOMINALIZATIONS

Verb nominalization may be interpreted as *eventive* with the semantic of *action of* and *stative* when it takes the semantic of *effect of*. Eventive nominalizations denote an activity and they are frequently combined with indications of location, duration or date. Eventive nominalizations inherit the arguments of the verbal base in such a way that they are capable of expressing the same semantic roles that the verb itself. Stative nominalizations are related with the result of the action of the verb. In most cases this result is an entity or a state. The following sentences contain the nominalization of the verb *publish*. The first sentence contains an eventive nominalization and the second a stative one.

- The software system must register the number of copies of every *publication*.
- The *publication* of books, and even of journals, requires resources that have to be available on time in order to minimize costs.

Ambiguity, completeness, and structuring of natural language documents are related among them. A slightly formalized glossary contributes to improve completeness since it contains a set of application domain notions materialized through subjects, objects, activities and states and their interrelations. The perception by the requirements engineer of any of those glossary elements helps to discover more information about the related glossary symbols. This clearly contributes to reduce incompleteness.

The experience acquired along many study cases led to observe the weaknesses that occur by nominalization of verb symbols. The semantic flaws produced due to nominalizations are of such nature that sometimes is quite different to register the verb itself or its nominalization in the LEL. The actual alternatives of verb nominalization may be:

1. Verb and its nominalization have exactly the same meaning.
2. Verb and its nominalization have different meaning.
    a. Just verb semantic is relevant in the application domain.
    b. Just nominalization semantic is relevant in the application domain.
    c. Both verb and its nominalization semantic are relevant in the application domain.
3. There is more than one nominalization for the same verb.

Table 2. Scenario model

Scenario: description of a situation in the application domain. Syntax: Title + Goal + Context + {Resources}$_1^N$ + {Actors}$_1^N$ + {Episodes}$_2^N$ + {Exceptions}
Title: identification of the scenario. In the case of a sub-scenario, the title is the same as the episode sentence (see below in the Episode definition), without the constraints. Syntax: Phrase | ([Actor | Resource] + Verb + Predicate)
Goal: aim to be reached in the application domain. The scenario describes the achievement of the goal. Syntax: [Actor | Resource] + Verb + Predicate
Context: composed by at least one of the following sub-components: Geographical Location: physical set of the scenario. Temporal Location: time specification for the scenario development. Precondition: initial state of the scenario. Syntax: {Geographical Location} + {Temporal Location} + {Precondition} where Geographical Location is: Phrase + {Constraint} where Temporal Location is: Phrase + {Constraint} where Precondition is: [Subject | Actor | Resource] + Verb + Predicate + {Constraint}
Resources: relevant physical elements or information that must be available in the scenario. Syntax: Name + {Constraint}
Actors: persons, devices or organisation structures that have a role in the scenario. Syntax: Name
Episodes: set of actions that details the scenario and provides its behaviour. An episode can also be described as a scenario. Syntax (using partial BNF): <episodes>::= <group series> | <episode series> <group series>::= <group> <group> | <non-sequential group> | <group series> <group> <group>::= <sequential group> | < non-sequential group> <sequential group>::= <basic sentence> | <sequential group> <basic sentence> <non-sequential group>::= **#** <episode series> **#** <episode series>::= <basic sentence> <basic sentence> | <episode series> <basic sentence> <basic sentence>::= <simple sentence> | <conditional sentence> | <optional sentence> <simple sentence>::= <episode sentence> CR <conditional sentence>::= **IF** <condition> **THEN** <episode sentence> CR <optional sentence>::= **[** <episode sentence> **]** CR where <episode sentence> is described: (([Actor | Resource] + Verb + Predicate) | ([Actor | Resource] + [Verb] + Title)) + {Constraint}
Exceptions: usually reflect the lack or malfunction of a necessary resource. An exception hinders the achievement of the scenario goal. The treatment of the exception may be expressed through other scenario. Syntax: Cause [(Solution)] where Cause is: Phrase | ([Subject | Actor | Resource] + Verb + Predicate) where Solution is: Title
*Constraint***:** a scope or quality requirement referring to a given entity. It is an attribute of Resources, basic Episodes or sub-components of Context. Syntax: ([Subject | Actor | Resource] + **Must** [**Not**] + Verb + Predicate) | Phrase
+ means composition, {x} means zero or more occurrences of x, () is used for grouping, | stands for **or** and [x] denotes that x is optional

The purpose of the LEL is to represent the vocabulary used in the application domain, therefore, nominalizations could appear or not as part of that vocabulary. Nominalizations are not a problem provoked by the Requirements Engineering process or by the requirements engineer himself or herself. It is an obstacle that he or she must manage by identifying the variants of the term and by establishing the meaning of those variants in the application domain. When capturing the vocabulary used in the application domain, it could happen and it usually happens that the requirements engineer does not perceive one or more of the possible meanings of a nominalized verb. Once this happens, it is very likely that he or she describes only the captured meaning keeping all the omissions undiscovered.

SOLUTIONS AND RECOMMENDATIONS

Each one of the cases enumerated in the previous section should be treated in a particular way, as shown in Table 3. When the requirements engineer runs across with a verb symbol, he or she does not know in which case the verb falls. To avoid omissions or ambiguities he or she has to find out how the symbol is used in the application domain, and then to which case it belongs in order to take out the correct action.

Table 3. Guidelines to manage verbs and nominalizations

Syntactic Form	Meaning	Action
Used as a verb	Action of	Register as a verb symbol
	Effect of	N/A
	Both	N/A
Used as a nominalization	Action of	Register as a verb symbol
	Effect of	Register as an object or state symbol
	Both	Register both as a verb symbol and as an object or state symbol. Label both as homonyms
Used as a nominalization with more than one nominalization	Action of	Register each of them as a verb symbols. Consider that eventually any nominalization may be a synonym of another
	Effect of	Register each of them as object or state symbols. Consider that eventually any nominalization may be a synonym of another
	Both	Register as a verb symbol and as an object or state symbols. Consider that eventually any nominalization may be a synonym of another
Used both forms	Action of	Register both forms as a verb symbol, choose the most used form as key entry name and the least used as synonym (see Table 3)
	Effect of	N/A
	Both	Register both as a verb symbol and as an object or state symbol (see Table 4). Consider that the nominalization may be also a synonym of the verb form, then label both entries as homonyms
Used both forms with more than one nominalization	Action of	Register all forms as verb symbols. Consider that any nominalization may be a synonym of the verb form; choose the most used form as the key entry name and the other as synonym. Label homonyms if applicable
	Effect of	N/A
	Both	Register as a verb symbol and as object or state symbols. Consider that one of the nominalizations may be a synonym of the verb form; choose the most used form as the key entry name and the other as synonym. Consider that eventually any nominalization may be a synonym of another. Label homonyms if applicable (see Table 5)

Table 3 strictly considers the possible consequences of the use of nominalizations without paying attention to the particular semantic of the verb itself or its nominalizations. Actually a verb or a nominalization may have more than one interpretation in the application domain, producing eventually homonyms. Therefore, any of the cells of third column of Table 2 may produce more symbols than it is indicated. Watching how the nominalizations are used is not enough to detect such additional homonyms cases. This happens with any single symbol of the LEL, regardless if it is the nominalization of a verb or not. The particular semantic of each symbol should be clearly understood in order to discover hidden or partially hidden homonyms, and possible synonyms.

Table 4 shows an example about the Study Case Production Management of Cardboard Boxes. In this example, the requirements engineer detects two different synonyms, used both in that context, for the same action: Plan Production and Production Planning.

In Table 5 there are two different symbols, one is a Verb symbol, Pay, and the other is an Object symbol, Payment, belonging to the same study case, Management of Treatments given by Medical Providers, where the Object refers to the verb nominalization used as effect of.

In Table 6 the symbol Authorize Treatment is a Verb, and there are three different nominalizations. The first one, Treatment Authorization, is a synonym of Authorize Treatment, being both verbs. Treatment Authorization as a Verb is also the homonym of Treatment Authorization as an Object. The third nominalization has generated a State symbol Authorized Treatment.

Table 4. Verb and its nominalization used as action of, being both synonyms; Study Case: Production management of cardboard boxes

Symbol Name/s	**Plan Production / Production Planning**	**Type: Verb**
Notion	• Process to establish the *production schedule* for all the shifts of the next week. • It is performed every Tuesday.	
Behavioral Response	• *Manufacturing programs* for each of the 21 shifts per week are generated. • Deployments boxes are organized to *reduce cardboard scrap*. • *Production orders* received from a *collaborative supplier* are considered *urgent orders*.	

Table 5. Verb and its nominalization used as effect of; Study Case: Management of treatments given by medical providers

Symbol Name/s	**Pay**	**Type: Verb**
Notion	• Action performed by the *treasury staff* producing an economic compensation to a *medical provider*. • It takes place after the *payment* has been approved by the *medical director*.	
Behavioral Response	• The *treasury staff* issues the *payment* thru the *system*. • The *treasury staff* notifies the *medical provider* upon the issued *payment*.	
Symbol Name/s	**Payment**	**Type: Object**
Notion	• Document issued by the *treasury staff*, establishing the cancellation of a debt acquired due to a *treatment* given by a *medical provider*.	
Behavioral Response	• It is registered in the system. • It requires the *director* approval before given to the *medical provider*. • A copy signed by the *medical provider* is stored.	

Table 6. Verb and two nominalizations used as action of and effect of, producing synonyms and homonyms; Study Case: Management of treatments given by medical providers

Symbol Name/s	**Authorize Treatment / Treatment Authorization**	**Type: Verb**
Notion	• Action that allows the *patient* to receive *treatment*. • It is performed at the *patient service office*.	
Behavioral Response	• The staff checks the *medical credit* of the *patient* thru the *system*. • The staff checks the *clinical order* given by the *patient*. • The staff issues an *authorization*. • The staff delivers the *authorization* to the *patient*. • The *patient* annexes the *clinical order* to the *authorization form* in order to get its *treatment*.	
Symbol Name/s	**Treatment Authorization / Authorization**	**Type: Object**
Notion	• Document issued by the *patient service staff*, allowing a *patient* to get a *treatment*.	
Behavioral Response	• It is generated thru the *system* based on the *clinical order* exhibited by the *patient*. • It is signed by the *service director*. • It is assigned a sequential number and an expiration date.	
Symbol Name/s	**Authorized Treatment**	**Type: State**
Notion	• Condition that a *treatment* takes after *treatment authorization*.	
Behavioral Response	• The *patient* can get a *treatment* thru a *medical provider* before its expiration date. • After the *patient* gets the *treatment*, the *medical provider* issues an *invoice* to receive the *payment*.	

FUTURE RESEARCH DIRECTIONS

This chapter presents the results of an exploratory research which has allowed discovering, as a regular pattern, the presence of many nominalizations of verbs that are relevant in the application domain. Frequently, such nominalizations have created different types of defects in the glossaries. The knowledge of the existence of those defects and the understanding of their cause has allowed proposing guidelines in order to reduce quantitative and qualitative consequences of such defects. These guidelines have been proven to be effective in few and small study cases. It is planned to perform a set of more structured experiments to quantify the efficiency of the proposed guidelines and to obtain reliable statistics and metrics of the quality enhancement of the glossaries and the importance of this on the whole Requirements Engineering process.

CONCLUSION

The research whose results are reported in this chapter may be summarized as:

- The relevant words and phrases of any application domain include several verbs.
- The full understanding of the verbs is important for improving the knowledge about the application domain.
- Nominalization of verbs obscures the perception of their eventive or stative semantic.
- Frequently one of the possible verb nominalizations hides the perception of the others.
- Losing an eventive or a stative meaning prevents discovering important information.

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KEY TERMS AND DEFINITIONS

Ambiguity: Phrase or sentence that does not have a single clear meaning. It provokes two or more possible interpretations.

Application Domain: The context in which the software system will be used.

Completeness: The state or condition of having all the necessary or appropriate parts of a model or document.

Language Extended Lexicon: A glossary composed by a set of symbols, which are words or phrases peculiar and frequently used in a given application domain. The lexicon symbols have an additional description, not present in other glossaries. It contains hypertext links that interconnect symbols.

Natural Language Model: A model in narrative text produced during Requirements Engineering process, with a structure and content easily read by all stakeholders.

Nominalization: The result of forming a noun from a verb, or the act of forming a noun from a verb. Nominalization itself is the nominalization of the verb *nominalize.* In this chapter it is used as a verb and as the effect of the verb (a state).

Omission: Information that has not been included in a model or document. It is the nominalization of the verb *omit.* In this chapter it is used as the effect of the verb (a state).

Scenario: The description of a situation that currently happens or will happen in the application domain. The former are called Current Scenarios and the latter are referred as Future Scenarios.

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Chapter 17
Word Formation Study in Developing Naming Guidelines in the Translation of English Medical Terms Into Persian

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ABSTRACT

Lack of appropriate equivalences for terms or technical words is the result of ineffective translation guidelines adopted in the translation process. This chapter provides a comparative analysis of the characteristics of Persian medical terms, using the universal naming guidelines and local naming principles in Persian. The aim of the study is to determine the similarities and differences of the compatible and incompatible terms (Persian equivalents) with respect to the applied translation procedures and the employed word formation processes. The descriptive statistics and qualitative analysis were employed to analyze the collected data which consisted of a population of 339 English medical terms and their pairs in Persian. The research was based on two theoretical frameworks, namely Sager's naming criteria and word designation principles by the Persian Language and Literature Academy to investigate the effective translation procedures and word formation parameters for the translation of English medical terms into Persian through morphosemantic comparison of the terms.

INTRODUCTION

The medical translation is a critical tool for communication between patients and health care professionals. A correct translation finds itself significant when a medical translator, as a skilled mediator, acts accurately and precisely by transferring the messages between a medical professional and a patient. This study is of utmost importance as it aims to find guidelines specific to translation procedures of English medical terms into Persian through word formation processes for linguists and translators. Such guidelines can be employed by translators to find the required equivalents. Persian linguists from the

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Persian Language and Literature Academy (PLLA) and Medical Science Academy in Iran may also find it beneficial. It may be effective and applicable to information technology and machine translation systems linguistic databases. This study presents the findings obtained by a comparative analysis of the Persian translation equivalents found in "راهنمای کدگذاری بین المللی بیماریها" (Guide to ICD-9-CM in Persian) using the universal naming guidelines and local naming principles in Persian, with regard to their pairs in English selected from medical terms in "ICD-9-CM." The study went through the research questions to investigate the naming characteristics of the English-Persian medical terms with respect to Sager's criteria (1990, p. 88) who provides 12 criteria for the perfect idealized requirement in a serious controlled condition for naming, the PLLA principles, the effectiveness of the adopted TPs in naming, the contribution of the morphosemantic factors to the naming process and to propose the specific naming parameters for the translation of English-Persian medical terms. The objectives of the study were also in line with the research questions. The analysis focused on Sager's naming criteria, the PLLA naming principles, and the applied translation procedures on the selected English medical terms into Persian equivalents during the translation process.

BACKGROUND

According to Ashuri (1995, p.29), one of the problems for Persian today is the fact that it is a combination of ancient writings and translation works. Scientific language of new works mostly deals with translation together with a lot of English and French words and syntactical structures. He suggests that the word formation is a solution for enriching a language with new concepts.

Beheshti (1999, pp.25-31) explains that one of the most significant contemporary linguistic issues is scientific-technical word formation, which is based on the language grammar and linguistic principles. She discovered that only 50 percent of the total terms studied had the equivalences in Persian; thus, indicating that the translators have not yet shown interest in employing Persian equivalents in their works. Further investigation is crucial to uncover the underlying reason. According to her, equivalent findings or naming of imported medical terms should be based on the features specific to medical terms. This means that medical terms, either in the source language or the target language, should be studied to find their systematic characteristics and some patterns in order to help the translators or linguists in the word formatting process or naming imported terms in the future. She suggests a study on the patterns based on the term characteristics of morphology, etymology, word formation and translation procedures.

Naseri et al. (2011, pp.41- 47) believe that the present problems of Persian in the areas of science and technology are due to the application of foreign language structures, lack of consistencies in scientific terms, and no consensus among authors and translators. Sadeqi (1993) believes that the solution to these problems is stabilizing the scientific and technical terminology at the basic levels and mass media. He states that the scientific terminologies are not consistent and in some cases, there are various Persian equivalents for a single foreign word in different dictionaries, or there are various foreign equivalents for a single Persian word. As a result, it is claimed that the scientific expressions are inconsistent (Kafi, 1992). According to Beheshti (1999, p.31), a language that borrows a large number of words suffers from negative consequences in the general language and can denigrate the capacity for people to speak their native language (i.e. such as German language in interaction with the English language). The Persian language in interaction with other languages will lose its capabilities and will be converted to a totally different language if it is not protected against the foreign words imported from many languages.

Therefore, activating the Persian language capabilities for naming the scientific and non-scientific foreign words is considered as a necessity which should be based on definite principles or patterns.

MAIN FOCUS

It is of the interest of this study to investigate what types of universal naming criteria and principles are followed by the selected data. While naming process should follow the international naming guidelines, the state or local naming principles may not be skipped, as creation of an equivalent in the target language should be lexically and semantically based on the cultural, terminological, linguistic and language factors of the target language.

The naming criteria suggested by Sager (1990, p.88) provides guidance on the creation of terms to be referred to when the translator deals with the difficulties in coining translated terms because of different structures and term formation techniques found in various languages. It remains difficult to generalize on a broad level. Sager provides 12 criteria for the perfect idealized requirement in a serious controlled condition for naming. "Criterion" is abbreviated as "C" in this study and it is followed by a numerical digit showing the number of criterion suggested by Sager. For example, "C1" represents the first criterion Sager has proposed for term formation. These criteria are outlined as below:

C1: The term must relate directly to the concept. It must express the concept clearly. A logical construction is advisable.
C2: The term must be lexically systematic. It must follow an existing lexical pattern and if the words are of foreign origin, a uniform transcription must be preserved.
C3: The term must conform to the general rules of word formation of the language which will also dictate the word order in compounds and phrases.
C4: Term should be capable of providing derivatives.
C5: Terms should not be pleonastic (i.e. no redundant repetition, e.g. combining a foreign word with a native word having the same meaning).
C6: Without sacrificing precision, terms should be concise and not contain unnecessary information.
C7: There should be no synonyms whether absolute, relative or apparent.
C8: Terms should not have morphological variants.
C9: Terms should not have homonyms.
C10: Terms should be monosemic.
C11: The content of the terms should be precise and not overlap in meaning with other terms.
C12: The meaning of the terms should be independent of context.

In this study, Persian word formation structures will be processed according to the Naming Guidelines approved by the Persian Language and Literature Academy (2009). These principles, obligatory for the word formation teams, have been approved by PLLA, as word designation and equivalent findings for the imported terms are the concerns of the Academy according to Article 2 and 3 of the second provision of the Islamic Republic of Iran constitution."Principle" is abbreviated by "P" which is followed by a numerical digit showing the Principle number approved by PLLA. For example, "P2" is the second principle which is proposed by PLLA for naming. PLLA provides nine principles for naming which are outlined as below:

P1: Persian words should be based on "basic Persian language today" i.e. the common language used by the learnt societies.
P2: Word designation should adhere to the correct grammar structure of the Persian language.
P3: Word designation should avoid dissonance and cacophony and should be based on Persian phonetics. As a result, the designated word, as much as possible, should be shorter than its pair in the source language.
P4: Equivalents with derivational and inflectional capabilities and also words with noun, adjective and verb possibilities are required to determine word designation priorities.
P5: Word designation should consider the following hierarchy as criteria:
P5.1: Older common and accustomed words in the Persian language
P5.2: Neologisms according to Persian word formation processes using Persian words
P5.3: Arabic words, common and accustomed in the Persian language
P5.4: Neologisms according to Persian word formation processes using Arabic words common in the Persian language
P5.5: Words borrowed from several Persian language dialects in Iran today
P5.6: Words borrowed from medieval and ancient Persian Languages
P6: In word designation, the priority is given to the words with clear meaning compared to the ones with ambiguous meaning.
P7: In word designation, especially in scientific areas, one word should be designed for any word with special meaning regardless of any probable diversity.
- Nota bene: Designation of multiple equivalents is applicable for any foreign word with several scientific definitions, according to scientific tradition, history and convention.

P8: No equivalent is needed for foreign words that are universally known and accepted.
P9: The Language Academy Council will make the final decision in case of failure in word designation process based on common Persian language patterns.

Based on a comparison between the Persian medical equivalents with Sager's naming criteria and the PLLA naming principles, the goal of the study is to determine the similarities and differences of the compatible and incompatible terms (Persian equivalents) with respect to the applied translation procedures and the applied word formation processes and to identify those with the highest number of frequencies.

The compatible and incompatible equivalents with Sager's criteria and the PLLA Principles provide the data for this study and enable statistical descriptive and qualitative analysis to be carried out. The collected data included a population of 339 Persian medical terms from the target text with regard to their pairs from the source text, which is sufficient with respect to the statistical descriptive method of analysis. It should, however, be noted that the selected terms reflected only the results limited to the selected system of the human body (the musculoskeletal system and connective tissue). Furthermore, the results obtained in this study do not necessarily reflect all the guidelines available for the translation of all the medical terms of other human body systems mentioned in ICD-9-CM into Persian.

This study establishes a conclusion about the integration of the findings of the study. It begins with a discussion of inferences drawn from the study and is followed by a comparative description of the findings and recommendations.

Data Analysis and Methods

The study needs preliminary information for analyzing the data including grammar, morphology, etymology and syntax. The Persian term will be broken down into components or morphemes based on the Katamba morphology (1994) and Tabatabaee's structures (2009). The analysis will focus on the characteristics of the Persian terms in accordance to the naming guidelines provided by ISO and criteria suggested by Sager (1990, p.88). The terms will subsequently be processed based on the principles recommended by the PLLA.

This is designed to uncover the fact that those English medical terms with certain characteristics can be translated through certain translation procedures and word formation processes and are compatible with certain Persian word formation patterns. It should be noted that in this research, a positive or compatible equivalent indicates the positive compatibility of the equivalent with all the PLLA principles and Sager's criteria; and a negative or incompatible equivalent indicates negative or no compatibility of the equivalent with at least one of the PLLA principles or Sager's criteria. The conclusion will be uncovering the effective naming parameters or patterns for translating the medical terms from English into Persian.

The analysis of each term from the source language and its pair in the target language is performed according to the arranged elements of a data table (Table 1). For better explanation, suppose that the term ''عضلانی استخوانی [azolāni ostoxāni] has been selected among the related terms of the selected system of the human body in the target text.

Table 1. Data table

English Term			**Musculoskeletal**	
Equivalent in Persian			عضلانی استخوانی (azolāni + oś̌toxāni)	
Gloss			muscular + skeletal	
Back Translation			muscular-skeletal	
Parts of Speech			adjective	
Morphological Analysis	azolāni [muscular]			ostoxān+i [skeletal]
	root			root + suffix
Parts of Speech	adjective			adjective
Tabatabaee's Persian Structure			balanced structure Adj+ - + Adj. = Adj	
Morphosyntactic Structure			Adj + Adj	
Word Formation			(borrowing, derivation) + derivation	
Translation Procedure			through translation + substitution	
Sager's Criteria		**PLLA Principles**		
Result		**Result**		

Among the selected terms, a few have equivalents that are composed of two separate words, one with borrowing and derivation processes and the other with only the derivation process. As in the example, the single Greco-Latin term of "musculoskeletal" (Dorland's Medical Dictionary, 2005) is composed of two free root words of "musculus" and "skeleton" which have been embedded by the derivational Latin suffix "al". Like other examples of this group of terms, the equivalent consists of two separate words,"عضلانی" [azolāni] /azola:nI/ (muscular), which is Arabic, and "استخوانی" [ostoxāni] /ostoxa:nI/ (skeletal), which is Persian. The former matches with the borrowing process, while the latter is a native word in the target language. Both of them indicate derivation in their word formation processes as well. The suffix "i" as an adjectival suffix is observed in both Persian words. In Persian, it is not possible to combine the two words together by adding the suffix only to one of them, so the translator is required to produce two independent adjective words which do not make a phrase. In this example the translation procedure is through translation since "musculoskeletal" is a compound word.

Table 1 shows the analysis of the equivalent produced and it could be concluded that this compound equivalent is not applicable due to its unconformity to Sager's 7 and 8 criteria and mismatches with principle 7 in naming Principles of PLLA. However, it indicates that there is a compatible structure with the Balanced Structure of Tabatabee's structures i.e. adj + - + adj.

The problem with the above example is multiplicity. With respect to Sager's criteria 7 and 8, it is found that another synonym like [azole i] "عضله ای" (muscular) can be used that follows the Persian structure, i.e. [azole] (root) + i (adjectival suffix), while [azole] "عضله" (muscle) is borrowed from Arabic as an independent word. On the other hand, [azolāni] "عضلانی" is also imported from Arabic as an independent adjective. Since [azolāni] is an Arabic adjective, it cannot be matched with any Persian structure, because there is no [āni] suffix in Persian structures that can combine the borrowed noun [azole]. Thus, no derivability can be found for [azolāni] as it is an adjective imported directly from another language. It violates principle 7 in the naming PLLA principles.

Findings

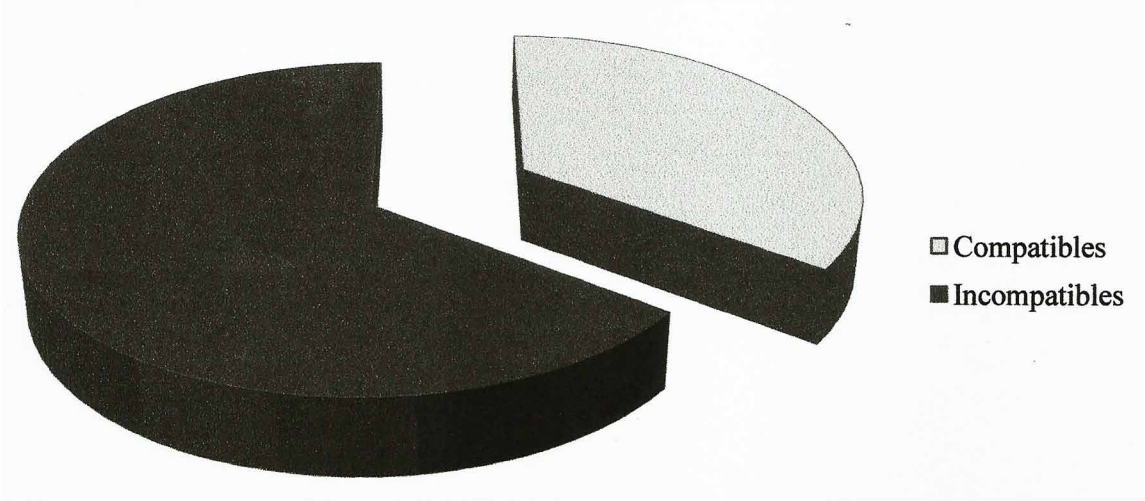
The findings of the equivalents under this study can be classified into two groups: compatible and incompatible equivalents. The compatible terms are the ones which follow all of Sager's criteria together with all of the PLLA principles. These terms or words are compatible with all the requirements for naming. In other words, the compatible terms automatically present those features of translation procedures which are effective for naming the Persian medical terms. The incompatible terms are the ones which do not follow one or more naming criteria suggested by Sager or the naming principles recommended by the PLLA. Such terms or words are incompatible with all or some of the naming requirements for naming. In other words, the incompatible terms automatically present those features of translation procedures which are ineffective for naming the Persian medical terms. Table 2 indicates the frequency of distribution for these two groups of equivalents under this study.

The study identified that around 67% of the terms are incompatible with the basal naming guidelines employed in the study (Figure 1). Generally, the findings of this study are not limited to the incompatible equivalents, but to the compatible ones also. The compatible equivalents can indicate the effective translation procedures and naming requirements for the secondary word formation of English medical terms into Persian. According to Sager (1990, pp.80-83), the terms which belong to scientific and technological innovations basically differ from the terms accompanying the transfer of scientific and technological knowledge from one linguistic society to another: "while the former is spontaneous, the latter

Table 2. Frequency and percentage of the compatible and incompatible equivalents

Equivalents	Frequency	Percent
Compatibles	112	33.04
Incompatibles	227	66.96
Total	339	100

Figure 1. Distribution of the compatible and incompatible equivalents



can be designed and engineered". Primary term formation is a process starting with concept formation in a scientific area. Such a process is out of external control, and is therefore monolingual and affected by "existing patterns of terms already created".

The incompatible ones illustrate the incorrect methods which should not be followed in the translation processes; however, they can be changed to compatible ones by employing the guidelines provided through this study. The incompatible frequencies, as well as the applied translation procedures, are important findings of this research and will be discussed in the next sections.

Compatible Terms or Equivalents

The finding shows that Criteria 10, 11 and 12 (C10, C11 and C12) are the criteria which are fulfilled by the terms in this study. It means that firstly, all the equivalents under this study follow some semantic criteria. Secondly, the respective terms belong to one meaning each and the meaning does not overlap with other terms; and thirdly their meanings can be learnt out of context.

Given the PLLA principles, the compatible principles that resulted in the equivalents in this study are principles 1, 5, 8 and 9 (P1, P5, P8 and P9). Based on the analysis, all equivalents in this study have been formed in the Persian language area today, and they follow the regularities of word designation discussed in P5. Principles 8 and 9 are items suggested by PLLA to help the translators and linguists in case of inquiry. Principle 5 has been classified in lexicology category. As all equivalents in this study

are compatible with P5, some of the terms are conflicting with those principles suggested by PLLA in semantic area.

On the other hand, some equivalents are totally compatible with all Sager's criteria and the PLLA principles. Those terms are formed by through translation procedure of the ones classified by Newmark (1988, p.81) including transference, naturalization, through translation, shift, modulation, recognized translation, literal translation etc. For some terms, substitution and naturalization have been identified as the translation procedures, and they are utilized in the translation process, which lead the equivalents to be compatible with all basal guidelines. It indicates that through translation and naturalization are two effective procedures in translating English medical terms into Persian if they are applied independently and are not combined with any other procedure.

Incompatible Terms or Equivalents

The most incompatible equivalents have been found the ones which do not fulfill the Sager's criteria 4 and 7 together with principle 3 of the PLLA. Such terms, with a frequency of 54 occurrences, consists of 16% of the total terms and 26% of the incompatible terms in this study. The applied translation procedure in these equivalents include (substitution + shift + through translation) with 50 terms and (shift + through translation + naturalization) with 4 terms. It indicates that the majority of incompatibility in the equivalents belongs to (substitution + shift + through translation). Substitution is a translation procedure suggested by C. Heah (1989, p.191) in which borrowing is employed as a word formation process.

The study also found that the next high frequency of incompatibilities is related to the equivalents which do not fulfill criterion 4 and principle 3 with a frequency of 48 terms consisting of 14% of the total terms and 23% of the incompatible terms in this study. The applied translation procedures for these equivalents are (substitution + shift) with 40 terms and shift with 8 terms. It is clear that the second important area which is targeted by incompatibilities in this study is (substitution +shift).

Results

The finding of the current study is as below:

1. The equivalents in this study are more incompatible with the guidelines in the lexicology area compared to the semantics area.
2. With respect to Sager's criteria, around 52% of the equivalents have been constructed without any derivational capability (-C4).
3. With respect to the PLLA Principles, around 56% of the equivalents have translations that are longer than their pairs in the first language (-P7).
4. With respect to the applied translation procedures, most of the equivalents are incompatible with Sager's criteria and those equivalents are constructed by (substitution + shift + through translation) feature of translation procedures.
5. 22% of the terms mentioned in the previous item do not have any derivational capabilities (-C4) and 15% have at least one more or other synonym (-C7).
6. With respect to the applied translation procedures, around 33% of the equivalents constructed by (substitution + shift + through translation) feature of translation procedures are incompatible with the PLLA principles.

7. 22% of the terms mentioned in the previous item have longer translations than their pairs in the first language (-P3). This frequency has been repeated for terms without any derivational capability (-P4) and for those that have not been constructed with special meaning (-P7).
8. The medical Persian equivalents incompatible with C4 can be categorized into three categories:
    a. Equivalents that have been constructed in a phrase pattern which do not leave any opportunity for derivational discussion. Such equivalents should be made into single nouns in derivational area and not into phrases.
    b. Equivalents that do not have any derivation in the source language term pair; therefore, there is no need to explain them in derivational area.
    c. Equivalents that have been translated incorrectly by the translators which do not follow the derivational capability.
9. The main problem of incompatibility of Persian medical terms with Sager's criteria or the PLLA principles is due to borrowing and substitution procedures. Therefore, naming through word formation should be done carefully with respect to the compatibility with basal guidelines.

THE RECOMMENDED GUIDELINES SPECIFIC TO THE TRANSLATION OF ENGLISH MEDICAL TERMS INTO PERSIAN

The findings and discussions conducted the study to many guidelines specific to medical translation, providing facilities for English-Persian translation of medical terms. Although the current medical equivalents in Persian, either compatible or incompatible, are largely used in the Persian language society, the following guidelines recommended by this study, will be applicable as the rectification of the existing translation procedures and naming Persian medical equivalents in the future. The guidelines are as follows:

1. Through translation and naturalization are the translation procedures applicable in the translation of English medical terms into Persian if no other translation procedure is involved simultaneously and if the equivalent is a single word and not in a phrase structure.
2. The source language medical term which appears in the form of an adjective or a derived word can be translated into Persian by through translation or naturalization if no other translation procedure is involved simultaneously. In this case, the equivalent will be a single word with derivational capability in the form of a noun or adjective.
3. Substitution and through translation can be employed simultaneously to translate an English medical term into Persian if the equivalent is a single word with derivational capability.
4. Naturalization and through translation procedures can be employed simultaneously in the translation process of an English medical term into Persian if the equivalent is a single word with derivational capability.
5. In Persian which is a language without any combining form morphemes, the third principle of PLLA cannot be applied in the naming of words or in the word formation process of the medical terms, unless the combinational capability of the Persian language is modified.
6. Obviously, derivational capability will not be discussed in the naming process of the Persian medical terms if the medical equivalent construction is conducted toward phrasal word formation. Therefore, C4 is not applicable in order to produce such terms or equivalents.

7. If the (substitution + shift + through translation) feature is employed for the translation of English medical terms into Persian, for the component of the phrase which has been formed by substitution (or borrowing), the translation procedure should adhere to either Sager's criteria or the PLLA principle. Such situations can be observed for single-word English medical terms, while their equivalents are in phrase forms.
8. If the constructed equivalent is a noun phrase, the translator should consider a single-word synonym as the 'illustrate' equivalent for derivational applications.

IMPLICATIONS

The ever-increasing number of imported words and specific terms into the native language is due to the rapid development of technology and science. It is challenging to find appropriate equivalents for terms or technical words because of the lack of effective translation guidelines applicable in the translation process. Research needs to be conducted to solve the problem. The goal of this study is to propose guidelines specific to translation procedures of English medical terms into the Persian language through term formation processes. If there is a specific guideline for naming the terms, translators will not seek equivalents based on individual preferences and there should be consensus within the field and this will reduce the discrepancy in establishing terminology equivalents. It will also be beneficial for Persian linguists from the PLLA and Medical Science Academy in Iran, as they can finally come across standardized and acceptable equivalents in Persian.

Borrowing several equivalents with different word origins for just one imported word illustrates that none of the available equivalents has been effectively adopted. The problems in scientific and technical language are due to imitating or borrowing language structures and grammar from several languages, which is the result of a lack of fixed or standardized scientific terminology or the disagreement among authors and translators (Sadeqi, 1993, pp.125-6).

Regarding the equivalents incompatible with either Sager's criteria or the PLLA principles, it should be emphasized that the problematic area for the translation process of the English medical terms into Persian has been identified by this study. However, this study highlights that caution needs to be exercised by translators or linguists not to adopt some features of translation procedures.

RECOMMENDATION FOR FURTHER STUDIES

This research focused on the study of one of the human body systems classified by ICD-9-CM. Future students, researchers, linguists and translators should conduct further investigations in other systems of the human body to find more comprehensive or universal results. Indeed, this study is considered a step towards recognizing any unknown problem in the medical translation process. Therefore, the following investigations and studies are recommended:

1. To find basic and general guidelines specific to the translation of English medical terms into Persian, further research is needed to include other human body systems. Comparing the findings and conclusions with the findings and conclusion of this study will allow us to have more reliable and fundamental translation approaches or naming guidelines.

2. Other languages, given their basic language characteristics, may follow this research methodology to identify their problems with translation of the English medical terms into their language, which will allow them to have effective guidelines.
3. The guidelines in this study may be applicable to those languages with characteristics similar to those of the Persian language, which need further investigation by related linguists, terminologists and translators.
4. This research style can be employed for the terms in other technological and scientific fields to find their potential problems with the translation process of the English terms into their equivalents in Persian, which suggests effective guidelines that are unique to the related field.
5. The guidelines in this study may be applicable to other technological and scientific fields, which depend on the source language and the target language (Persian).
6. The applied research methodology, the employed research style and the resulted guidelines in this study may be effective and applicable to information technology and machine translation systems linguistic databases.

CONCLUSION

In conclusion, this research attempts to look at this issue from the naming secondary term formation perspective based on the two basal guidelines and the translation procedures employed in translating medical terms from English into Persian and highlights the compatibility of the equivalents with respect to translation procedures and word formation processes, finding problematic areas and presenting guidelines unique to translation of English medical terms into Persian.

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KEY TERMS AND DEFINITIONS

Cacophony: According to Encyclopedia Britannica, "cacophony", the opposite of "euphony", refers to combination of words that produce harsh discordance of sound. Linguistically, euphony and cacophony belong to the study of inherent pleasantness or unpleasantness of the sound of certain utterances. This knowledge is called "phonaesthetics". Morphologically, this word is derived from two Greek word parts that mean "voice-sound" and "aesthetics." Despite cacophony, euphony is achieved through the use of vowel sounds in words. Vowel sounds, which are more easily pronounced than consonants, are more euphonious; the longer vowels are the most melodious. See dissonance.

Compatibility: In this study, the characteristics of the equivalents or terms will be investigated and discussed according to the compatibility status with Sager's criteria and the PLLA principles. In other words, it will be studied if the terms follow the naming guidelines (as compatible equivalents) or appear out of naming guidelines (as incompatible equivalents).

Effectiveness: "Effective" or "ineffective" are the terms which are employed in this study for the effectiveness of the applied translation procedures in the translation process of English medical terms into Persian. It is evaluated based on four terminological factors suggested by Meyer and Bowker (2006: p.117) which belong to morphosemantics in linguistics. Conciseness, absence of competing terms, derivative form capability, and compliance with the rules of the language are the four factors that can all contribute to the effectiveness of the applied translation procedures in translating the English medical terms into Persian.

Morphosemantics: Morphosemantics is generally a knowledge in linguistics, pertaining to morphological analysis combined with a semantic interpretation of words.

Naming Guidelines: It refers to the criteria or principles which should be followed in naming or word designation process. Naming guidelines can be categorized into the ones which are common for all the languages around the world, namely universal or international guidelines, and the ones which are specific to a certain language society namely local guidelines.

Naming / Word Designation Process: Naming occurs once a new concept, object, phenomenon and the like appears. In this process, a name has undergone multiple attempts and word formation processes (Sager, 1990: p.63).

Translation Procedures: It refers to particular translation courses which are applicable to sentences and the smaller units of language. (1988). (p. 81). Newmark.

Word Formation Processes: It speaks of the continuous development of new terms and new applications of old terms leading to language productivity in the way a language is evolved based on its user's requirements (Yule, 1988: p.52). There are different ways for word formation to enter lexicon.

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Section 4
Multimedia Technology

Chapter 18
Adaptive Hypermedia Systems

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ABSTRACT

Adaptive hypermedia systems are systems that modify the different visible aspects based on the user profile. To provide this adaptation, the system is modeled according to a user model, which stores the information about each user. This information can include knowledge, interests, goals and tasks, background and skills, behavior, interaction preferences, individual traits, and context of the user. This chapter's goal is to introduce adaptive hypermedia systems fundamentals and trends. In this context, this chapter identifies some methods and techniques used to adapt the content, the presentation, and the navigation of the system. In the end, some applications (ELM-ART, Interbook, AHA!, AdaptWeb®) and trends (standardization, data mining, social web, device adaptation, and gamification) are exposed. As a result, this chapter highlights the importance of the improvement and the use of adaptive systems.

INTRODUCTION

With the growth of access to technology, the limitation of the traditional hypermedia applications has become evident: it provides the same contents and links to all users, disregarding their profiles and individual characteristics. Considering a diverse user population, the traditional system is not able to be "all things to all people", since students with different goals will need different explanations, readers with different interests will enjoy different books and visitors with different knowledge will avail different curiosities about a place (Brusilovsky, 2001). An attempt to bypass the negative effects of the

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"one-size-fits-all" approach is in providing these systems the ability to adapt themselves according to the needs of the individual user (Brusilovsky et al., 1998).

Based on that, Adaptive Hypermedia (AH) systems are all hypertext or hypermedia systems that reflect some features of the user (e.g., goals, preferences and knowledge) in a user model and modify their various visible aspects according to this model (Brusilovsky, 1996). When hypermedia records and stores learners' preferences, individual needs and learning goals, using them throughout interaction in order to meet their personal needs and to promote a better learning, then hypermedia becomes AH (Turel, 2015). To be considered an AH, the system should satisfy three criteria: being a hypermedia (or hypertext) system, having a user model and using this model to adapt the hypermedia (Brusilovsky, 1996).

In order to meet the first criterion, the system should store all information into small units (usually called nodes) containing text (hypertext) or other forms of information (hypermedia). These units are presented one per window, being interconnected by links that allow users to navigate in a predefined way (Akscyn et al., 1988). To meet the second criterion, it must have a model where data about the users (e.g., knowledge, interests, goals and individual traits) are stored (Brusilovsky & Millán, 2007). Finally, the AH system must adjust its presentation – content (defining the most relevant contents to each user and how to structure them) and interface (making a presentation more efficient and meaningful to the user) (Bunt et al., 2007) – and navigation (guiding the user in the hyperspace through the selection and presentation of the most important links in order to continue the navigation system) (Brusilovsky, 2007) based on the data to be stored in the user model.

There are different application areas to AH systems, e.g.: Educational Hypermedia, On-line Information, On-line Help, Information Retrieval, Institutional Information, Personalized Views, etc. The AH educational systems goal is to create an instructionally sound and flexible environment that supports learning for students with a range of abilities, disabilities, interests, backgrounds, and other characteristics, enabling students to learn as much as possible on the available material (Shute & Zapata-Rivera, 2012).

The aim of this chapter is to present Adaptive Hypermedia Systems fundamentals and trends. To achieve it, section 2 introduces the background about user modeling. Section 3 describes some methods and techniques that allow adaptation. Section 4 illustrates some of the existing AH systems. Section 5 points out trends and future directions and Section 6 concludes this work.

BACKGROUND

User model is the representation of information about an individual user, which is essential to make the AH system behave differently according to each user. Based on this model, the AH system can prioritize the most relevant results of a search, manipulate links to facilitate the navigation and present the content adaptively. During the user modeling, the amount and nature of the sorted user information depends on the kind of adaptation effect the AH system has to deliver (i.e., content, presentation and/or navigation) (Brusilovsky & Millán, 2007). The most common stored data are described below based on Brusilovsky & Millán (2007) and Schiaffino & Amandi (2009).

- Knowledge about the application domain enables proper assistance or content adaptation. The users' knowledge is a changeable feature that can increase (i.e., learning) or decrease (i.e., forgetting) from time to time. The AH system must recognize this change and update the user model to provide a more reliable and assertive adaptation. The knowledge about each element can be

represented in binary form (i.e., knowing or not) or in scalar form, either quantitative (e.g., from zero to ten) or qualitative (e.g., beginner, intermediate, expert).

- Interests can represent news, web pages, documents, work-related or hobbies-related topics that can be classified as short-term or long-term interests. These interests can be stored in several ways: through weighed vector of keywords (weights usually represent the relevance of each keyword), topic hierarchies (each node in the hierarchy represents a topic of interest, defined by a set of representative words) and topic ontology (an human-understandable, but machine-readable format).
- Goals and Tasks represent the immediate purpose or objective for a user's work within the system, usually being a learning goal in educational AH systems. The goal or task is almost always changing from session to session or even several times within one single session, being the most changeable user feature. Plan recognition is not trivial but it is a useful technique that helps discovering the user' intention by observing the set of input tasks and inferring the next (most probable) one and, hence, the user's goal. Goals or tasks can be represented in the user model with the same patterns of the knowledge, but also as a Bayesian network where nodes represent user tasks and arcs represent probabilistic dependencies between them.
- Background and Skills are a set of features related to the user's previous experience outside the core domain of the system (e.g., profession, work experience or language) and they are used most frequently for content adaptation. They are very similar to user' knowledge and they can be also stored as binary or scalar form, but their update is typically explicitly (requesting users themselves or their superior – e.g., teacher, boss – to fulfill their background and skills).
- Behavior represents a repetitive pattern that can be used to assist the user. The modeled behavior type depends on the application domain: some systems help users to schedule their day (by learning rules and suggesting meetings based on them), buying things (by recording preferences) and learning (by recording the period of time that an action occurs), for instance.
- Interaction preferences refer to the users' interaction habits and preferences when they interact with an interface. The AH system should infer the preferred agent action (e.g., warning, suggestion or interruption of the work) and modality for different situations or contexts. For example, one student is creating a study group to review the content on Saturday, but another student involved probably will not attend because he never attended commitments on Saturday. Some students would prefer a simple warning, while others would want suggestions about an alternative date. To learn users' interaction preferences, the AH system must store information about the necessary situations and the intervention type.
- Individual traits define who the user is as an individual, including demographic information (e.g., sex, age, marital status, country, number of children), personality traits (e.g., introvert/extravert), cognitive styles (e.g., holist, serialist), cognitive factors (e.g., working memory capacity) and learning styles.
- Context involves any information that can be used to characterize the person, place or object which is relevant to the interaction between the user and the AH system, including the user and the system themselves. Context-aware systems provide relevant information based on the context and the adaptation is guided by the user needs.

The process of acquiring information to fulfill the user model involves capturing the appropriate data, selecting the relevant information and interpreting the user interactions activities (Koch, 2001). This acquisition can be explicitly (through the input of data via forms provided for this purpose) or implicitly

(observing actions). The problem of explicitly acquisition is that users are not willing to fill in long forms providing information about them and, if they do, it may not be the truth about them (intentionally or deliberately). Based on data stored in the user model, the AH system can perform the adaptation with many different methods and techniques.

METHODS AND TECHNIQUES

Many techniques and methods can be used to adapt hypermedia systems. While techniques are a part of the implementation level (being characterized by a specific kind of knowledge representation and by a specific adaptation algorithm), methods are part of the contextual level (being generalizations of one or more techniques) (Brusilovsky, 1996). This section describes some existing methods and techniques divided into three levels: content, presentation and navigation.

Content Adaptation

Content level enables the AH system to modify content, showing basic or detailed information about a topic according to users' knowledge, for example. The content adaptation aims to increase the system usability for a group of users with different knowledge, background and goals. This adaptation consists essentially in providing additional, comparative or alternative content, also hiding the irrelevant parts of content for each user (Gasparini, 2003). Content adaptation methods can be divided into: Additional Content, Explanation Variant and Sorting, described below based on Brusilovsky (1996) and Kobsa et al. (2001).

- **Additional Content:** Shows only the relevant fragments based on goals, interests, preferences or levels of knowledge of each user. It is the most widely used method to adapt the content, being divided into:
  - **Additional Explanation:** Hides irrelevant fragments to the current level of knowledge of the user (i.e., inability to understand) or in agreement with user interest.
  - **Prerequisite Explanation:** Modifies the fragments based on prerequisites among related concepts and on user' knowledge. AH system considers that the user knows about the related concepts (i.e., prerequisites) if the user has already accessed each one.
  - **Comparative Explanation:** Presents a comparative explanation (defining similarities and differences) between the presented concept and related ones. This method is based on similarity links between concepts.
- **Explanation Variant or Variant Content:** Stores variants of the fragments and shows only the ones considered more appropriate for each user. This method is usually used when showing or hiding fragments is not enough, since users may need information fundamentally different.
- **Sorting:** Places the fragments in a hierarchical order and the most relevant fragments are displayed first, based on the user's background and knowledge.

Content adaptation techniques are described below based on Brusilovsky (1996), Kobsa et al. (2001) and Knutov et al. (2009):

- **Conditional Text:** Divides all information into fragments and each fragment is associated with one or more conditions represented in the user model (if conditions are satisfied, the content is presented). This is used to implement the Additional Content and Explanation Variant methods.
- **Adaptive Stretchtext:** Shows or hides all fragments related with a specific "hotword". It replaces the hotword with the fragments if they are important and relevant, based on the user' knowledge and preferences. Otherwise, fragments will be collapsed and the user will only see the hotword. This technique is used to implement the Additional Content method.
- **Page Variant:** Stores two or more variants of a page to present differently the same concept. This technique is used to implement the Explanation Variant method.
- **Fragment Variant:** Stores two or mode variants of a fragment to be combined during the presentation of a single page, in a way that best suits the user model. This technique is considered more complex to implement than the Page Variant technique, since the page needs to be dynamically created with the predefined fragments. This technique is used to implement the Additional Content and Explanation Variant methods.
- **Fragment Coloring:** Presents the same content while highlights the fragments of information according to their classification (e.g., very relevant, relevant, less relevant and irrelevant) for each user. This technique is used when all users must view the same content (sorting method) because it has a relatively low adaptation.
- **Frame-Based Approach:** Represents all information about a particular concept in form of a frame. These slots of a frame can contain several explanation variants of the concept, links to other frames and examples that are shown, hidden and reordered based on the user model. This technique is used to implement the Additional Content, Explanation Variant and Sorting methods.

Presentation Adaptation

Presentation level enables the AH system to present more or less navigational functionalities based on user' knowledge, background and skills. The presentation adaptation aims to increase the system usability for users, by making a visual change (layout) or textual change (language) (Gasparini, 2003). Presentation adaptation methods can be divided into: Multi-language and Layout Variant, described below based on Koch (2001).

- **Multi-Language:** Changes the system language according to the user's preference, which may also depend on the context.
- **Layout Variant:** Creates several alternatives for required items of interface: color, font size, font style, size, maximum image size, text orientation.

Presentation adaptation techniques to implement the presentation adaptation methods are almost the same techniques used for adapt the content, except for the adaptive stretchtext and the fragment coloring. The Conditional Text, Page Variant, Fragment Variant and Frame-based Approach techniques can be used to implement Multi-language and Layout Variant methods. Beyond these techniques, there is the Styleguiding technique, which defines different styleguides for the same page, to implement the Layout Variant method (Koch, 2001).

Navigation Adaptation

Adaptive navigation helps users to find their paths in hyperspace by modifying the presentation of links (Brusilovsky, 1996). A link is a visible and "clickable" representation of related pages for which the user can navigate, being classified by its kind: Local Non-contextual Links, Contextual Links, Links from Index or Content Pages and Links on Local or Global Hyperspace Maps. Navigation adaptation methods can be divided into: Local Guidance, Global Guidance, Local Orientation, Global Orientation and Personalized Views, described below based on Brusilovsky (1996).

- **Local Guidance:** Helps users to continue the navigation, suggesting the best link(s) from the current page, based on users' preferences, knowledge and background.
- **Global Guidance:** Helps users to find the shortest path to get to what they are looking for, through the suggestion of the most appropriate links from the current page, for example.
- **Local Orientation:** Helps users to understand the different possibilities of navigation and to follow the most appropriate link from a given position.
- **Global Orientation:** Helps users to understand the structure of the entire hyperspace and their position within this structure.
- **Personalized Views:** Generates and updates the hyperspace with a personalized view for the user, building a working interface in a personalized way through adaptation.

Navigation adaptation techniques can be divided into: Direct Guidance, Sorting of Links, Link Hiding, Link Removal, Link Disabling, Link Annotation and Map Adaptation, described below based on Brusilovsky (1996), De Bra & Calvi (1998) and Knutov et al. (2009).

- **Direct Guidance:** Chooses the best page to continue the navigation. This is the most flexible technique, since it is possible to recommend a link that is not directly related to the actual one.
- **Sorting of Links:** Classifies and orders the available links, placing the most relevant links first. Its usage can reduce the navigation time, but it also can confuse users who reminds the link location, since the AH system reorders the links on each access.
- **Link Hiding:** Restricts the navigation by hiding irrelevant links. This is one of the most used techniques to adapt the navigation because it can be used with all kinds of links described above, besides reducing the workload of the user.
- **Link Removal:** Restricts the navigation by removing irrelevant links, instead of hiding them. This technique is usually combined with the Sorting of Links technique, which defines the most relevant links to be shown while the others are removed.
- **Link Disabling:** Restricts the navigation by disabling the functionality irrelevant links (i.e., removing anchors of links). In this case, the link is still visible to the user, but clicking on it will have no effect.
- **Link Annotation:** Adds comments to the link, allowing users to know more about its actual state. This comment can be textual or visual (using icons, colors or different font size) and it can classify links in several ways (e.g., visited/not visited, very relevant/relevant/irrelevant, not ready to be learned/ready to be learned/learning/learned) instead of only two (relevant/not relevant).

- **Map Adaptation:** Is a combination of all other techniques listed above, being applied to a graphical presentation of the navigational structure (i.e., map). It can be used to adapt the map without changing its structure, while reducing the browsing space by elimination anchors and guiding users in order to prevent them to get lost in the hyperspace.

There are several applications that use these methods and techniques to perform the adaptation of the system, described in the following section.

APPLICATIONS

Focusing on Educational Hypermedia, one of the first web-based AH systems created was the ELM-ART (acronym for ELM-Adaptive Remote Training), which was originally implemented to help students in learning LISP programming language (Brusilovsky et al., 1996). Even with the positive results of several empirical studies, ELM-ART approach received few expansions since its original version had many limitations (e.g., it can only focus on beginners due the high complexity of advanced concepts compared with the benefits of the possible learning support and it allows only the authors to add new content and activities) (Weber & Brusilovsky, 2015). Another Educational AH system is Interbook, created as an attempt to refine and improve some features of ELM-ART. Interbook uses users' knowledge to provide adaptive guidance (via direct guidance) and adaptive navigation (via link annotation) (Brusilovsky et al., 1998).

One of the most famous AH system is AHA! (Adaptive Hypermedia Architecture), which is an open-source and web-based system originally created for educational area (De Bra et al., 2006) that likewise distilled some of the ELM-ART limitations. AHA! uses the AHAM reference model and some methods to adapt its content (e.g., additional content) and presentation (e.g., layout variant), in addition to some techniques to adapt the navigation (e.g., link hiding, link removal and link annotation) (De Bra & Calvi, 1998) (De Bra et al., 2003).

The AdaptWeb® system is an Educational AH system focused on distance education. The AdaptWeb® architecture is based on four modules: authoring, storage, content adaptation and adaptive interface modules. The authoring module structures and organizes the instructional content via an authoring tool (creating a structure of concepts, establishing prerequisites criteria and associating files, examples, exercises and complementary materials for each the concept). The storage module receives this structure and stores data in an XML file, which serves as a basis to generate files for the adaptation modules. The content adaptation and adaptive interface modules work together, adapting the content, presentation and navigation through the XML generated and the user model (De Oliveira et al., 2003). Based on user's educational level, AdaptWeb® applies some techniques such as fragment variants to adapt content and direct guidance and link removal, disabling and annotation to adapt navigation. Based on user's working environment, AdaptWeb® adapts content using conditional text technique and, based on user's knowledge, it adapts the navigation using link disabling and annotation techniques. AdaptWeb® has been constantly updated and improved. Recently, the system incorporated a recommender system, learning analytics and gamification techniques, which are some of the trends and future research directions described in the next section.

FUTURE RESEARCH DIRECTIONS

Although it is not a new area, many trends have been explored in recent years. A study conducted by Somyürek (2015) raised some of these trends, divided into seven categories: standardization, semantic web, modular frameworks, data mining, machine learning techniques, social web and device adaptation. Here we describe some of these trends described by (Somyürek 2015) and we identified another: gamification.

Standardization aims to develop a set of interoperable, reusable and accessible resources, besides facilitating the management of them in the educational context. Standardization in AH systems usually occurs at the metadata level, which are ways of describing learning objects and user model to enable the integration with other AH systems (Fischer, 2001). Some metadata standards currently used are: Dublin Core, IMS Learning Resource Metadata and IEEE Learning Object Metadata (LOM).

Data mining is used to construct an understandable structure by means of analyzing large quantities of data, being divided into clustering and classification. Clustering assigns students with similar characteristics in the same group, while classification determines which these characteristics are (e.g., interests, skills, cognitive and learning styles). These data are usually used to recommend learning objects more effectively to each characteristic or even to implement a recommender system (Somyürek, 2015).

Social web has become very popular in recent years since knowledge has become more personal, social, distributed and dynamic by nature. In addition, mobile devices (e.g., laptops, smartphones and tablets) are becoming increasingly available and, therefore, they can be used for educational purposes. Because of that, device adaptation is necessary to provide a better presentation of the content based on the students' devices and, also, on their skills (Somyürek, 2015). In this sense, the work of (Machado & Oliveira, 2014) proposes the adaptation and resource recommendation for students using mobile devices.

Gamification is a new approach that can be used to motivate and engage students with game elements and design in non-game contexts (Deterding et al., 2011). In the educational area, there are many initiatives involving the use of gamification (e.g., (Grant & Betts, 2013), (Ibanezet al., 2014) and (Hanus & Fox, 2015)). Although the theme is new, there are already initiatives in order to unite the AH systems and gamification, as the work of (Klock et al., 2015). This work is in development and aims to perform the adaptation of gamification based on the characteristics of the students, since not all students will be motivated by the same game elements.

CONCLUSION

Adaptive Hypermedia (AH) systems are able to adjust their status in accordance with the users' profile, behavior and context (Gasparini, 2013), building a user model with various information about user characteristics, such as: skills, knowledge, needs, preferences, behavior, way of interaction with the system, etc. AH systems bring a new perspective and they can improve the user interaction with computer systems (Gasparini, 2013), being also an alternative to one-size-fits-all approach and, since they allow different students to use the same form of environment adapted to their profile, being useful in educational area.

Through the adaptation of hypermedia systems, it is possible to know the characteristics of students and facilitate a learning process centered on the user. In this chapter, it was exposed some techniques and methods used for adaptation and identified some of the main characteristics of students considered for such adaptation. Thus, it is possible to visualize the importance of AH systems when we analyze the students' learning difficulties. This area is expanding and it presents various trends such as standardization, data mining, social web, device adaptation and gamification.

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KEY TERMS AND DEFINITIONS

Adaptable Hypermedia System: A hypermedia system that allows the user to customize its preferences in a non-automatic way.

Contextual Links or Real Hypertext Links: Links that can be embedded in the context of the page (e.g., using "hotwords" in texts, "hot spots" in images), but they cannot be removed. They are not easy to manipulate as the local non-contextual links.

Links from Index or Content Pages: Appear on pages that contain only links presented in a fixed order (by alphabetical order for index pages and by content for content pages). These links are usually easy to manipulate, unless the page is implemented as an image.

Links on Local or Global Hyperspace Maps: Appear on maps that represent a local area or even an entire hyperspace as a network of nodes connected by arrows. Using these maps, users can directly navigate to all visible nodes just by clicking on the representation of the desired node.

Local Non-Contextual Links: Are links independent from the content, being easy to manipulate and appearing as a set of buttons, links or a pop-up menu.

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Chapter 19
Group Synchronization for Multimedia Systems

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ABSTRACT

Group or inter-destination media synchronization (IDMS) addresses the presentation of a stream at all the receivers of a group, simultaneously. To ensure synchronized delivery of multimedia information, intelligent synchronization protocols/techniques are required. This chapter illustrates various issues on intra- and inter-media synchronization and presents the basic schemes for inter-destination media synchronization (IDMS). It presents in short IDMS standardization efforts and novel solutions for new multimedia applications. Finally, it outlines future research directions for multimedia group synchronization.

INTRODUCTION

An important feature of multimedia applications is the integration of multiple media streams that have to be presented in a synchronized fashion (Li *et al.*, 1997). Synchronization is mainly the preservation of the temporal constraints within and among multimedia data streams at the time of playout. Temporal relations define the temporal dependencies between media objects (Blakowski & Steinmetz, 1996). An example of a temporal relation is the relation between a video and an audio object that are recorded during a concert. If these objects are presented, the temporal relation during the presentations of the two media objects must correspond to the temporal relation at the time of recording. Discrete media like text, graphics, and images are time-independent media objects, while the semantic of their respective content does not depend upon a presentation to the time domain. A discrete media object is frequently presented using one presentation unit. On the contrary, a time-dependent media object is presented as a media stream. In a continuous media stream (e.g. video), the presentation durations of all units of a time-dependent media object are equal (Li *et al.*, 1997). For example, a video consists of a number of ordered frames. Each of these frames has fixed presentation duration.

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Most of the components of a multimedia system support and address temporal synchronization. These components include the operating system, communication subsystem, databases, documents and even applications. In distributed multimedia systems, networks introduce random delays in the delivery of multimedia information, and there are four sources of asynchrony that can disrupt synchronization (Akyildiz & Yen, 1996):

- Delay Jitter and Local Clock Drift.
- Different Initial Collection Times. Let us consider two media sources, one providing voice and the other video. If these sources start to collect their media units (MUs) at different times, the playback of the MUs of voice and video from the two sources at the receiver loses semantic meaning.
- Different Initial Playback Times. If the initial playback times are different for each user, then asynchrony will arise.

To ensure synchronized delivery of multimedia information, intelligent synchronization protocols/techniques are required. This article illustrates various issues on intra- and inter-media synchronization and presents the basic schemes for inter-destination media synchronization (IDMS). It presents IDMS standardization efforts and novel solutions for new multimedia applications. Finally, it outlines future research directions for IDMS.

BACKGROUND

Intra-Media Synchronization

Intra-media synchronization refers to the time relations between the presentation units of one time-dependent media object. An example is the time relations between the single frames of a video sequence. The spacing between subsequent frames is dictated by the frame production rate. Jitter may destroy the temporal relationships between periodically transmitted MUs that constitute a real-time media stream, thus hindering the comprehension of the stream. *Playout adaptation algorithms* undertake the labor of the temporal reconstruction of the stream, which is referred to as the *restoration of its intra-stream synchronization quality* (Park & Choi, 1996). *Adaptive media playout* (AMP) improves the media synchronization quality of streaming applications by regulating the playout time interval among MUs at a receiver. To mitigate the effect of the jitter, MUs have to be delayed at the receiver in order a continuous synchronized presentation can be guaranteed. Therefore, MUs have to be stored in a buffer and the size of this buffer will correspond to the amount of jitter in the network. As the synchronization requirements can vary according to the multimedia application on hand, we must control the individual synchronization (delay sensitivity, error tolerance etc.) for each media separately. To this direction, Park and Choi (1996) investigated an efficient multimedia synchronization method that can be applied at intra-media synchronization in a consistent manner. They proposed an adaptive synchronization scheme, based on the delay offset and playout rate adjustment that can match the application's varying synchronization requirements effectively. Park and Kim (2008) introduced an AMP scheme based on a discontinuity model for intra-media synchronization of video applications over the best-effort networks. They analyzed the temporal distortion (i.e., discontinuity) cases, such as playout pause and skip, to define a unified discontinuity model. Finally, Laoutaris and Stavrakakis (2002) surveyed the work in the area of playout adaptation.

Inter-Media Synchronization

Inter-media synchronization refers to the synchronization between media objects of a multimedia object. An example of inter-media synchronization is the *Lip Synchronization* that refers to the temporal relationship between an audio and video stream for the particular case of human speaking (Aggarwal & Jindal, 2008). There are many systematic specification methods to describe synchronization problems. Blakowski and Steinmetz (1996) illustrated the main synchronization specification methods: interval-based specifications, control flow-based specification, axes-based synchronization, event-based synchronization, scripts, and comments. A *Synchronization Specification* of a multimedia object can describe all temporal dependencies of the included objects in a multimedia object. It is comprised of:

- Intra-object synchronization specifications for the media objects of the presentation.
- Quality of Service (QoS) descriptions for intra-object synchronization.
- Inter-object synchronization specifications for media objects of the presentation.
- QoS descriptions for inter-object synchronization.

To achieve inter-media synchronization various algorithms have been applied. There are several types of synchronization control such as *Skipping* (Ishibashi et al., 2002a), *Buffering* (Ishibashi et al., 2002a), *Adaptive Buffer Control* (ABC) (Wongwirat & Ohara, 2006), *Queue Monitoring* (QM) (Hikichi et al., 2002), *Virtual-Time Rendering* (VTR) (Ishibashi et al., 2002b), and *media adaptive buffering* (Isomura et al., 2011). Boronat *et al*. (2009) have reviewed the most powerful inter-media synchronization algorithms. The building blocks of these algorithms are the synchronization techniques utilized both at the sender and receiver sides. These algorithms can use multiple of synchronization techniques to achieve the synchronization mechanism even from different categories (Din & Bulterman, 2012).

Classification of Inter-Media Techniques

Synchronization techniques can be categorized according to the '*location'*, '*purpose'*, '*content'*, and '*information* used' (Boronat *et al*., 2009).

- **Location of Synchronization Technique:** The synchronization control can be performed either by source or receiver. If control is performed by the source, most of the time it will require some feedback information from the receiver. The receiver will tell the source about the degree of asynchrony at the current instance.
- **Live vs. Synthetic Synchronization (Type of Media):** In *live* media, the temporal relations are exactly reproduced at a presentation, as they existed during the capture process. Synthetic synchronization techniques are used for *stored* media.
- **Information Used for Synchronization Technique:** The information included in the MU can be different like timestamp, sequence number. Some techniques use either sequence number or timestamp, while others may use both.
- **Purpose of Synchronization Technique:** The techniques can be divided into four subcategories with respect to its purpose:

- The basic control techniques, which are required in almost all the algorithms. Examples are the attachment of synchronization information in MUs at source and buffering of MUs at receiver.
- The common control techniques, which can be applied in both ways.
- The preventive control techniques, which are used to prevent the asynchrony in the streams.
- The reactive control (or corrective) techniques are designed to recover synchronization in the presence of synchronization errors.

Table 1 shows a classification of inter-media techniques, based on the above criteria.

MAIN FOCUS OF THE ARTICLE

Group or *inter-destination media synchronization* (IDMS) addresses the presentation of a stream at all the receivers of a group, simultaneously. For example, in real-time distance learning, tutor multicasts a multimedia lesson to a group of students located at different areas. The levels of required synchrony among the receivers depend on the application on hand. Akyildiz and Yen (1996) introduced group synchronization protocols for real-time, multimedia applications, including teleconference and multi-

Table 1. Classification of inter-media techniques

Technique	Location	Description
Basic Control	Source control	• Add information useful for synchronization: timestamps, sequence numbers (identifiers), event information and/or source identifiers.
	Receiver control	• Buffering techniques
Common Control	Source control	• Skip or pause MUs in the transmission process. • Advance the transmission timing dynamically. • Adjust the input rate. • Media Scaling.
	Receiver control	• Adjust the playout rate. • Data interpolation.
Preventive Control	Source control	• Initial playout instant calculation. • Deadline-based transmission scheduling. • Interleave MUs of different media streams in only one transport stream.
	Receiver control	• Preventive skips of MUs (e.g. discardings) and/or preventive pauses of MUs (repetitions, insertions or stops). • Change the buffering waiting time of the MUs. • Enlarge or shorten the silence periods of the streams.
Reactive Control	Source control	• Adjust the transmission timing. • Decrease the media streams transmitted. • Drop low-priority MUs.
	Receiver control	• Reactive skips (eliminations or discardings) and/or reactive pauses (repetitions, insertions or stops). • Make playout duration extensions or reductions (playout rate adjustments). • Use of a virtual time with contractions or expansions. • Master/slave scheme • Late event discarding (Event-based). • Rollback techniques (Event-based)

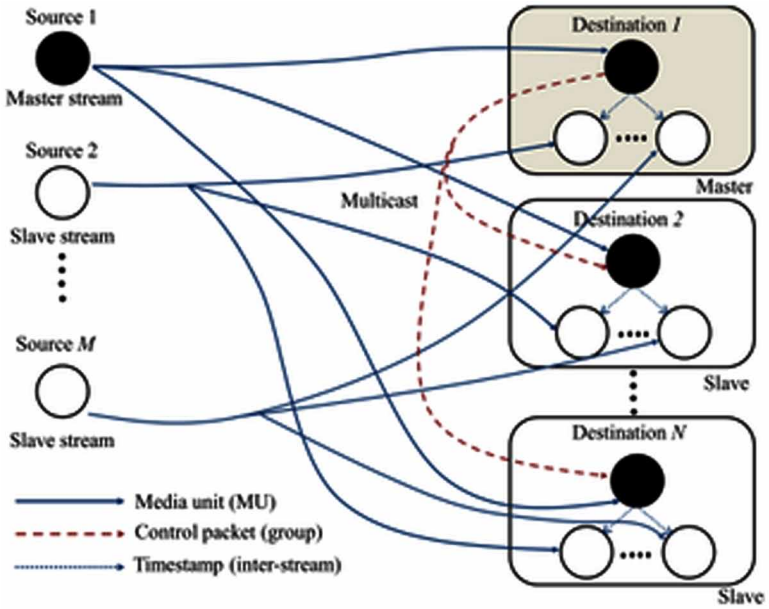
media on demand services. Their protocols achieve synchronization for all configurations (one-to-one, one-to-many, many-to-one, and many-to-many), and do so without prior knowledge of the end-to-end delay distribution, or the distribution of the clock drift. The only a-priori knowledge the protocols require is an upper bound on the end-to-end delay. Recently, Boronat *et al.* (2009) reviewed the most popular multimedia group and inter-stream synchronization approaches. Group synchronization techniques can be classified at three schemes. These schemes are based on the *Virtual-Time Rendering (VTR) media synchronization algorithm* to determine the output timing of each MU, so that the timing can be the same at all the destinations. For better understanding of these schemes, consider that *M* sources and *N* destinations/receivers are connected through a network. MUs of *M* different streams have been stored with timestamps in *M* sources, and they are broadcasted to all the receivers. The timestamp contained in a MU indicates its generation time. The streams fall into a master stream and slave streams. At each receiver, for inter-media synchronization, the slave streams are synchronized with the master stream by using an inter-media synchronization mechanism.

Master/Slave Receiver Scheme (MSRS)

In MSRS (Ishibashi *et al.*, 1997), the receivers are categorized into one Master receiver and Slave receivers. Multiple streams are received at each receiver and one of these streams acts as master stream in order inter-media synchronization to be achieved at each receiver (Figure 1).

None of the slave receivers send any feedback information about the timing of the playout processes. It adjusts the playout timing of MUs to that of the master receiver. Only the master receiver sends (multicasts) its playout timing to all the other (slave) receivers. The master receiver controls and computes the presentation time of the MUs according to its own state of the received stream data. Group synchroniza-

Figure 1. Master/slave receiver scheme
Sithu and Ishibashi, 2015.



tion is achieved by adjusting the presentation time of the MUs of master stream at the slave receivers to that of the master receiver. Therefore, the slave receivers should present MUs at the same timing as the master receiver. The synchronization of the slave receivers is achieved as follows:

- The master receiver multicasts a control packet to all slave receivers. This control packet includes the presentation time of its first MU of master stream. This process is called "initial presentation adjustment".
- When the target presentation time of the master receiver changes, the master receiver notifies all the slaves about this modification by multicasting a control packet. This control packet contains the amount of time that is modified and the sequence number of the MU for which the target presentation time has been changed.
- The master receiver periodically multicasts proper control packets to accommodate the newly joined slave receivers.

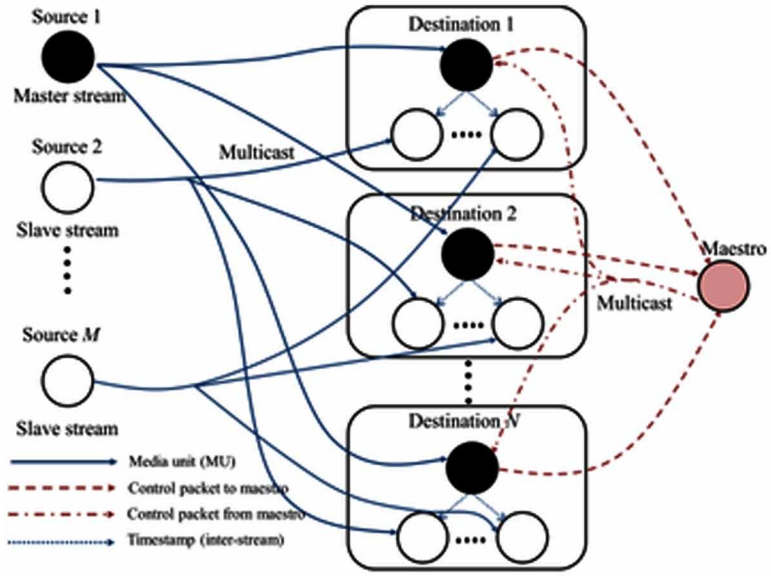
Boronat *et al.* (2008) presented MSRS by extending the RTP/RTCP (Real-time Transport Protocol/ RTP Control Protocol) messages for containing the synchronization information. Figure 1 presents the different type of message exchanges in the basic MSRS. The advantage of the MSRS technique is its simplicity and decreased amount of information exchange (i.e. control packets) to support group synchronization. However, the selection of the master receiver can influence the performance of the scheme. If the faster receiver is selected as the master receiver, it can cause the *Buffer underflow* in the (slower) slave receivers, which can result as the poor presentation quality at slow receivers. On the contrary, if the slowest receiver is selected as master, it can cause *Buffer overflow* on fast slave receiver(s). This will result as high packet drops at faster slave receiver(s). A problem with the MSRS technique is that the master can act as a bottleneck in the system. A second problem deals with the associated degree of unfairness with the slave receivers. Boronat *et al.* (2011) discussed possible options with pros and cons for the master selection in this scheme.

Synchronization Maestro Scheme (SMS)

In SMS scheme, all the receivers are handled fairly as there are not master and slaves (Ishibashi & Tasaka 1997). SMS involves a *Synchronization Manager* (SM), which can be performed by one of the source or receiver. For example, in Figure 2, one receiver/destination performs the SM.

Each receiver estimates the network delay and uses the estimates to determine the local presentation time of the MU. Then, each receiver sends this estimated presentation time of MU to the SM. After that, the SM gathers the estimates from the receivers, and adjusts the presentation timing among the receivers by multicasting control packets to receivers. The SMS scheme assumes that clock speed at the sources and receivers is the same, and that the current local times are also the same (i.e., globally synchronized clocks). Figure 2 depicts the basic principle of the SMS technique. Boronat *et al.* (2009) presented the RTCP based schemes, which follow the same basic principle. The SMS scheme (like the MSRS) is a centralized solution, and thus it can confront the bottleneck problem. The advantage of the SMS scheme over MSRS is its fairness to the receivers, as the feedback information of all the receivers is accounted for determining the presentation time of the MU. However, this fairness costs more communication overhead among the receiver and the synchronization manager.

Figure 2. Synchronization maestro scheme
Sithu and Ishibashi, 2015.



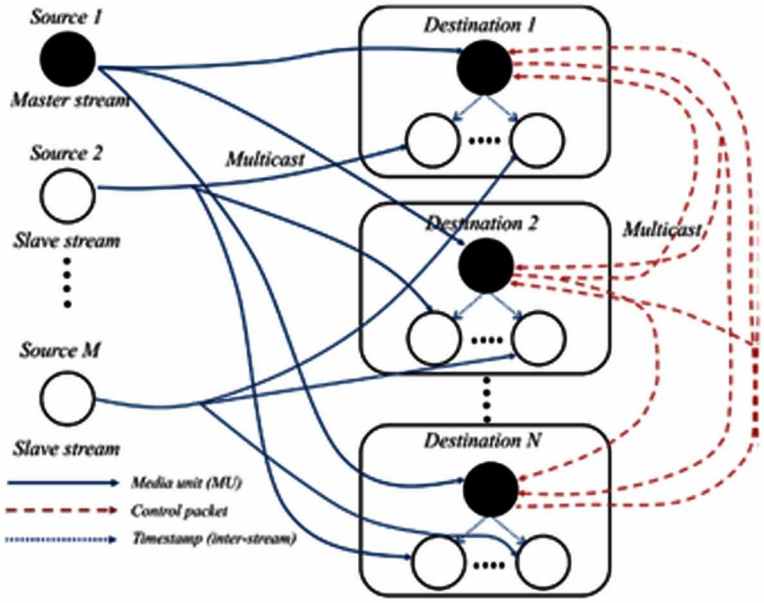
Distributed Control Scheme (DCS)

Figure 3 illustrates the DCS scheme (Mauve *et al*., 2004). Each receiver estimates the network delay, and then determines the presentation time of the MU. Then, it sends (multicasts) this presentation time to all the receivers. After that, every receiver will have the entire view of the estimated time of MU. Each receiver has the flexibility to decide the reference play out time among the timing of all the receivers. The DCS scheme provides higher flexibility to each receiver to decide the presentation time of MU. For example, it is possible that by selecting the presentation time of other receiver, it can achieve higher group synchronization quality, but it may cause the inter-media or intra-media synchronization degradation. In this case, the receiver has the flexibility to choose between the types of synchronization depending upon the nature of application on hand. If the application on hand requires the higher inter-media or intra-media synchronization and can sacrifice on the group synchronization to certain limit, then receiver can select its own determined presentation time and vice versa. DCS is a distributed scheme by nature and does not suffer from the bottleneck problem. If one or more receivers leave the system, it will not disturb the overall scheme. This greater flexibility and the distributed nature of DCS make it complex in terms of processing. This happens because the receiver does more calculations and comparisons before deciding the presentation time of MU. Finally, DCS has higher message complexity, as each receiver multicasts the estimated presentation time.

SOLUTIONS AND RECOMMENDATIONS

Standardization of IDMS has been carried out within ETSI (European Telecommunications Standards Institute) TISPAN (Telecoms & Internet converged Services & Protocols for Advanced Networking). In

Figure 3. Distributed control scheme
Sithu and Ishibashi, 2015.



addition, such standardization is a highlight for the IETF AVTCORE WG (Internet Engineering Task Force - Audio/Video Transport Core Maintenance Working Group). The specification (ETSI, 2009) does pose IDMS and the synchronization of media streams from different sources as a requirement for providing synchronization-sensitive interactive services. These use cases are mostly in the categories of low or medium synchronization, and not very high requirements are posed to delay differences between various user equipments. The protocol specification gives a delay difference of between 150 and 400 ms as a guideline for achieving transparent interactivity, based on ITU guidelines for interactivity in person-to-person communication. ETSI TISPAN has done the first work on standardizing RTCP usage for IDMS. The ETSI proposal is a dedicated solution for use in large-scale IPTV deployments, with low to medium level synchronization requirements. Other services such as Internet-based video services may also benefit from IDMS, and other use cases require higher levels of synchronization, and are not supported by the ETSI solution (Montagud et al., 2012). Within the Internet Engineering Task Force (IETF), the AVTCORE working group (Brandenburg et al., 2012) carries out standardization of the RTCP-based IDMS protocol. This is the core group that is responsible for the RTP and accompanying RTCP protocol. Most RTCP extensions are developed within the IETF. Boronat *et al.* (2009) described most IDMS solutions that define new proprietary protocols, with specific control messages, that should increase the network load. Montagud *et al.* (2012) presented up to 19 use cases for IDMS, each one having its own synchronization requirements.

Presentation adaptation and flow control is a feasible solution to achieve a smooth multiple-stream distributed multimedia presentation. Huang et al. (2001) proposed the *Pause-And-Run* approach for *k*-stream (PARK) multimedia presentations over Internet to achieve reliable transmission of continuous media. They evaluated the application of the PARK approach over the Internet. The evaluation results

revealed a suitable buffering control policy for the audio and video media, respectively. The characteristics of the PARK approach are:

- PARK adopts TCP to achieve reliable transmission for continuous media.
- A novel flow adaptation scheme is proposed to reduce the overhead of the network and end-hosts as the slow-start scheme is embedded in TCP. The server adapts its transmission rates to the buffer situation of the client and prevents the client's buffers from overflow and underflow as much as possible.
- With the provision of multiple-stream synchronization and the multi-level adaptation control, the client achieves smooth multimedia presentations and graceful presentation degradation.

Realization of *Synchronous shared experiences* requires that users feel that they are *coherently* communicating with each other. Vaishnavi *et al.* (2011) analyzed challenges that need to be tackled to achieve coherence: *Quality of service, mobility* and *distributed media synchronization*. They presented their solution to distributed media synchronization. Their design uses the local lag mechanism over a distributed control or master–slave signaling architecture. Montagud and Boronat (2012) presented an evolved version of an RTCP-based IDMS approach, including an AMP scheme that adjusts the play-out timing of each one of the geographically distributed consumers in a specific cluster, if an allowable asynchrony threshold between their play-out states is exceeded. Montagud et al. (2014) presented an IDMS solution based on extending the capabilities of RTP/RTCP protocols. To enable an adaptive, highly accurate and standard compliant IDMS solution, they specified RTCP extensions, in combination with several control algorithms and adjustment techniques. Montagud et al. (2015) reviewed the existing sync reference models by examining the involved features, components and layers in each one of them. Their study reflects the need for a new modular and extensible theoretical framework to efficiently comprehend the overall media sync research area. Belda et al. (2015) presented *Wersync*, a web-based platform that enables distributed media synchronization and social interaction across remote users. Costa and Santos (2014) surveyed the existing media sync solutions focused on the TV area, classifying them in terms of: types of involved devices, types of media content, types of sync techniques, targeted applications or scenarios, and evaluation methodologies.

Ishibashi *et al.* (2014) carried out QoE (Quality of Experience) assessment of fairness between players in a networked game with olfaction. They investigated the influence of the time it takes for a smell to reach a player on the fairness. They illustrated that the fairness is hardly damaged when the constant delays are smaller than about 500 ms. The used media synchronization algorithm considers the human perception of intra-stream and inter-stream synchronization errors. Ghinea and Ademoye (2010) conducted a perceptual measurement of the impact of a synchronization error between smell sensory data and audiovisual content, assuming the audiovisual lip skew is zero. Their results show a synchronization threshold of 30 s, when olfaction is ahead of audiovisual data, and of 20 s when olfaction is behind.

In *joint musical performance*, multiple users play their respective same or different types of musical instruments together, but the media synchronization quality and interactivity may seriously be deteriorated owing to the network delay. Sithu and Ishibashi (2015) proposed a new media synchronization control called the '*dynamic local lag control'*. By QoE assessment, they demonstrated that the new control can achieve high quality of media synchronization and keep the interactivity high.

Huang et al. (2013) have presented a historical view of temporal synchronization studies focusing on continuous multimedia. They demonstrated how the development of multimedia systems has created new challenges for synchronization technologies. They concluded with a new application-dependent, multi-location, multi-requirement synchronization framework to address these new challenges.

FUTURE RESEARCH DIRECTIONS

Group synchronization techniques could benefit from the cross-layer optimization. Cross-layer optimization allows communication between OSI RM layers by permitting one layer to access the data of another layer to exchange information and enable interaction (Bin-Salem & Wan, 2012). It contributes to an improvement of quality of services under various operational conditions. The cross-layer control mechanism provides a feedback on concurrent quality information for the adaptive setting of control parameters of a multimedia system. Thus, it can help to the utilization of synchronization techniques (e.g. preventive control techniques). Soon, researchers will develop more comprehensive multimedia synchronization sub-systems that will integrate preventive and reactive methods and will take into account the cross layer optimization and other components (the operating system, communication subsystem, databases, documents and applications). Such systems must be able not only to achieve intra- and inter-media synchronization, but also the IDMS to a diversity of new multimedia applications.

In RTP-based multimedia streaming services, client-driven media synchronization mechanisms must be developed to provide accurate media synchronization such as to reduce: the initial synchronization delay, the processing complexity at the client device, the number of required user datagram protocol ports, and the amount of control traffic injected into the network. Such a synchronization mechanism was recently proposed by Jung and Seo (2016). In their method, the server does not need to send any RTCP SR packets for synchronization. Instead, the client device derives the precise normal play time for each video and audio stream from the received RTP packets containing an RTP timestamp.

CONCLUSION

This article has illustrated various issues on intra and inter-media synchronization. It has presented basic schemes of IDMS and has mentioned IDMS standardization efforts and novel solutions for new multimedia applications. Also, it has outlined future research directions on IDMS. Certainly, standardization of IDMS will facilitate the uptake of implementations and of the interoperability between different implementations, ensuring a more extensive use of IDMS. Interactive 3D tele-immersive applications are future applications that can provide geographically distributed users with a realistic and immersive multimedia experience. Such applications can lead to new requirements for synchronization, and thus novel multidimensional synchronization models for next-generation multimedia environments must be proposed. There is also a strong demand to describe the impact of future application heterogeneity on human synchronization perception.

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KEY TERMS AND DEFINITIONS

Delay Jitter: The variation of end-to-end delay; an inherent characteristic of best-effort networks.

Preventive Control Techniques: They used to prevent the asynchrony in the media streams. They minimize latencies and jitters and involve disk-reading scheduling algorithms, network transport protocols, operating systems, and synchronization schedulers.

Quality of Experience (QoE): A measure of a customer's experiences with a service (e.g. IPTV).

Reactive Control Techniques: These techniques are designed to recover synchronization in the presence of synchronization errors.

Scripts: A synchronization specification method that describes synchronization scenarios in multimedia objects.

Synchronous Shared Experiences: New social multimedia applications and services wherein groups of users in different locations can watch multimedia content, while synchronously communicating with each other.

Synthetic Synchronization: Such synchronization is used in presentation and retrieval-based systems with stored data objects that are arranged to provide new multimedia objects. The temporal relations have been artificially assigned to media that were created independently of each other.

Virtual-Time Rendering (VTR) Algorithm: A popular intra- and inter-stream synchronization algorithm applicable to networks with unknown delay bounds. It makes use of globally synchronized clocks, and consists of the dynamic adjustment of the MUs rendering-time, according to the network condition.

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Chapter 20
Metadata Standards in Digital Audio

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ABSTRACT

Audio metadata is an essential tool that supports control and management of systems that create, transmit, describe, manage, and store digital audio. Technical and structural metadata enable audio in devices and software applications; descriptive metadata provide context. Metadata also relate and incorporate audio in a multimedia environment resulting in profound effects on conception, reception, and consumption. This chapter explores metadata standards in digital audio.

INTRODUCTION

Audio metadata are an essential tool that supports control and management of systems that create, transmit, describe, manage, and store digital audio. Throughout the lifecycle of digital audio objects—pre-production, acquisition and production, post-production, distribution, storage, transmission, and archiving—metadata "describe the attributes of a resource, characterize resource relationships, and support resource discovery, management, and effective use" (Vellucci, 1999). Technical and structural metadata enable audio in devices and software applications; descriptive metadata provide context. Metadata also relate and incorporate audio in a multimedia environment resulting in profound effects on conception, reception, and consumption.

Issues of audio metadata are intertwined with audio equipment, music production, and information technology. Holmes (2006) gives a broad overview of the technology; Gilmer (2004) provides the background for usage in multimedia production; Lu & Hanjalic (2009) and Kriechbaum (2009) detail the technical aspects in database systems; Casey & Gordon (2007) offer the information professional perspective. International audio metadata standards are chiefly issued by the European Broadcasting Union (EBU), the Society of Motion Picture and Television Engineers (SMPTE), and the Audio Engineering Society (AES). Guidelines for usage and implementation are routinely published by these three organizations, as well as by manufacturers, libraries, and archives.

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BACKGROUND

Analog sound recording technologies had been in use for over a century when the Compact Disc Digital Audio (CD-DA) technology emerged in the late 1970s following breakthroughs in signal processing and the optical medium. Audio continued to be produced in a mixture of analog and digital systems consisting of single-purpose devices designed for recording and producing audio to be transmitted in either analog or digital form. The production system was largely determined by the transmission medium—wire, wax cylinder, shellac disc, vinyl disc, magnetic tape, broadcast, optical disc—each requiring an assortment of specialty equipment, typically supplied by a single manufacturer. In such vertically integrated systems, controls and switches that supplied parameters and characteristics (metadata) to the audio were generally integrated in the hardware. Where metadata were specified and shared, the necessity for interoperability was limited to the devices immediately before and after in the production chain.

As digital signal processing technologies evolved, the proliferation of recording formats, compression methods, and media formats made it no longer sensible to build a separate integrated system for each device combination. In such a mixed production environment, devices need to be able to pass along and recognize standardized metadata throughout the production process. For several decades since the 1970s, the broadcast industry attempted to standardize metadata within device categories to allow for interchangeable equipment for each step of the production. But demands for higher flexibility and broader scope mounted as increasing prevalence of computer software and data networks shifted production workflow and transmission toward a distributed model. The industry was compelled to re-conceive use of metadata in not only audio, but also video production in a digital environment where data and content would be stored and transmitted in the form of computer files. These files, ideally, would encapsulate all necessary metadata, interoperable through the production chain, regardless of media format or equipment.

EBU and SMPTE established the Task Force for Harmonized Standards for the Exchange of Program Material as Bit Streams in 1995 to study the long-term interoperability and stability of production systems. In its 1997 report, the Task Force elevated metadata to be equal in significance to the signals, casting the formulas "Content = Essence + Metadata" and "Asset = Content + Rights." (Essence includes video, audio, and data; metadata represents information about the essence, including rights.) And, among other technical details, the Task Force, anticipating the need to store and transmit digital multimedia as computer files, specified the generalized file format, or "wrapper." This format consists of three parts—the preamble, consisting solely of metadata, the body, containing the essence and additional metadata, and the end-of-file marker. The wrapper provided the means to link metadata and essence logically and physically. This structure allowed audio files to contain an ever-increasing variety of metadata. SMPTE published the Metadata Element Dictionary Structure (SMPTE 335:2012) and established the SMPTE Registration Authority (2010), a public metadata registry, to serve as a basis and the administrative body for the development of future metadata standards. Open standards will guide the development of audio and multimedia metadata standards to handle increasingly complex and horizontal system design. Global adoption of well-defined international standards will facilitate data exchange and re-use, as well as guarantee long-term preservation and combat format obsolescence.

Efforts to standardize audio metadata also dramatically shaped the consumer experience and conception of audio. With analog audio, consumers' ability to produce and manipulate audio was limited to using audiocassette systems. As the Sony Corporation introduced the Walkman, a portable cassette player, in 1979, listening became personalized. Later, personal portable players were extended to the Compact Disc medium, even though recording devices did not reach consumers until much later. With

the advent of storing and transmitting audio as computer files, however, audio consumption was no long tied to specific media or carriers. Personal computers allowed manipulation of audio and the associated metadata, and distribution of audio files over data networks. Widespread integration between personal computers, data networks, and personal portable players spurred consumer demands for describing and organizing digital audio. Descriptive metadata standards evolved and expanded in scope alongside techniques to generate audio semantics and analyze consumer preferences and behaviors, resulting in the ability to create personalized and customizable audio collections.

EMBEDDED METADATA IN DIGITAL AUDIO FILE FORMATS

Pulse-Code Modulation

Pulse-code modulation (PCM) is a method of representing analog signals in digital binaries. It was first developed in 1937 by British engineer Alec H. Reeves for audio transmissions over telegraph. Reeves was granted patents in France in 1938, in Britain in 1939, and in the United States in 1942, but lacked the equipment to produce the digital audio efficiently (Deloraine & Reeves, 1965; Robertson, 2005). The digital coding of analog signals is accomplished in three steps. Sound signals are sampled at specific time intervals (8,000 times per second for typical telephone speech; 44,100 for Compact Disc Digital Audio; up to 96,000 and beyond for high quality recordings). Then, the sampled signals are assigned values, or quantized. Finally, each of these values is represented in binary code. The uncompressed digital audio is called Linear PCM (LPCM), while compressed variants are variously called μ-law, A-law, differential PCM, adaptive differential PCM, etc., depending on technique and application. Today, with the widespread use of semiconductor equipment, PCM serves as the basis for virtually all forms of digital communications.

Compact Disc Digital Audio

Compact Disc Digital Audio is the standard format for audio on compact discs first released in 1980 by Koninklijke Philips and Sony in a publication commonly known as the Red Book. The Red Book specifies the maximum duration of a disc (79.8 minutes), tracks per disc (99), and index points per track (99), the minimum duration of a track (4 seconds), the use of the International Standard Recording Code (ISRC) (ISO 3901), and the audio format (2 channels of 16-bit LPCM sampled at 44.1 Hz). The Red Book standard was codified in 1987 in the International Electrotechnical Commission publication IEC 60908, and its second edition was published in 1999.

Several extensions to the Red Book specification have been introduced. CD-Text, introduced by Sony in 1996 as part of its Multimedia Command Set, provides the ability to store 4 megabytes of textual information about the audio contents such as album title, track title, and authors in the Interactive Text Transmission System (IEC 61866), which is also used for MiniDiscs and digital radio broadcasting. CD-Text has been widely adopted, and CD-Text metadata have been harvested and made available via online databases such as Gracenote (formerly Compact Disc Database, or CDDB) and freedb.

Compact Disc + Graphics (CD+G) was introduced by Philips and Sony in 1985 for storing low-resolution graphics for on-screen display during audio playback. This is an early specification involving storing images as metadata. CD+G and its later revision, Compact Disc + Extended Graphics (CD-EG)

are chiefly used for interactive audio playback such as karaoke, but, while part of the Red Book standard, they are otherwise not widely adopted.

Interchange File Format

The Interchange File Format (IFF) (EA IFF 85), developed by Electronic Arts, was originally introduced in 1985 for graphic files in Commodore-Amiga systems, but it is a generic file format that can be used for a variety of media types, including audio. The IFF file consists of a sequence of chunks. Each chunk includes an area that declares the chunk, followed by an area that specifies size, and then the area for the data (known as Key-Length-Value encoding, or KLV), which may include other nested sub-chunks. The concepts of chunks, as well as the requirement for each chunk to provide metadata to self-identify and self-describe, lay the foundation for the basic audio file formats, including Audio Interchange File Format, developed by Apple Computer, and the Resource Interchange File Format, developed by the Microsoft Corporation and the International Business Machines Corporation (IBM), on which their Waveform Audio File Format is based.

Audio Interchange File Format

The Audio Interchange File Format (AIFF) is an audio application of IFF developed in 1988 by Apple. AIFF originally supported only uncompressed PCM audio; support for compressed audio was added in its 1991 revision, AIFF-C. Metadata elements specified in AIFF are listed in Table 1. AIFF requires technical metadata (Common Chunk) and the audio (Sound Data Chunk), while AIFF-C requires an additional version number (Format Version Chunk). Other optional chunks include additional technical and descriptive metadata designed to provide machine-actionable capability (such as looping), user- and application-interactive features (such as commenting), and extensibility. The concept of time-stamped comments pegged to specific points in the audio data is widely applied today for versioning, subtitling, user tagging, and provenance tracking. Extensibility provided by the Application Specific Chunk allows applications to create custom metadata and incorporate external metadata for storing state parameters such as date last played, last stop position, and user ratings, additional descriptive metadata such as ID3 tags, as well as other binary files such as album cover art—all popular features of audio file management software today.

Resource Interchange File Format

The Resource Interchange File Format (RIFF) was introduced in 1991 by Microsoft and IBM. The format is identical to IFF except for the labeling of chunk names and endianness, the ordering of bytes within computer memory, which are opposite in the processors used in Apple and IBM computers. Microsoft, which develops software on IBM computers, has implemented several file formats based on RIFF, including the WAV, also introduced in 1991.

Waveform Audio File Format

Metadata elements specified in WAV are listed in Table 2. The functionalities offered by WAV are similar to those offered by AIFF/AIFF-C, and also allow custom-defined chunks to be included in the

Table 1. Metadata elements specified in AIFF

Chunk (All Optional Unless Marked)	Comment
Format Version (AIFF-C only, required)	The version of the AIFF-C format.
Common (required)	Technical metadata: number of channels, number of sample frames, bits per sample, and sample rate. Compression type code and a human-readable compression type name were added to AIFF-C.
Instrument	Defines the basic parameters of the playback sound sampler, i.e. the "instrument" as well as looping of audio data segments.
Saxel (AIFF-C draft only)	Sound accelerator data for eliminating decompression artifacts when playback begins at a point other than the beginning of the audio data. This chunk was not officially adopted.
Comments	Free text that can be time-stamped and linked to a marker.
Marker	A marker points to a position in the audio data. It can be used by the Instrument Chunk, the Comments Chunk, or any other element in the Application Chunk.
Sound Data (required)	The audio data. Uncompressed LPCM in AIFF; in AIFF-C, the audio data can be compressed as defined in the Common Chunk.
Name	The name given to the audio.
Author	The creator of the audio.
Copyright	The copyright statement for the audio.
Annotation(s)	Free text, but using the Comments Chunk is preferred.
Audio Recording	Information that identifies the recording device (according to AES3: AES standard for digital audio - Digital input-output interfacing - Serial transmission format for two-channel linearly-represented digital audio data, section 7.1, channel status data).
MIDI Data (s)	Additional metadata included in the MIDI specification but not in the AIFF / AIFF-C.
Application Specific	Custom chunks created for any purpose by device or software application manufacturers.

file. The latest addition to the WAV format, Wave Format Extensible, supports multichannel audio with additional technical data.

Broadcast Wave Format

The Broadcast Wave Format (BWF) is an extension of the WAV format. The BWF specification was first published by EBU in 1997 (EBU Tech 3285) as Version 0. Its Version 1, published in 2000, added support for the Unique Material Identifier in the SMPTE 330 standard, and was followed by 6 supplemental updates listed in Table 3, all of which were subsequently incorporated into the latest Version 2, published in 2011. BWF gained worldwide acceptance and has been incorporated into other file specifications such as MXF, AES57, and EBUCore/AES60. BWF restricts the audio coding to uncompressed LPCM and compressed MPEG and specifies an additional Broadcast Audio Extension Chunk (BEXT). The additional metadata facilitate exchange of audio files between computer platforms and applications, documentation of processing activities, as well as synchronization with other audio files. Table 4 lists BEXT metadata fields in BWF Version 2. Supplements of BWF specify additional metadata chunks for

Table 2. Metadata elements specified in the WAV format

Chunk (All Optional Unless Marked)	Description
Format (required)	Specifies the format, and technical metadata: number of channels, sampling rate, average sampling rate, and data block size.
Fact	Specifies the length of the audio.
Cue Points	Identifies a series of positions in the audio.
Playlist	Specifies the play order of a series of cue points.
Associated data list	Provides Label (title) and Note sub-chunks to be associated with a cue point; defines a Text with Data Length Information sub-chunk that associates a segment of the audio chunk with free text, purpose, country, language, and dialect.
Wave data	The audio data. Uncompressed LPCM or compressed as defined in the Format Chunk.
File	Contains data or metadata described in other file formats.
Instrument (added in the 1994 update)	Defines the basic parameters of the playback sound sampler, i.e. the "instrument"
Sample (added in the 1994 update)	Metadata for sampling keyboards to recognize the WAV audio as an instrument.

various applications. BWF has been extended to incorporate multichannel (MBWF) support of Wave Format Extensible. EBU also introduced RF64, which extended the definition of RIFF to support file size exceeding 4 gigabytes. The latest update in 2009 incorporates MBWF in R64 (EBU Tech 3306).

Other Digital Audio File Formats

Formats that have been developed for more specialized use and narrower functionalities include Sun Microcomputer's AU format, Computerized Speech Labs's NSP format, Entropic Research Laboratories's ESPS and HTK formats, INRS Telecom's file format, IRCAM's Soundfile format, and AT&T Bell Laboratories's SPPACK format (Kabal, 2011).

Table 3. Supplements to BWF version 1

Supplement	Description
MPEG Audio	Specifies the additional technical metadata necessary to describe MPEG audio.
Capturing Report	Specifies additional information for the full transmission history of the analog-to-digital conversion and digital transfers, in order to safeguard the original quality of the audio.
Peak Envelope	Specifies additional information about peak audio signal levels in the file, in order to speed up opening, display, and processing.
Link	Provides a mechanism to link multiple BWF files for seamless output. Metadata is expressed in XML.
AXML	Formally defines the use of XML metadata in this BWF chunk.
Dolby	Specifies additional information associated with Dolby technologies, such as Dolby E, Digital and Dolby Digital Plus.

Table 4. BEXT metadata fields in BWF version 2

BEXT Data Field	Description
Description	A brief description of the audio.
Originator	Name of the producer of the audio.
Originator Reference	An identifier for the Originator, defined in EBU R 99.
Origination Date	Creation date of the audio.
Origination Time	Creation time of the audio.
Time Reference	Time code of the start of the audio.
Version	Version of BWF of the file.
UMID	Unique Material Identifier defined in SMPTE 330M.
Loudness Value	
Loudness Range	
Max True Level	
Max Momentary Loudness	
Max Short Term Loudness	
Reserved	Reserved for future extension.
Coding History	Record of the transmission chain—processing applied to the audio.

Proliferation of digital audio and video on the Internet prompted rapid development of compressed audio and multimedia technologies. Some digital audio file formats have become known by their compression method, or codec, most notably the popular formats MP3, Advanced Audio Encoding (AAC), and Microsoft's proprietary Windows Media Audio (WMA) format; some are subsumed under wrapper file formats designed for multimedia and streaming delivery, such as the MXF, Ogg, a series of MPEG standards, and Microsoft's proprietary Advanced Systems Format. Consequently, the development of audio metadata diverged—technical metadata continue to be embedded within the audio file or specified as part of the multimedia file format, while descriptive metadata evolved independently to coordinate with these formats.

DESCRIPTIVE METADATA

ID3v1 and ID3v2

ID3v1 and ID3v2 are two related versions of metadata containers for descriptive metadata developed without a standardization body, but are standards in the de facto sense for their wide adoption by software applications and hardware manufacturers. The introduction of ID3 in 1996, now called ID3v1, is attributed to programmer Eric Kemp. A chunk of data was appended to the end of the MP3 file container to store descriptive metadata. The format was extended in 1997 to ID3v1.1, attributed to Michael Mutschler, which increased the storage size for the metadata (Nilsson, 2006). The ID3v1 chunk is 128 bytes long with fixed-length metadata tags for title, artist, album, year, comment, indicator for the use of the track number, track number, and genre code (listed in Table 6). The current standard ID3v2 provides an ad-

ditional 227 bytes for extensions of title, artist, and album, as well as new tags for speed, genre (free text), and fading. In 1998, a group of developers introduced ID3v2 (Nilsson, 2012), which makes use of frames of variable size (up to 16 megabytes each and a total of 256 megabytes). The list of tags is shown in Table 5. In addition to textual metadata, ID3v2 allows for external URL links as well as embedding graphic images through the "APIC" frame.

The ID3v2 frame structure has been incorporated in AIFF, but not in WAV and BWF, although incorporation is possible by way of a custom ID3 Chunk. The set of ID3v2 tag names is also supported in WMA and the MPEG-4 (MP4) file formats, but the metadata are stored in a different data structure.

Table 5. List of ID3v2 tags

Frame Name	Frame Code			Description
	2.2.0	2.3.0	2.4.0	
GENREID				genre ID
CONTENTGROUP	TT1	TIT1	TIT1	content group description
TITLE	TT2	TIT2	TIT2	title/song title/content description
SUBTITLE	TT3	TIT3	TIT3	subtitle/description refinement
ARTIST	TP1	TPE1	TPE1	lead performer(s)/soloist(s)
BAND	TP2	TPE2	TPE2	band/orchestra/accompaniment
CONDUCTOR	TP3	TPE3	TPE3	conductor/performer refinement
MIXARTIST	TP4	TPE4	TPE4	interpreted, remixed, modified by
COMPOSER	TCM	TCOM	TCOM	composer
LYRICIST	TXT	TEXT	TEXT	lyricist/text writer
LANGUAGE	TLA	TLAN	TLAN	language(s)
CONTENTTYPE	TCO	TCON	TCON	content type
ALBUM	TAL	TALB	TALB	album/movie/show title
TRACKNUM	TRK	TRCK	TRCK	track number/position in set
PARTINSET	TPA	TPOS	TPOS	part of set
ISRC	TRC	TSRC	TSRC	international standard recording code
DATE	TDA	TDAT		date
YEAR	TYE	TYER		year
TIME	TIM	TIME		time
RECORDINGDATES	TRD	TRDA		recording dates
RECORDINGTIME			TDRC	recording time
ORIGYEAR	TOR	TORY		original release year
ORIGRELEASETIME			TDOR	original release time
BPM	TBP	TBPM	TBPM	beats per minute
MEDIATYPE	TMT	TMED	TMED	media type
FILETYPE	TFT	TFLT	TFLT	file type
COPYRIGHT	TCR	TCOP	TCOP	copyright message
PUBLISHER	TPB	TPUB	TPUB	publisher

continued on following page

Table 5. Continued

Frame Name	Frame Code			Description
	2.2.0	2.3.0	2.4.0	
ENCODEDBY	TEN	TENC	TENC	encoded by
ENCODERSETTINGS	TSS	TSSE	TSSE	software/hardware settings for encoders
SONGLEN	TLE	TLEN	TLEN	length (ms)
SIZE	TSI	TSIZ		size (bytes)
PLAYLISTDELAY	TDY	TDLY	TDLY	playlist delay
INITIALKEY	TKE	TKEY	TKEY	initial key
ORIGALBUM	TOT	TOAL	TOAL	original album/movie/show title
ORIGFILENAME	TOF	TOFN	TOFN	original filename
ORIGARTIST	TOA	TOPE	TOPE	original artist(s)/performer(s)
ORIGLYRICIST	TOL	TOLY	TOLY	original lyricist(s)/text writer(s)
FILEOWNER		TOWN	TOWN	file owner/licensee
NETRADIOSTATION		TRSN	TRSN	Internet radio station name
NETRADIOOWNER		TRSO	TRSO	Internet radio station owner
SETSUBTITLE			TSST	set subtitle
MOOD			TMOO	mood
PRODUCEDNOTICE			TPRO	production credit
ENCODINGTIME			TDEN	encoding time
RELEASETIME			TDRL	release time
TAGGINGTIME			TDTG	tagging time
ALBUMSORTORDER			TSOA	album sort order
PERFORMERSORTORDER			TSOP	performer sort order
TITLESORTORDER			TSOT	title sort order
USERTEXT	TXX	TXXX	TXXX	user defined text information frame
WWWAUDIOFILE	WAF	WOAF	WOAF	official audio file URL
WWWARTIST	WAR	WOAR	WOAR	official artist/performer URL
WWWAUDIOSOURCE	WAS	WOAS	WOAS	official audio source URL
WWWCOMMERCIALINFO	WCM	WCOM	WCOM	commercial information URL
WWWCOPYRIGHT	WCP	WCOP	WCOP	copyright/legal information URL
WWWPUBLISHER	WPB	WPUB	WPUB	publisher's official URL
WWWRADIOPAGE		WORS	WORS	official Internet radio station homepage URL
WWWPAYMENT		WPAY	WPAY	payment URL
WWWUSER	WXX	WXXX	WXXX	user defined URL link frame
INVOLVEDPEOPLE	IPL	IPLS		involved people list
MUSICIANCREDITLIST			TMCL	musician credits list
INVOLVEDPEOPLE2			TIPL	involved people list
UNSYNCEDLYRICS	ULT	USLT	USLT	unsynchronized lyrics/text transcription
COMMENT	COM	COMM	COMM	comments

continued on following page

Table 5. Continued

Frame Name	Frame Code			Description
	2.2.0	2.3.0	2.4.0	
TERMSOFUSE		USER	USER	terms of use
UNIQUEFILEID	UFI	UFID	UFID	unique file identifier
CDID	MCI	MCDI	MCDI	music CD identifier
EVENTTIMING	ETC	ETCO	ETCO	event timing codes
MPEGLOOKUP	MLL	MLLT	MLLT	MPEG location lookup table
SYNCEDTEMPO	STC	SYTC	SYTC	synchronized tempo codes
SYNCEDLYRICS	SLT	SYLT	SYLT	synchronized lyrics/text
VOLUMEADJ	RVA	RVAD		relative volume adjustment
VOLUMEADJ2			RVA2	relative volume adjustment (2)
EQUALIZATION	EQU	EQUA		equalization
EQUALIZATION2			EQU2	equalization (2)
REVERB	REV	RVRB	RVRB	reverb
PICTURE	PIC	APIC	APIC	attached picture
GENERALOBJECT	GEO	GEOB	GEOB	general encapsulated object
PLAYCOUNTER	CNT	PCNT	PCNT	play counter
POPULARIMETER	POP	POPM	POPM	popularimeter
BUFFERSIZE	BUF	RBUF	RBUF	recommended buffer size
CRYPTEDMETA	CRM			encrypted meta frame
AUDIOCRYPTO	CRA	AENC	AENC	audio encryption
LINKEDINFO	LNK	LINK	LINK	linked information
POSITIONSYNC		POSS	POSS	position synchronization frame
COMMERCIAL		COMR	COMR	commercial frame
CRYPTOREG		ENCR	ENCR	encryption method registration
GROUPINGREG		GRID	GRID	group identification registration
PRIVATE		PRIV	PRIV	private frame
OWNERSHIP		OWNE	OWNE	ownership frame
SIGNATURE			SIGN	signature frame
SEEKFRAME			SEEK	seek frame
AUDIOSEEKPOINT			ASPI	audio seek point index

Compiled from Harvey (2013) and Nilsson (1998, 1999, 2000b), and adapted from Solboda (2011).

VorbisComments in Ogg

VorbisComments is a textual metadata specification for the open source Ogg file container format developed by the Xiph.org Foundation. Appeared in 2000, this specification is primarily concerned with the structure and encoding. There is no mandatory field, and users are free to create any field. The Xiph.org Foundation recommends a “minimal list of standard field names” (listed in Table 7) and later added

Table 6. ID3v1 and ID3v2 genre codes

Code	Genre	Code	Genre	Code	Genre
0	Blues	65	Cabaret	130	Terror
1	Classic Rock	66	New Wave	131	Indie
2	Country	67	Psychedelic	132	Brit Pop
3	Dance	68	Rave	133	Afro-Punk
4	Disco	69	Showtunes	134	Polsk Punk
5	Funk	70	Trailer	135	Beat
6	Grunge	71	Lo-Fi	136	Christian Gangsta Rap
7	Hip-Hop	72	Tribal	137	Heavy Metal
8	Jazz	73	Acid Punk	138	Black Metal
9	Metal	74	Acid Jazz	139	Crossover
10	New Age	75	Polka	140	Contemporary Christian
11	Oldies	76	Retro	141	Christian Rock
12	Other	77	Musical	142	Merengue
13	Pop	78	Rock & Roll	143	Salsa
14	R&B	79	Hard Rock	144	Thrash Metal
15	Rap	80	Folk	145	Anime
16	Reggae	81	Folk-Rock	146	J-Pop
17	Rock	82	National Folk	147	Synthpop
18	Techno	83	Swing	148	Abstract
19	Industrial	84	Fast-Fusion	149	Art Rock
20	Alternative	85	Bebop	150	Baroque
21	Ska	86	Latin	151	Bhangra
22	Death Metal	87	Revival	152	Big Beat
23	Pranks	88	Celtic	153	Breakbeat
24	Soundtrack	89	Bluegrass	154	Chillout
25	Euro-Techno	90	Avant-garde	155	Downtempo
26	Ambient	91	Gothic Rock	156	Dub
27	Trip-Hop	92	Progressive Rock	157	EBM
28	Vocal	93	Psychedelic Rock	158	Eclectic
29	Jazz+Funk	94	Symphonic Rock	159	Electro
30	Fusion	95	Slow Rock	160	Electroclash
31	Trance	96	Big Band	161	Emo
32	Classical	97	Chorus	162	Experimental
33	Instrumental	98	Easy Listening	163	Garage
34	Acid	99	Acoustic	164	Global
35	House	100	Humor	165	IDM
36	Game	101	Speech	166	Illbient
37	Sound Clip	102	Chanson	167	Industro-Goth

continued on following page

Table 6. Continued

Code	Genre	Code	Genre	Code	Genre
38	Gospel	103	Opera	168	Jam Band
39	Noise	104	Chamber Music	169	Krautrock
40	Alt. Rock	105	Sonata	170	Leftfield
41	Bass	106	Symphony	171	Lounge
42	Soul	107	Booty Bass	172	Math Rock
43	Punk	108	Primus	173	New Romantic
44	Space	109	Porn Groove	174	Nu-Breakz
45	Meditative	110	Satire	175	Post-Punk
46	Instrumental Pop	111	Slow Jam	176	Post-Rock
47	Instrumental Rock	112	Club	177	Psytrance
48	Ethnic	113	Tango	178	Shoegaze
49	Gothic	114	Samba	179	Space Rock
50	Darkwave	115	Folklore	180	Trop Rock
51	Techno-Industrial	116	Ballad	181	World Music
52	Electronic	117	Power Ballad	182	Neoclassical
53	Pop-Folk	118	Rhythmic Soul	183	Audiobook
54	Eurodance	119	Freestyle	184	Audio Theatre
55	Dream	120	Duet	185	Neue Deutsche Welle
56	Southern Rock	121	Punk Rock	186	Podcast
57	Comedy	122	Drum Solo	187	IndieRock
58	Cult	123	A Cappella	188	G-Funk
59	Gangsta Rap	124	Euro-House	189	Dubstep
60	Top 40	125	Dance Hall	190	Garage Rock
61	Christian Rap	126	Goa	191	Psybient
62	Pop/Funk	127	Drum & Bass	CR	Cover
63	Jungle	128	Club-House	RX	Remix
64	Native American	129	Hardcore	255	None

Compiled from Harvey (2013), "Liste" (2013), and Strnad (2002).

0-79 were introduced with ID3v1; extended to 80-110 by the Winamp application in 1997; extended to 111-115, 116-141, 142-147 in 1998; extended to 148-191 in 2010; CR and RX values appear in ID3v2 only.

a mechanism for embedding digital images. Additional VorbisComments field names as well as other mechanisms for embedding descriptive metadata are being proposed, discussed, and tested by the user community.

Material Exchange Format

The Material Exchange Format (MXF) consists of a series of specifications published by SMPTE beginning in 2004. MXF grew out of the Advanced Authoring Format (AAF), and is a comprehensive

Table 7. Recommended fields for VorbisComments metadata

Recommended Field	Description
TITLE	Title of the work.
VERSION	May be used to differentiate multiple versions of the same TITLE.
ALBUM	The collection name to which this track belongs.
TRACKNUMBER	The track number of this piece if part of a specific larger collection or album.
ARTIST	The author(s), creator(s) or composer(s) of the work.
PERFORMER	The artist(s) who performed the work. Omitted if it is the same as ARTIST.
COPYRIGHT	Copyright attribution.
LICENSE	License information.
ORGANIZATION	Name of the organization or label producing the track.
DESCRIPTION	A short text description of the contents.
GENRE	A short text indication of music genre.
DATE	Date the track was recorded.
LOCATION	Location where track was recorded.
CONTACT	Contact information for the creators or distributors of the track.
ISRC	The International Standard Recording Code.
METADATA_BLOCK_PICTURE	Embedded digital image.

file format that addresses the interoperability issue in the production chain. The format is supported by EBU, the Association of Radio Industries and Businesses (ARIB), the Professional-MPEG Forum, the Advanced Authoring Format Association, as well as equipment manufacturers. The specifications focus on technical and structural metadata, and leaves open mechanisms for embedding descriptive metadata. Several recommended practices have been published (SMPTE 377-1, EBU R 121, SMPTE 380M). Although MXF metadata are KLV-encoded, mechanisms for incorporating XML metadata have been developed (EBU R 121, SMPTE 380M, SMPTE ST 434:2014). The *SMPTE Metadata Registries and Related Items* web site serves as a clearinghouse for metadata standards developed for MXF, including EBUCore.

EBU and AES Metadata Specifications

The co-publication of EBUCore (EBU Tech 3293) in 2008 and AES60 (formerly AES-X098A) in 2011 was the result of the metadata harmonization project between EBU and the AES. EBUCore assumes the use of BWF, and, an extension of the Dublin Core metadata schema expressed in XML, was designed as a minimum list of elements for describing audio and video. The EBUCore metadata set includes 19 elements: Title, Creator, Subject, Description, Publisher, Contributor, Date, Type, Format, Identifier, Source, Language, Relation, Coverage, Rights, Version, Publication History, Metadata Provider, and Entity Type. EBUCore has been widely adopted by production and broadcasting organizations internationally. The EBUCore standard is now in Version 1.6, published in 2015; the corresponding AES standard is due to be revised in 2016. In 2015, EBU generalized the technical metadata area of EBU Core with the Audio Definition Model (ADM) (EBU Tech 3364), which enables descriptions of audio containing tracks of mixed formats.

AES also published complementary standards for embedding technical metadata in MPEG Layer II compressed audio file format (AES41) and for the archiving of analog audio in digital form (AES57, formerly AES-X098B). Administrative metadata for audio production workflow (AES-X155) and the history of signal processing (AES-X098C) are currently in development.

EBU has registered EBUCore with the SMPTE Registration Authority, and continues its development of metadata specifications towards linked data and semantic web applications. EBUCore has been simultaneously published as a RDF/OWL ontology, which has formed the basis for the development of the W3C Ontology for Media Resources, an interlingua ontology and an associated API.

PBCore

PBCore, first introduced in 2005 with the support of the Corporation for Public Broadcasting, is a community-developed metadata standard for describing analog and digital audio assets primarily in broadcasting. An extension of Dublin Core, PBCore provides elements that enhance description in the areas of instantiation (analog and digital), intellectual content, and intellectual property. PBCore 2.0, introduced in 2011 (updated to version 2.1 in 2015), enhances the ability to draw relationships and include rights information at the instantiation level, including the handling of segments, multi-part assets, and derivatives. The PBCore schema allows external URI references for all element values.

MPEG-7 Audio

The Multimedia Content Description Interface (MPEG-7), developed by the Motion Picture Expert Group, is a suite of ISO standards (ISO/IEC 15938) in 13 parts published between 2002 and 2008. Following a comprehensive approach to describing multimedia content, MPEG-7 allows fast and efficient searching and retrieval. The standard defines the XML-based Description Definition Language (DDL), which serves as the basis for developing Description Schemes (DSs) and Descriptors (Ds). MPEG-7 Part 4 includes structures for describing technical parameters of audio signals such as silence, timbre, harmonic features, spectral features, and signal features, as well as descriptive metadata such as audio signature, musical instrument sounds, melody description, general sound recognition and indexing, and spoken content. The division between technical and descriptive is blurred since MEPG-7 audio metadata are in part based on the characteristics of the audio itself rather than of human description. These metadata enable searching and filtering based on sound segments, sound characteristics, and lexical inputs. Since its inception, MPEG-7 has spurred research and development in semantic indexing as well as in automatic and interactive extraction and retrieval of multimedia information.

IEEE 1599

The Institute of Electrical and Electronics Engineers published a standard in 2008 for music encoding (IEEE 1599) that provides an XML language to encapsulate a holistic sound object. The goal of this standard is to integrate symbolic computer notations, printed scores, machine rendering, recorded performances, and related objects to enhance real-time human interaction with these facets of a single musical work, as well as between musical works.

FUTURE RESEARCH DIRECTIONS

Digital audio will continue to evolve in a distributed environment with increasing demand for search and retrieval in a multimedia context. The development of the semantic web will bridge audio essence and semantics through automatic and semi-automatic semantic extraction processes. These uses of digital audio necessitate mapping KLV-style metadata to XML, refining syntactic structures to better describe audio essence, developing multimedia ontologies, and harmonizing relationships among metadata elements and schemes.

Audio information segmentation, classification, and retrieval will remain major topics of research, as will automatic speech recognition and audio-enriched metadata extraction based on knowledge of music theory. These audio metadata will form the basis of semantic audio, which will significantly impact not only the production, transmission, and consumption of audio, but also open up new areas of applications in scientific, social, informatics, business, and artificial intelligence research.

CONCLUSION

By the turn of the 21st century, metadata standards have evolved together with production and transmission technologies from equipment-dependent formats to the Open System Interconnection model (ISO/IEC 7498-1) where digital audio objects are stored and transmitted in a distributed network. Metadata standards have also developed alongside the transition from carrier- and device-dependent audio formats to web-based, personalized delivery. In this new environment, audio metadata enable the re-contextualization, repackaging, and commodification of audio, integrating it with multimedia contextual elements and transforming it into a new cultural product.

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KEY TERMS AND DEFINITIONS

Descriptive Metadata: Describe a resource for the purpose of identification, discovery, and retrieval.

Digital Audio: Digital coding of analog audio signals.

Embedded Metadata: Metadata that are stored in the same file that carries the object described by the metadata.

Extensible Markup Language: A markup language that defines a set of rules for encoding textual data recommended for semantic web publishing.

Metadata Schemas: Structures that establish and define data elements, the relationships between them, and the rules governing their use.

Metadata Standards: Specifications or definitions that establish common meaning, usage, and interpretation of metadata.

Semantic Audio: The extraction of symbols and meaning related to audio, including speech and non-speech content.

Technical Metadata: Describe the state, the creation process, and the digital characteristics of a resource.

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Chapter 21
Multimedia-Enabled Dot Codes as Communication Technologies

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ABSTRACT

The author has been using new dot codes developed independently by Gridmark, Inc. and Apollo Japan and conducting school activities with original handmade teaching materials overlaid with these dot codes in collaboration with schoolteachers all over the world. In the chapter, just touching the "invisible" dot codes printed on the paper or symbol icons by using a sound pen clearly reproduces voices and sounds. By using a scanner pen connected to a tablet or PC, multimedia sources such as movies, web pages, and PowerPoint files, in addition to voices and sounds, can be reproduced on its screen. In this chapter, state-of-the-art dot code technology including a recently developed new application for a smart phone is outlined, and basic information regarding the creation of original handmade materials using dot codes and the use at both general and special needs schools is presented.

INTRODUCTION

Augmentative and alternative communication (AAC) technologies are widely used, providing students with severe speech, language, and communication difficulties the opportunity to improve their communication, and by extension, their relationships with others. AAC systems utilize assistive technology (AT) devices that range from no-tech to high-tech. Modifying young children's environments by using AT, defined as any tool, device, or adaptation that allows them more ways to gain access to the people, places, and setting where they can be exposed to typical developmental activities, increases opportunities for learning (Sadao & Robinson, 2010). Dell, Newton, and Petroff (2016) described the practical use of such devices in a classroom. Carpenter, Johnston, and Beard (2014) published a text for both in-service and pre-service educators to introduce AT. Jonge, Scherer, and Rodger (2007) provided an opportunity to try to understand the experiences of AT users in the workplace.

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A widely used AAC tool, voice output communication aids (VOCAs) utilize single-level or multi-level outputs to convey sounds. Although there are a variety of VOCAs catering to students with different abilities and needs (Inclusive design research center, 2016; RESEARCH AUTISM, 2016), most devices are severely hampered by their low-output numbers and short lengths of time that they can record.

Approximately ten years ago, to address the above problems the present author started using Scan Talk dot codes developed by Olympus Co. (1999). Such codes transform voices and sounds into two-dimensional dot codes directly outputted on ordinary paper. Students with severe hand, finger, or mental challenges, however, could not correctly trace Scan Talk codes using the Scan Talk Reader. The present author, therefore, used new dot codes developed independently by Gridmark, Inc. (2009) and Apollo Japan (2005) and conducted school activities with original handmade teaching materials overlaid with these dot codes. In our work, just touching the "invisible" dot codes printed on the paper or symbol icons by using a sound pen clearly reproduces voices and sounds. By using the identical sound pen or a scanner pen connected to a tablet or PC, multimedia sources such as movies, Web pages, and PowerPoint files, in addition to voices and sounds, can be reproduced on its screen.

In this article, state-of-the-art dot code technology is outlined, and basic information regarding the creation of original handmade materials using dot codes and the use at both general and special needs schools is presented.

BACKGROUND

Outline of Dot Code Technology

GridOnput Dot Codes

GridOnput (Gridmark, 2009) is a set of novel two-dimensional codes comprising extremely small dots. Such dot codes can invisibly overlay any graphically printed letters, photos, and illustrations with no impact on the designed visual images, meaning that letters, photos, and illustrations can be changed into information-trigger icons. A maximum of four voices and sounds can be linked to each icon, as well as other media such as movies, Web pages, and PowerPoint files. Simply touching the dot codes printed on ordinary paper with a sound pen (e.g., G-Talk or G-Speak) or a scanner pen (e.g., G-Pen) enables students to directly access the corresponding digital information.

To print document content that includes the "invisible" GridOnput dot codes, industry-standard Cyan-Magenta-Yellow-Black (CMYK) processes are required. More specifically, carbon ink that absorbs infrared rays is used only for dot code printing, while non-carbon ink is used to print graphics. The sound and scanner pens read the invisible dot codes using built-in infrared cameras.

ScreenCode Dot Codes

Developed by Apollo Japan (2005), ScreenCode is a microscopic barcode that allows developers to map data onto printed surfaces, such as printed documents. Unlike other data-coding systems that map data onto expensive metallic-based inks, ScreenCode allows users to map data using regular ink similar to that found in household printers. Apollo Japan has recently published their ScreenCode smartphone and tablet application in which the built-in camera of the smartphone and tablet, using a specially designed

lens, can identify ScreenCode and reproduce linked multimedia such as movies, audio files, photos, and Web pages on their screen.

Other Dot Codes

Developed by DENSO WAVE, Inc., the well-known QR code (1994) is an open code that anyone is allowed to use; it has become quite widespread as Micro QR codes, iQR codes, SQRCs, and Frame QRs. These QR codes incorporate high-level features such as illustrations, letters, and logos, and provide high-capacity data encoding, small printout sizes, Japanese Kanji and Hirakana character support, dirt and damage resistance, 360-degree readability, and structured appending features. DENSO WAVE distributes their QR-code-generation programs, QRdraw Ad (DENSO WAVE, 2016a) and QRmaker Ad (DENSO WAVE, 2016b), free of charge.

Developed by TOPPAN TDK LABEL Co., LTD, the Z code (TOPPAN TDK LABEL, 2016) is composed of tiny dot codes and does not spoil illustrations or texts. The Z code is now used to integrate digital media with analog media and assess whether printed matter is genuine or false.

Developed by ZAK Co., the Simple Microdot Code (SMC) (ZAK, 2009) creates a sophisticated algorithm to print data on a 2.5 mm^2 area that can be decoded with an optical device. These tiny swatches of encoded dots can also be used to trigger electronic links, applications, databases, etc. The SMC dot code patterns can easily be integrated into a print file by end users using any of today's desktop publishing software that support CMYK printing processes, thus allowing SMC dot code patterns to be placed anywhere on a printed surface, either as a standalone pattern or embedded in a directional graphic element.

Franklin Electronic Publishers, Inc. developed AnyBook (Franklin Electronic Publishers, 2016) using dot code technology, which is a set of reading enhancement products that allow children to hear their parents or a loved one reading any book for a more intimate learning experience, even when these readers are not physically present. These products consist of a reading pen that enables the words and pictures to talk with any book using vocal recording software. A variety of AnyBooks are available; for example, holding up to 200 h of audio, AnyBook Anywhere (DRP-5100) has 420 reusable stickers with pre-recorded sounds that are created using a special glue that does not harm the pages of the books, a headphone jack for private listening, and backup and sharing capabilities with AnyBook Case.

Afaya Technology Co., Taiwan, has developed a dot code incorporating charge coupled device scanning technology, which identifies the printed K-layer that hides index data in two-dimensional bar codes of four to five ink-coated sheets of paper or books. This technology also includes an MP3 database and a visual-authoring tool. They sell a variety of Afaya-Pens (2016) in cooperation with their business partners and have produced many publications with pre-printed dot codes.

In Japan, under the new Course of Study (revised in 2008), "Foreign Language Activities" in the 5th and 6th grades are required at all elementary schools. The overall objectives of these new activities are "to deepen the understanding of languages and cultures through the experience of foreign language learning; to encourage efforts towards communication; to familiarize children with foreign language sounds and fundamental expressions; and to develop a foundation of basic communication abilities." (TOKYO SHOSEKI, 2016a) With this as an opportunity, many English textbooks, side-readers, and picture books overlaid with dot codes have entered the market (EC kids, 2016; ECC, 2016; Kumon, 2016; Pendoku, 2016; Sailor, 2016, TAKAHA, 2016; TOKYO SHOSEKI, 2016b). The hope here is that these new foreign language activities may help students acquire conversational English skills more smoothly.

MAIN FOCUS OF THE ARTICLE

Each and every student has individual hopes, needs, and desires, as well as a history of learning. Therefore, schoolteachers ideally should develop original independent content suitable for each individual. Given the challenges in doing so, easy-to-handle and less-costly software and hardware solutions are crucial to schoolteachers for creating original content for students in their class (Ikuta et al., 2013, 2015, 2016).

We have been collaborating with two Japanese venture business companies, Gridmark, Inc. and Apollo Japan, to help students, especially those with various handicaps, by developing original handmade content and conducting fruitful school activities. Gridmark, Inc. has kindly provided us, free of charge, with their valuable software for creating handmade content for sound pens, allowing us to distribute it to collaborating schoolteachers.

We recently created an original sheet (called a magical sheet) overlaid with GridOnput dot codes. Each sheet, as shown in Figure 1, has 117 "Post-it" sticker icons, which can be taken off and pasted elsewhere. Up to four audio clips can be linked to each icon by using the specially designed software (*NANA.exe*), which was kindly given to us by Gridmark. Schoolteachers can now create original handmade content and conduct school activities in their class without buying anything, instead of using a specially designed linkage table file, filelist.csv, that can be opened and edited with Microsoft Excel. In this file, each mp3 audio file is linked to the corresponding dot code icon's number. The content folder, produced by double-clicking *NANA.exe*, can then be copied onto the Micro SD card of a sound pen. Touching the symbol icons pasted just beside the illustrations and texts with a sound (G-Talk or G-Speak) or scanner pen (G-Pen) plays back the original voices and sounds, as well as multimedia such as movies on the screen of a tablet or PC.

Figure 1. Magical sheet with GridOnput dot code symbol icons, G-Speak, and G-Pen

The executable file that can reproduce multimedia has also been distributed to collaborating schoolteachers free of charge; as such, they can edit a specially designed URLLIST.csv and replace old movies with new ones. Here, *NANA.exe*, *filelist.csv,* and *the folder* including an executable to reproduce multimedia are sent on request free of charge.

Gridmark, Inc. has just published their software (i.e., *SoundLinker* and *FileLinker*) and make it available to the market; their software can easily link audios and multimedia to dot code symbol icons. The executable file, created with *FileLinker*, enables the *sound* pen, G-Speak, connected to your tablet or PC to reproduce the multimedia sources like movies in addition to the *scanner* pen. More costly software called the *Gridmark Authoring Tool (GAT)*, which can directly overlay the GridOnput dot codes on illustrations or text of a PDF file, is also available now; unfortunately, this *GAT software* requires a costly color printer to print the overlaid file.

Apollo Japan has recently published a new application called *ScreenCode*, which can be used with an iPhone or iPad with a built-in camera; note that the built-in camera must have a specially designed small lens to reproduce multimedia such as movies, audio files, and photos already saved on the iPhone or iPad. Entering a uniform resource locator (URL) with a software keyboard also reproduces Web pages. As shown in Figure 2, the present author has started to distribute sheets with ScreenCode dot codes free of charge, as schoolteachers do not need to buy the costly software, *Garyu Tensei for Smartphone.* Clearly, *ScreenCode* is a very attractive application for connecting to digital media from a smartphone to the dot codes on paper. University students are now developing original handmade content for younger students at both general and special needs schools, as detailed further in the next section.

Figure 2. Handmade sheet generated by ScreenCode and a specially designed lens

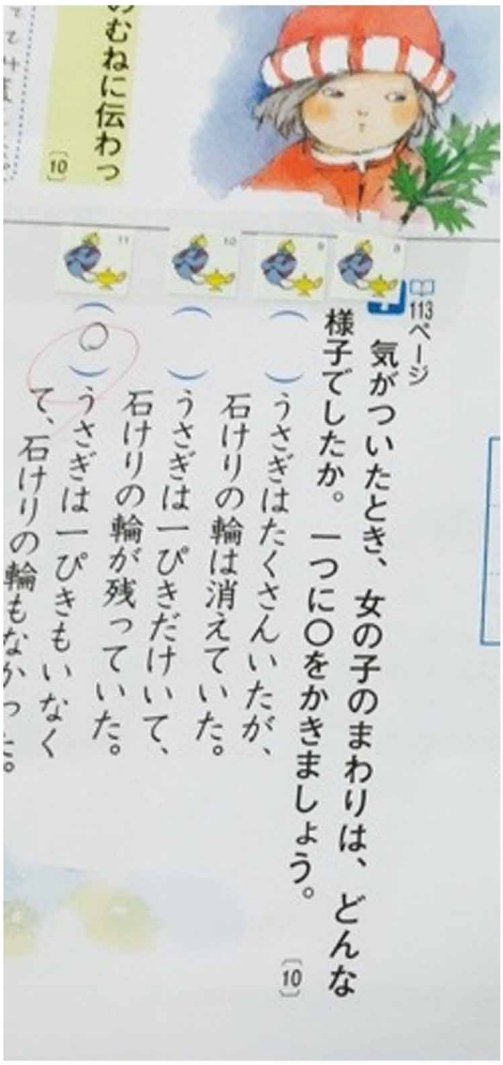
SOLUTIONS AND RECOMMENDATIONS

Original Handmade Content and School Activities

The teachers at Honmachidahigashi elementary school in Machida, Tokyo, conducted an activity using dot code symbol icons, as shown in Figure 3, for a 5th grade male student with a reading disability. At the school, the homeroom teacher gave the student a test with a worksheet after finishing each unit, but the student consistently could not answer anything. The homeroom teacher could not understand this.

We provided a sound pen to the homeroom teacher, and she recorded every question using her voice on the sound pen, linking it to the corresponding symbol icons beside each question. The student could now listen to the audio with a sound pen instead of reading by himself.

Figure 3. Worksheet with GridOnput dot code symbol icons



As the first achievement since the given activity started, the student earned a grade of 70; all of the teachers at the school were at first surprised, but soon realized he had a reading disability. They confirmed the importance of knowing and understanding the difficulties each student faces and trying to remove such difficulties with the help of teaching aids and tools. The homeroom teacher now continues to create suitable content for this student.

A student of Otsuma Women's University, Miki Endo, also created content; as shown in Figure 4-a, younger students can learn about our solar system (NASA 2016) using audio clips and movies. The GridOnput dot codes were overlaid on each planet using the *GridLayouter* software (which has unfortunately been withdrawn from the market); Gridmark, Inc. has just published new software with similar functionality (i.e., the *GAT*).

Younger students at several elementary schools near the university enjoyed the content very much; by touching each planet with sound and scanner pens, they were able to listen to explanations for each planet and watch movies of the corresponding planets. A snapshot of such activities is shown in Figure 4-b.

Teachers at the Osaka Prefectural Special Needs School for the Visually Impaired also created handmade content for blind students, in which even student with total blindness could find the symbol icons and listen to the voices with a sound pen by touching the symbol icons beside the three-dimensional stickers with numeric numbers. A snapshot of these activities is shown in Figure 5. Here, the teacher intentionally placed dot code symbol icons all over the sheet such that the students could enjoy finding them and listening to a fortune slip with voices. The teacher also created a booklet that could be used at a school event focused on music appreciation.

The present system using a sound pen and handmade content was also introduced to special training school students for the visually impaired. A student with weak eyesight said, with deep emotion, "I am always afraid how I can read picture books for my children in the future. When I try to read a picture book for my child, I have to hold the book to my eyes and cannot look at my child's face at all; however, now, with the help of this sound pen, I record my voice beforehand using the recording functionality of the sound pen and can really read a picture book to my child." The sound pen has been able to realize a dream for people with weak eyesight and the totally blind.

Figure 4. (a) Handmade sheet with GridOnput dot codes to learn about our solar system and (b) activities at elementary school

(a) (b)

Figure 5. Activities with handmade sheet for a totally blind student at the Osaka Prefectural Special Needs School for the Visually Impaired

The *ScreenCode* application for iPhone and iPad, recently developed by Apollo Japan, is now put on the market, with multimedia such as movies, photos, audio clips, and Web pages being able to be linked to ScreenCode dot codes overlaid on ordinary paper. A specially designed lens is attached to a built-in camera of the iPhone and iPad; this camera focuses on the dot codes. The augmented reality application *Aurasma* can also reproduce multimedia such as movies by focusing on the trigger illustration with the built-in camera of an iPhone or iPad. Focusing on the trigger illustration, however, is not so easy; a smaller illustration on paper cannot be focused. On the other hand, the *ScreenCode* application, with a built-in camera, can focus fairly well on smaller sized dot code symbols.

Apollo Japan is now distributing "a sample notebook with Screen Code" overlaid with ScreenCode on every page of a blank booklet in which you can write your own messages and link multimedia to the pages quite easily. The present author with university students is now creating handmade worksheets (overlaid with ScreenCode) for younger students at general schools and preparing school activities, as depicted in Figure 6. The present author also created a specially designed sheet with ScreenCode dot codes, as shown in Figure 2, created using the *Garyu tensei for Smartphone* software, and then started to share them with schoolteachers free of charge. Each symbol icon in the sheet can be cut-and-pasted on any item and linked with multimedia such as movies, audio clips, photos, and Web pages. Figure 7 shows snapshots of using the ScreenCode dot codes with an iPhone; note that the built-in camera is attached with a specially designed lens. Apollo Japan is now developing the system to focus the ScreenCode without using the specially designed small lens; this *ScreenCode* application may promote more widespread use of smartphones and tablets in the classroom.

Figure 6. Handmade content with ScreenCode dot codes

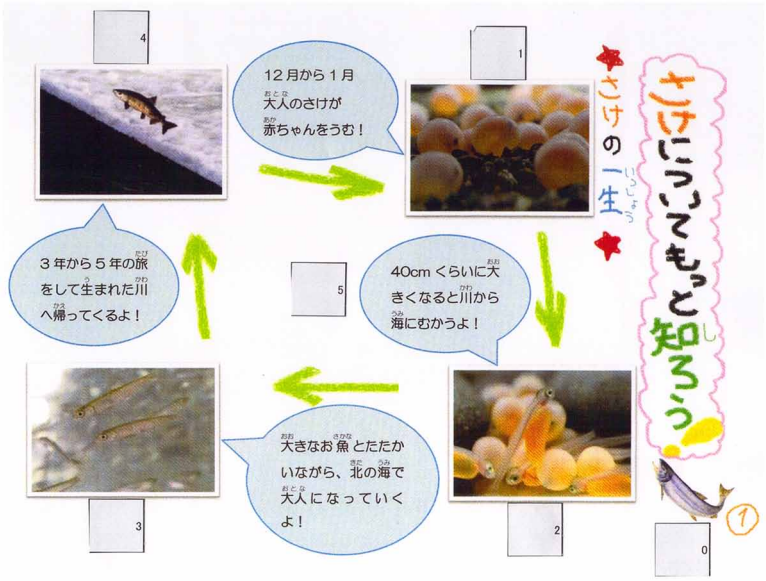


Figure 7. (a) Special lens attached to an iPhone and (b) snapshot of iPhone screen (school activity movie), focusing on ScreenCode dot codes

(a) (b)

FUTURE RESEARCH DIRECTIONS

The present author creates original handmade content and conducted many activities at both general and special needs schools in collaboration with schoolteachers not only in Japan but also in the United States, the United Arab Emirates, China, and Oman. All the schoolteachers wish to use easy-to-handle and less-costly software to create their original contents for each student in their class; it is difficult for schoolteachers to obtain the funds to buy costly software and hardware to do so. The software presented in this article, for example, *Garyu Tensei for Smartphone* developed by Apollo Japan, costs more than

1,000 USD; thus, schoolteachers cannot buy it. Even cheaper software, such as *SoundLinker* and *FileLinker* developed by Gridmark, Inc. for linking audio clips and multimedia files to GridOnput dot codes, are still costly. Collaboration with university professors is crucial to start and continue developing easy-to-handle and less-costly software and creating outstanding original handmade contents for each student in a different set of needs and desires, degree of disability, and learning history.

The present author has conducted many long-term activities with schoolteachers at both special needs and general schools, and performed several assessments of such school activities using the original handmade teaching materials with the present multimedia-enabled dot codes (Ikuta et al., 2013, 2015, 2016). Each student has responded to these activities with confidence and joy, providing that such long-term activities could also improve the students' learning. The various effects noticed during the running of the school activities should be carefully analyzed and classified more in details for each kind of disability, so as to be able to focus the activities more precisely; such analysis is crucial to clarify the usefulness of assistive technology in the classroom.

Through many school activities performed at general and special needs schools, it was noticed that the sound pens require some changes. The positions of the power and audio volume buttons on the new sound pen G-Speak are located just at the pen center, and students with disabilities and in lower grades often make errors The present author therefore suggest that Gridmark moves these buttons to the side of the pen. The sound pens with Wi-Fi and Bluetooth connectivity could be used in the near future classroom. More effective uses of such new sound pens with original contents should be explored by the researchers in collaboration with schoolteachers in many parts of the world.

The help of university students is also crucial to developing original handmade content, since schoolteachers, especially in Japan, always have too much to do in their daily jobs. Collaboration with schoolteachers is very important and attractive for university students, especially those who wish to become teachers; these university students can learn much from current schoolteachers.

Good relationships and collaborations with developers, Gridmark, Inc., and Apollo Japan are also crucial to continuing and developing the present project. Also, funds provided by the Ministry of Education, Culture, Sports, Science and Technology, Japan, and the Institute of Human Culture Studies, Otsuma Women's University are essential for us to purchase software and hardware, and provide them to schoolteachers free of charge.

CONCLUSION

In collaboration with schoolteachers, a variety of original handmade content has been created and various activities at both general and special needs schools have been conducted. The present author has created specially designed sheets with "Post-it" symbol icons overlaid with dot codes; such sheets have been provided with sound pens and software to collaborating schoolteachers free of charge, so that they can create handmade content for students in their classrooms themselves without purchasing anything.

We asked schoolteachers to create original handmade content for students in their own classes instead of purchasing teaching materials already on the market, since each student has his or her own needs and desires and own history of learning. Perfect teaching materials and tools for one student do not always perform well with other students. Easy-to-handle and cheaper software and hardware are required if the schoolteachers are to proceed with these voluntary activities. Collaboration with software and hardware

companies and their kind help, therefore, are an important issue for the development of focused teaching materials and school activities.

Support given by the Grants-in-Aid for Scientific Research and the Institute of Human Culture Studies, Otsuma Women's University, is also important for ensuring the continuation of larger collaborations with worldwide schoolteachers. The help of university students is also a strong motivation for schoolteachers who wish to develop individual content for each of their students. Collaborations with foreign schoolteachers in the United States, United Arab Emirates, and Oman are also very important to extending and assessing present school activities performed in the classroom with new information communication technologies.

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KEY TERMS AND DEFINITIONS

Assistive Technology: Assistive technology (AT) devices range from no-tech to high-tech and help to properly assess the correct communication systems for students with severe speech-language deficits; as such, professionals work with students, teachers, and individuals who interact with students on a daily basis.

Communication Aid: Communication aids based on augmentative and alternative communication (AAC) technologies have been widely used to provide students with severe speech, language, and communication difficulties the opportunity to achieve successful communication and relationships with others.

Dot Code: Invisible dot codes developed by Gridmark, Inc. are a novel two-dimensional code technology consisting of extremely small dots practically imperceptible to the human eye. Each symbol icon can be linked to up to four audio clips. Multimedia such as movies can also be linked to the same symbol icon. A simple touch by sound and scanner pens on the symbol icon enables links between paper and digital content.

Handmade Content: *Original handmade* teaching content plays a key role in learning, as each student has different thoughts, feelings, needs, and desires. Independent teaching material should be prepared and used for each individual, especially in preschool and special needs classrooms.

Magical Sheet: This specially designed sheet has the order for each dot code imprinted on each symbol icon. The sheet has additional symbol icons with audio-recording functionality and mode changing. The icons can then be taken off and pasted onto a target object and touched with sound and scanner pens. The "magical sheet" enables the costly GridOnput system to be used at any school at a low cost.

Scanner Pen: Scanner pens such as the G-Pen can read dot codes printed on paper and play back multimedia (such as movies) on the screen of a G-Pen connected to a tablet or personal computer.

School Activity: School activities at special needs schools can be improved through the use of *original* and *individual* handmade teaching materials and aids suitable for each student with disabilities.

Sound Pen: Sound pens, such as G-Talk and G-Speak, reproduce original voices and sounds by simply touching the dot-coded symbol icons or the dot codes directly overlaid on the paper.

Voice Output Communication Aid: Voice Output Communication Aids (VOCAs) are widely used AT devices that utilize single-level or multi-level outputs to convey sounds. While a variety of VOCAs exist that cater to students of different abilities and needs, most devices are severely hampered by their low-output numbers and short recording times.

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Chapter 22
Semantically Enhanced Authoring of Shared Media

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ABSTRACT

This chapter examines current trends and future perspectives of semantically enhanced media/multimedia, considering all forms of non-linear storytelling, sharing, and authoring. Background is presented providing basic definitions, involved technology, achieved progress, and limitations. Recommendations and future research directions are then stated, aiming at serving a two-fold target: firstly, to present new, user-friendly forms of collaborative creativity, multimedia authoring, and storytelling; secondly, to suggest innovative adaptation mechanisms that can be utilized in both the media production and consumption ends. A semantically enhanced media authoring model is proposed, integrating most of the expected progress in augmented user interaction and the upcoming Web 2.0/3.0 services. The targeted Semantically-enhanced Multimedia Storytelling Services aim at engaging audience members individually, validating their involvement and positively reinforcing personal participation in the narration. Thus, the importance of the topic toward the transition to the Web 3.0 era is revealed.

INTRODUCTION

The rapid evolution of digital technology, among others, has revolutionized multimodal content production and distribution processes, propelling novel mediated communication services. Interactive media authoring and sharing technologies are currently being launched, bringing forward new ways of audiovisual (AV) content exchange. Web documentaries (web-docs) and hypermedia have appeared as a natural extension of filmed documentaries and digital TV, inheriting also some of their advantages.

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Narrative documentaries adopt AV mediated communication mechanisms that humans have been accustomed to be informed and communicate with each other, so that they are more informative and vivid compared with other documents (books, web-pages, multimedia, etc.). Thus, AV-documentaries, web-docs and generally interactive videos and hypermedia can be more easily distributed and attended from most ages and social groups (Dimoulas, Veglis, & Kalliris, 2015; Dimoulas, Kalliris, Chatzara, Tsipas, & Papanikolaou, 2014a; Kotsakis, Kalliris & Dimoulas, 2012; Matsiola, Dimoulas, Kalliris, & Veglis, 2015; Veglis, Dimoulas & Kalliris, 2016). Moreover, the continuous evolution of the computing power and the digital storage media favor digital video production and distribution. This is also fueled by the increased network speed, the efficiency of compression algorithms and the continuous decrease of the corresponding costs (Kotsakis et al., 2012; Dimoulas, Kalliris & Veglis, 2014b). High quality AV capturing equipment is currently available at low cost and size as part of smart phones and other mobile computing terminals with inherent networking capabilities, allowing easy AV-content production, contribution and sharing (Atzori, Delgado & Giusto, 2012; Dimoulas & Symeonidis,2015;Dimoulas et al., 2014a; 2014b; 2015; Sidiropoulos, Konstantinidis, Kotsakis & Veglis, 2015; Veglis et al. 2016; Vrysis, Tsipas, Dimoulas & Papanikolaou, 2015). In this context, more and more users are involved in the AV production and consumption chain, so that creative experience and AV media culture are cultivated. Nevertheless, AV media related achievements are still far from the progress that has been made in textual information management during the outspread of social media and Web 2.0 services.

Interactive services have also been introduced into the AV production industry, aiming at augmenting human-machine interaction (HMI). AV content is enhanced in functional and informative level, further stimulating users to actively participate in arousing interactive scenarios. While the transition from Web 2.0 to Web 3.0 is ongoing, intelligent AV-content processing and management services are pursued, facilitating users' involvement on media sharing, commenting and multichannel publishing. In this context, semantic annotation, social tagging and meta-processing can be part of collaborative media syncing, editing and multimedia management, thus propelling more sophisticated authoring (and sharing) of semantically-enhanced media. Although these technologies are rapidly evolving, there are still open challenges regarding upcoming semantic web services (De Bra, Freyne, & Berkovsky, 2013; Dimoulas et al., 2014a; 2014b; 2015; Dimoulas & Symeonidis, 2015; Matsiola et al., 2015; Monaghan, Handschuh, & O'Sullivan, 2011; Veglis et al. 2016). This chapter examines current trends and future perspectives of semantically-enhanced media /multimedia (SeMM), considering all forms of non-linear storytelling, sharing and authoring (web-docs, multichannel media publishing, interactive videos, adaptive hypermedia and generally multimedia services). Background is presented providing basic definitions, involved technology, achieved progress and limitations. Recommendations and future research direction are then stated, aiming at serving a two-folded target: firstly, to present new, user-friendly forms of collaborative creativity, multimedia authoring and storytelling that current technology allows to be successfully deployed; secondly, to suggest innovative adaptation mechanisms that can be utilized in both the media production and consumption ends, allowing for intelligent media management and augmented semantic interaction services to be launched. In this context, the importance of SeMM toward the transition to the Web 3.0 era is revealed.

BACKGROUND

Nowadays, hybrid models of mixed Page-Based Media (PBM) and Time-Based Media (TBM) are the most common multimedia web content, combining both spatial and spatiotemporal arrangement of all media entities (i.e. text, images, audio, video). These so-called Multimodal Media Assets (MMA) (Veglis et al., 2016; Dimoulas et al., 2015) may include multichannel audio and video, non-linear animations and photos, titles and more elongated textual descriptions that offer versatile presentation of information, enabling different views and audio-tracks selection, multilingual narration and subtitling. MMA schemes have many similarities to the early digital versatile disc (DVD-video) and are closer to the content entities and structures that contemporary web-docs and hypermedia utilize. The term hypermedia refers to hyperlinked multimedia, the same way that hypertext is about grouping relevant information in the form of hyperlinked PBM nodes. It is known that, while the term appeared in the early '90s, it was put aside since then, an issue that is associated to the broader meaning that the multimedia definition received, Thus hypermedia can be considered as a subcase of multimedia web services. Today, both terms are used somewhat as synonyms, with the multimedia definition to be wider, incorporating both TBM and MMA compositions with linear and non-linear navigation, but also referring to new, more sophisticated forms of creativity, digital storytelling and interaction. For this reason, the terms media and multimedia are mostly used in this chapter, instead of hypermedia. Obviously, there are still many technical issues and limitations associated with the involved diversities (i.e. different content types, formats and publishing channels, encoding and reproduction compatibilities, HMI and authoring technologies, semantics and meta-data management, etc.), so that SeMM is more than simple combinations of shared MMA entities.

One of the key terms of hypermedia is interactivity, which has advanced with the evolution of hypertext technology. Along with interactivity, new forms of digital storytelling are considered and pursued, aiming at providing rich media experience through highly valued Quality of Experience (QoE) media services having appropriate emotional impact on the users' side, thus stimulating their active engagement (Kalliris, Matsiola, Dimoulas & Veglis, 2014;Kotsakis, Dimoulas, Kalliris & Veglis, 2014;Matsiola et al., 2015). Hence, content contribution and sharing models along with social tagging and semantic interaction services can be considered as contemporary interaction forms that can be very useful in various ways. Today, every Internet user acts both as a receiver and transmitter of information by generating and disseminating textual content, along with audio, video and generally multimedia components (Dimoulas et al., 2014b; 2015; Veglis & et al., 2016). This is also the case for the user generated content (UGC) in social networks.

As previously implied, not all of the features that have been already achieved and adopted in textual information and PBM media can be easily applied and accommodated to the cases of TBM and MMA. Indeed, there are still many open issues regarding efficient AV content description and management automation, but also interoperability with transparent multimedia access. Hence, content-based searching and retrieval techniques are currently being implemented, using multimodal content detection, segmentation and summarization-highlighting algorithms along with intelligent processing and hybrid expert systems for pattern recognition and semantic analysis purposes (Cordara, Bober & Reznik, 2013; Dimoulas, Avdelidis, Kalliris & Papanikolaou, 2008; Dimoulas, Papanikolaou & Petridis, 2011; Diou et al., 2010; Kotsakis et al., 2012; Vegiris, Dimoulas & Papanikolaou, 2009). Furthermore, while much progress has been made in textual data mining approaches, semantic interaction and conceptualization efforts are still left behind, not only in AV-related media, but also for text and general PBM information, as well (Dimoulas et al., 2014b; Diou et al., 2010; Symeonidis & Mitkas, 2005; Veglis et al., 2016). This

hysteresis in the progress of AV versus textual information processing also explains why hypermedia did not flourish as hypertext. As it is analyzed later on, intelligent MMA processing is also considered to be a crucial prerequisite for the deployment of largescale semantically-enhanced collaborative multimedia authoring and sharing.

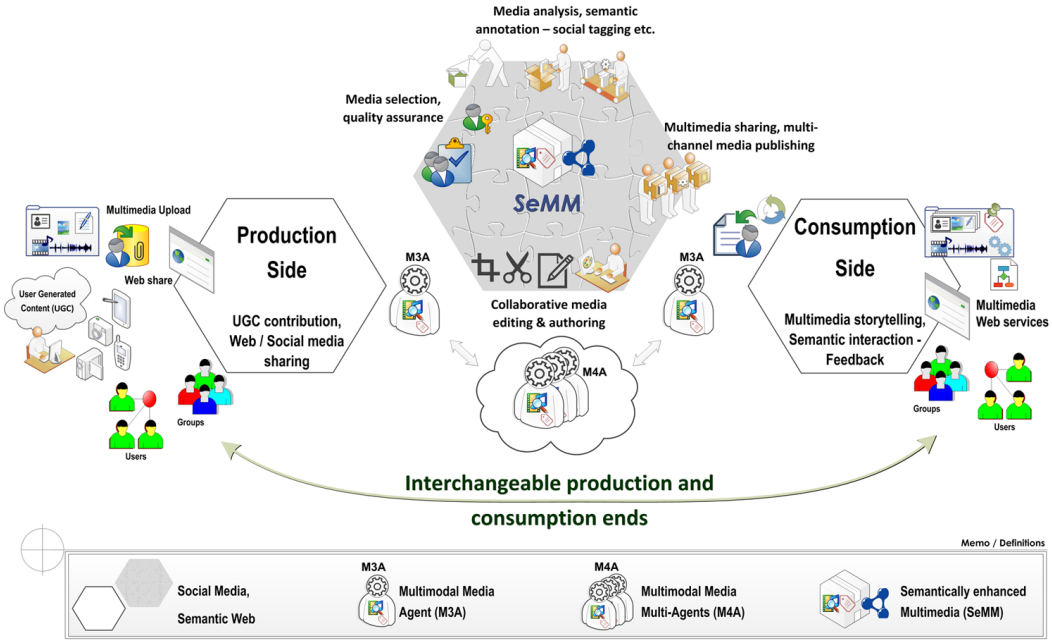
SEMANTICALLY ENHANCED MULTIMEDIA

Multimedia Semantics and Authoring Tools: Issues, Controversies, Problems

The term Multimedia (instead of media) in the SeMM model emphasizes the fact that multiple content types and communication means are usually encountered and involved in the associated sharing and authoring processes (without the necessity for each one of them to encompass all kinds of media entities). Many Web-TV platforms and popular AV social media (i.e. Youtube, Vimeo, Ustream, SoundCloud, etc.) have propelled AV-content contribution and dissemination (Dimoulas et al., 2014b; 2015; Tsipas, Zapartas, Vrysis & Dimoulas, 2015). These web environments are currently massively utilized from a variety of simple users, experts and media professionals for both AV content consumption and production, offering on demand upload-access and live streaming services, along with online processing, annotation, commenting, authoring and sharing throughout the entire Internet community (Dimoulas et al., 2014b; 2015; Spyridou, Matsiola, Veglis, Kalliris, & Dimoulas, 2013; Veglis et al., 2016). The availability of multiple broadcasting media led to the implementation of multichannel publishing models, offering alternative navigation routes and new forms of interactivity. In this context, collaborative media authoring and sharing can be considered as a multichannel publishing sub-case, where semantic meta-data and content quality metrics can be exploited toward intelligent cross-media publishing and mediated communication models (Kalliris et al., 2014; Kotsakis et al., 2014; Veglis et al., 2016). In most cases, these processes need to be expedited with the use of intelligent systems and media agents, so that content production, processing and authoring guidelines can be provided as they needed (especially from the average user) along with content recognition and semantic labeling automations (Dimoulas & Symeonidis, 2015; Sidiropoulos et al., 2015; Tsipas et al., 2015; Vrysis et al., 2015). As it is depicted in Figure 1, a recent modeling approach is the utilization of the so-called multimodal media agents (M3A) and multi-agents (M4A), which refer to media services able to sense its surrounding environments (at multiple levels, semiotic modes and/or communication channels) and autonomously adapt on their changes, responding on behalf of other (software) entities and human interactions (Matsiola et al., 2015). Hence, user-related adaptations and social networking intelligence are incorporated into mediating mechanisms that can facilitate multimedia communication, authoring and sharing, thus offering augmented and semantically-enhanced interactions, both at the media production and consumption ends.

In any case, multimedia production involves two complementary phases: content production (including UGC contribution) and authoring. The former can be delivered with a variety of tools and services, namely: discussion groups, weblog, collaborative publishing, Peer-to-Peer, XML Syndication (Dimoulas et al., 2014; Monaghan et al., 2011). The latter is usually accomplished with the use of software programming, declarative languages, web developing and scripting tools (Dimoulas et al., 2014b; 2015; Dimoulas & Symeonidis, 2015; De Bra et al., 2013; Dos Santos & Muchaluat-Saade, 2012; Matsiola et al., 2015). These tools have been utilized during the last years for the development of user friendly web-doc authoring platforms that offer easy operation, increased creativity choices, with different dis-

Figure 1. The processes of semantically-enhanced multimedia production, authoring and sharing



tribution and pricing models. As a consequence, many worth-mentioning featured web-docs have been appeared during the last decade, which fused and projected new levels of creativity, user interaction and participation, outclassing multichannel media publishing. User engagement is enhanced by means of adaptation and personalization, collaborative social tagging, resources recommendation and semantic interaction. The latter are dominant in the so-called adaptive hypermedia systems (AHS), which are very common in mediated learning and public administration services, narrative tools and serious gaming approaches, AV heritage and cultural projects (De Bra et al., 2013;Dimoulas et al., 2014a; Dos Santos & Muchaluat-Saade, 2012; Kalliris et. al., 2014; Kotsakis et al., 2014). In addition, much effort is put for inter-platform compliance and interoperability, although there are still issues that need to be addressed, especially for the majority of upcoming Web 3.0 services (Dimoulas & Symeonidis, 2016; Dimoulas et al., 2013; 2014; 2015; Veglis et al., 2016). Hence, while multimedia semantics require massive /diverse content labeling and meta-data processing through time-consuming and tiresome users-enabling tasks, media authoring and browsing decisions can offer such kind of ground-truth information in an easier, entertaining and self-extracted way. These potentials of semantically enhanced multimedia (through collaborative authoring and sharing models) have not been fully revealed or exploited yet, and are attempted to be enlightened in the current chapter.

Solutions and Recommendations: Modeling Semantically-Enhanced Authoring of Shared Media

SeMM authoring involves the incorporation of different MMA into various dialogic modes and HMI scenarios, including media sharing, UGC posts and comments, which is usually accomplished through the collaboration of many different users and groups. Semantic interaction, content annotation and

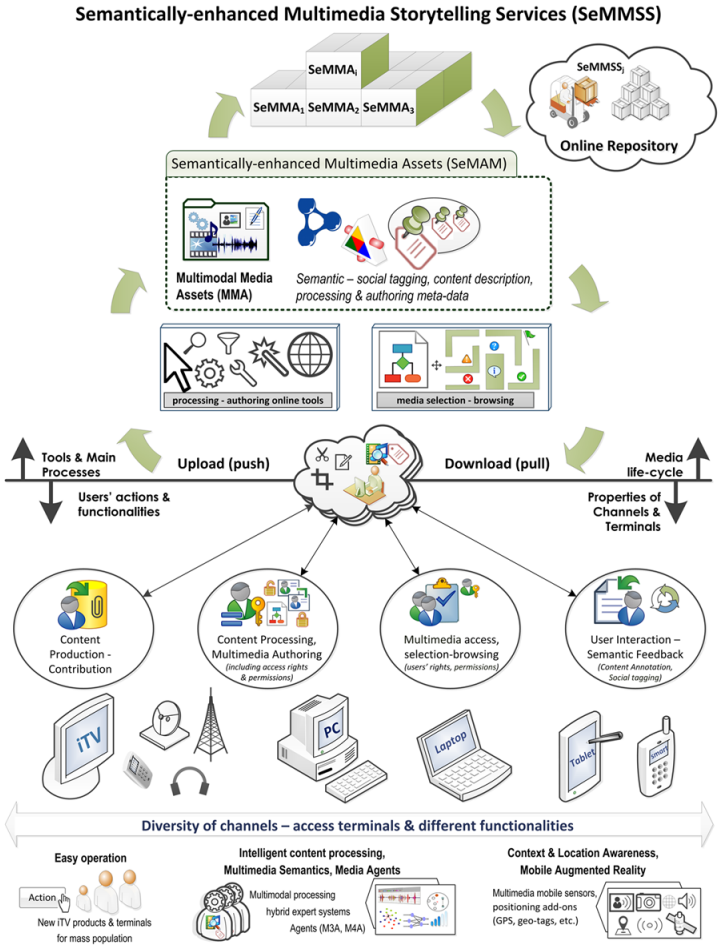
social tagging that are usually involved in Web 2.0/3.0 services can be augmented by and/or combined with the multimedia authoring choices. Thus, production organization and scripting can be part of the annotation and visualization meta-information (Ma, Liu, Wang, Teng, & Dai, 2012), while editing and authoring information can be logged into semantic meta-data (Dimoulas et al., 2014a; 2015). Most of the AV-authoring tasks (i.e. AV-production, clip selection-editing, navigation flow programming, etc.) can contribute to content description and meta-processing (i.e. keyword labeling, semantic tagging, topic and context classification, event detection-segmentation, long-term story summarization-highlighting, etc.). In fact, these tasks can now be easier and more creatively completed as part of the authoring process and not as separate obligatory annotation procedures. Similarly, end-users' interactions can also provide collaborative feedback for hypermedia adaptation and personalization, search-log-based annotations, social tagging and media recommendation (Dos Santos & Muchaluat-Saade, 2012; Monaghan et al., 2011; Tsikrika, Diou, de Vries & Delopoulos, 2011; Tsirellis & Delopoulos, 2011). Hence, storyline extraction, semantic conceptualization, intelligent content-based searching and retrieval can be supported, offering increased media management automation. Along with these, state of the art pervasive context- and location-aware services, serious games, ubiquitous mobile computing and augmented reality further enhance HMI experience, extending users' participation through a plethora of platforms and interface terminals (Atzori et al., 2012; Cordara et al., 2013; Dimoulas et al., 2014a; 2014b; 2015; Dimoulas & Symeonidis, 2015; Kalliris et al., 2014; Kotsakis et al., 2014; Matsiola et al., 2015).

A semantically enhanced media authoring model (SeMAM) is proposed in Figure 2, where the term authoring has a broader meaning, incorporating all the processes of content (and meta-data) production, processing (selection, editing, etc.), programming (multimedia authoring) and sharing, thus integrating the previously mentioned multimodal semantic interaction, context-awareness and adaptation features. Based on this model, MMA entities are assembled along with semantic and storytelling meta-data, forming the Semantically-enhanced Multimedia Assets (SeMMA), which correspond to the SeMM resources involved in an authoring project. SeMMA incorporate basic multimedia communication and interaction functionalities and can be combined as building blocks of semantically-enhanced multimedia storytelling services (SeMMSS), favoring the construction of semantic composition-decomposition models. Thus, semantic meta-data of all the edited-authored assets are also assembled, generating a composite semantic outcome. In this context, a complex semantic analysis tasks is delivered via semantic decomposition-composition of all the combined hypermedia assets and their editing (/authoring) decision lists (Dimoulas et al., 2014a; 2015). The construction of SeMM/SeMMSS repositories promotes sophisticated management with improved content selection, adaptation and reuse capabilities in the entire media life-cycle. The above are graphically presented in the upper part of Figure 2, where tools and main processes of the entire media lifecycle are depicted. It is obvious that an infinite number of users and user-groups can participate throughout the end-to-end shared-media chain, where the separate roles of producers and consumers no longer exist.

A diversity of devices is also exploited offering different features (depicted in lower part of Figure 2). Specifically, servers and powerful cloud computing terminals can be used for content storage, processing and intelligent semantic analysis services. Mobile terminals and their multimedia sensors are applicable in pervasive and/or immersive applications, while future iTV sets will allow for easy multimedia browsing that can be offered to the mass population without requiring special skills and knowhow. Furthermore, intelligent systems and media agents (M3A, M4A, etc.) are expected to play a very crucial role, sensing and adapting to the users' needs, while diminishing large-scale content and meta-data heterogeneity. Hence, content recognition and semantic conceptualization, voice command-

ing and multilingual adaptation or even virtual presentation through avatars and digital characters can be deployed, diminishing interfacing limitations (especially in mobile terminals), while facing various issues related to users' privacy. In addition to the versatile and/or multilingual information structuring, SeMMSS offer new presentation capabilities. Following the citizens-journalism paradigm, multiple UGC contributions on the same story can provide different points of view, offering increased user experience (i.e. multi-view selection, augmented projection, 3D-reproduction, panoramic and time-lapse virtual navigation, etc.). This can be very constructive in heritage projects, promoting multichannel content enhancement-restoration, archiving and documentation. Again, all these processes and their multimedia consumption counterparts can also contribute to semantic meta-data enhancement. On the other hand, security issues arise regarding systems, content rights and users' privacy, creating further difficulties and computational overheads, but also requiring the standardization of applicable mechanisms (Dimoulas & Symeonidis, 2015; Dimoulas et al., 2014a; 2014b; 2015; Kotsakis, Mislow, Kalliris & Matsiola, 2015; Matsiola et al., 2015; Sidiropoulos et al., 2015; Tsipas et al., 2015; Vrysis et al., 2015). The answer to these questions will determine future research directions and progress of hypermedia.

Figure 2. An integrated semantically enhanced media authoring model (SeMAM)



FUTURE RESEARCH DIRECTIONS

Considering the processes that SeMMSS authoring and sharing involve, there are many functional issues and technical challenges associated with the increased processing and bandwidth demands, and the applicable interaction modes that need to be properly addressed. It is quite difficult to encounter examples of multimedia services that incorporate all the above augmented interaction concepts. Neither it is easy, as in the case of text and images, to post, process online and author AV material in multimedia storytelling. One of the reasons can be found on the very interdisciplinary nature of web-docs and hyper-videos. Multimedia web authoring technologies cannot be easily adopted and utilized by the creators, since they usually don't possess software programming skills and knowhow. Thus, a plethora of user friendly web-doc authoring and hypermedia platforms were developed during the last years. Many of them appear in the cyberspace with many ambitious plans but soon disappear. This fact implies that although a high demand exists due to audience attraction for such kind of expression media, a viable and sustainable business model has not yet been found for these platforms. Furthermore, large-scale interoperability between different media formats, terminals and platforms is difficult to achieve, while security issues remain crucial, especially for augmented hypermedia services (Dimoulas et al., 2014a; 2014b; 2015; Veglis et al., 2016). Similarly, censorship actions are required and are expected to be more demanding for AV content (Chen & Wang, 2010; Koumartzis & Veglis; 2011).

Another important issue is related to the fact that multimodal intelligent content processing and semantic interaction techniques have many prerequisites and they have not yet reached a maturity for large-scale real world applications. Nevertheless, research is ongoing, investigating new descriptive AV-features (Cordara et al., 2013; Dimoulas et al., 2011; Kalliris et al., 2014; Kotsakis et al., 2012; 2014; Vegiris et al., 2009), flexible ground truth acquisition and linking mechanisms (Monaghan et al., 2011; Tsikrika et al., 2011; Tsirelis & Delopoulos, 2013), hybrid smart systems and multimodal decision-making approaches (Dimoulas et al., 2008; 2011; Diou et al., 2010). In this context, emotional control, augmented interaction, content filtering, semantic annotation and retrieval are further promoted (Chen & Wang,2010; Dimoulas & Symeonidis, 2015; Kalliris et al., 2014; Kotsakis et al., 2012; 2014; Matsiola et al., 2015). Perhaps, this is the real opportunity for the proposed SeMAM model to simultaneously serve, integrate and enhance all the augmented interaction and adaptation features of the future semantic-web services.

CONCLUSION

The current chapter focuses on the technologies of semantically-enhanced authoring of shared media. Current trends and future perspectives are analyzed. A semantically enhanced media authoring model (SeMAM) is proposed, integrating most of the expected progress in augmented user interaction and the upcoming Web 2.0/3.0 services. The targeted Semantically-enhanced Multimedia Storytelling Services (SeMMSS) aim at engaging audience members individually, validating their involvement and positively reinforcing personal participation in the narration. The expected result is intense loyalty, long-term engagement and a desire to share the experience. Although there are many issues that still require careful attention, current state of the art and research progress reveal that semantically-enhanced (collaborative) authoring of shared media will dominate. Hence, new perspectives are offered for the preservation of AV documents from the past, the exploitation of present and upcoming multimedia technologies and their dissemination with added value storytelling services in the future.

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KEY TERMS AND DEFINITIONS

Hypermedia: Combination of the linking mechanisms of hypertext and the multimodal presentation of information that is inherent in multimedia.

Multimodal Media Agents (M3A): Media services able to sense its surrounding environments (at multiple levels, semiotic modes and/or communication channels) and autonomously adapt on their changes, responding on behalf of other (software) entities and human interactions.

Multimodal Media Assets (MMA): A hybrid model of mixed time-based and page-based media (TBM, PBM) that are combined in non-linear presentation forms.

Semantic Interaction: Multimodal feature-based HMI utilizing artificial intelligence for concept recognition, semantic conceptualization and communication.

Semantically-Enhanced Media Authoring Model (SeMAM): A multimedia storytelling and authoring model that combines semantically-enhanced multimedia assets (SeMMA) with additional meta-data related to authoring decisions, augmented interaction and semantic feedback.

Semantically-Enhanced Multimedia (SeMM): Multimedia resources enhanced in semantic level through meta-data provided from many different users and groups, during the processes of production, authoring, sharing and consumption.

Semantically-Enhanced Multimedia Assets (SeMMA): Composite assets containing multimodal media (MMA) with authoring and semantic meta-data (SeMM serving as SeMMSS building blocks).

Semantically-Enhanced Multimedia Storytelling Services (SeMMSS): Multimedia services that combine various semantically-enhanced multimedia assets along with semantic meta-data and associated storytelling properties.

Web-Documentary: Documentary delivered through web, usually exploiting non-linear narration with multiple media and enhanced interaction scenarios.

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Chapter 23
Transmedia and Transliteracy in Nemetical Analysis

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ABSTRACT

The increasing diversification of interconnected media platforms, which provide a complex discourse, demands an effective use of the space that is now called "transmedia." This chapter provides terms and definitions for transmedia and for the new set of personal skills and abilities required to participate in it. It also presents the nemetic system, which facilitates analyzing, tracking, and visualizing communication interactions in virtual transmedia environments. Learning to use these new media platforms requires skills beyond the traditional listening and reading to be able to integrate multiple messages in multiple codes as an essential skill both for personal and professional communication. This transliteracy is a complex ability of intertextual navigation, the strategy for coding and decoding the multidiscourse in the digital ecosystem.

INTRODUCTION

The increasing diversification of interconnected media platforms, which provide a complex discourse, demands an effective use of the space that is now called "transmedia." This article provides terms and definitions for transmedia and for the new set of personal skills and abilities required to participate in it: "transliteracy." It also presents the nemetic system, which facilitates analyzing, tracking, and visualizing communication interactions in virtual transmedia environments.

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Since humans started to use both gestural and oral codes to communicate, messages have been elaborated and expressed differently when different communication channels were in use. In recent times, with the dawn of radio and television, that fragmentation of content has become of interest to researchers (Steinberg, 2012), and has been identified as a characteristic of mass media (McLuhan, 1994).

With social media, content is fragmented across multiple virtual and physical platforms, with varying degrees of interaction that add complexity to social communication. Interactivity among multiple authors and multiple audiences generates dynamic "cross-media" seriality, "transmedia narrative" that has been studied from educational, entertainment, and sociological points of view (Dena, 2009).

Learning to use these media requires skills beyond the traditional listening and reading, to be able to integrate multiple messages in multiple codes, as an essential skill both for personal and professional communication. This transliteracy is a complex ability of intertextual navigation, the strategy for coding and decoding the multidiscourse in the digital ecosystem.

These recursive communication experiences are the subject of recent research (Duarte, 2014) that explores cognitive patterns in narrative that can be represented through geometric models, consolidating the use of the term "fractal narrative" in the transmedia context. The aim of this multilevel analysis is to take into account individual discourse (micro level), collective interaction (meso level) and community knowledge building (macro level). Interested readers will find a practical example of this in the documentation of the co-creative process that led to Daniel Durrant's representation of a NEME (Figure 2 of this article) (Nemetics Institute, 2015).

In December 2010, Mark Frazier had explored the fractal essence of digital discourse, and debated with Spiro Spiliadis, Daniel Durrant, and Michael Josefowicz the possibilities of expressing its complexity using a symbolic language (Frazier, 2010). After this early work with Ebdish (Emergent by Design'ish), the nemetic system has emerged as a more elaborated code to express and visualize interactive communication processes in the transmedia ecosystem (De, 2014).

BACKGROUND: TERMS AND CONCEPTS

Transmedia

The term "transmedia" is attributed to Marsha Kinder, who in 1991 used it to refer to an emerging entertainment supersystem, involving intertextuality and multiple sources with different levels of interaction (Kinder, 1991). It applied to tools, processes, and concepts, and opened the door to media that had not been invented then, such as wearables, implants, or augmented reality devices.

In 2003 Henry Jenkins described a process of "transmedia storytelling" in which "each medium does what it does best, so that a story might be introduced in a film, expanded through television, novels, and comics, and its world might be explored and experienced through game play." (Jenkins, 2003) Later, he defined transmedia storytelling as a process "where integral elements of a fiction get dispersed systematically across multiple delivery channels for the purpose of creating a unified and coordinated entertainment experience." (Jenkins, 2007)

Probably the best-known example of transmedia storytelling is the Star Wars franchise. The fictional universe of Luke Skywalker, Yoda, Han Solo, Darth Vader, and Lord Sith is created through the synergy of films, books, role playing games, comics, video games, toys, and animated shows, to create a collective imaginary world. But transmedia storytelling is not limited to the entertainment world.

The notion of multiplatform narrative is expanding now to encompass every type of human communication, including marketing (Tenderich, 2014), political debates (Costanza-Chock, 2014), or personal learning networks (Richardson & Mancabelli, 2011). There is a need to identify the skills required to use transmedia, the processes for teaching and learning transmedia skills, and the techniques to analyze transmedia production and its metadata.

Transliteracy

The evolution from media to transmedia requires individuals to pass from personal linear communication skills and abilities (reading, writing, speaking, etc.) to intertextual skills. They include not only analogy, correlation, mental association, context awareness, or synthesis, but also empathy, engagement, and other emotional appreciations, essential to integrate and combine fragments of meaning into the holistic comprehension of a story.

The combination of these complex abilities can be understood as a new competency called transliteracy. Transliteracy has been defined as "the ability to read, write and interact across a range of platforms, tools and media from signing and orality through handwriting, print, TV, radio and film, to digital social networks." (Thomas, 2005)

In transliteracy, a coherent discourse is perceived through a series of transmedia fragments. It requires participants to move from discrete, perceptive skills to compound, intangible projective skills that can facilitate strategic thinking and collective problem solving. Interactions such as debating, negotiating, conciliating, or collaborating on social platforms are high value-added skills and become the energy for emerging collective creativity.

It would be impossible, for example, to understand the phenomenon of global warming and its varied impacts, without some comprehension of how the climate changes; the effect of human activity on the atmosphere; human migratory patterns; changes in food sources and food production due to changes in land, oceanic, and atmospheric conditions, and thus on refugee crises and terrorist activity, as well. No one medium or information source is capable of adequately presenting all these interrelationships, but if we are able, not only to "read" information from a variety of sources, platforms, and media, but to integrate it, and understand it as a complex holistic tangle of phenomena, we are using transliteracy to gain a higher level of consciousness, or "mindfulness," about the subject.

Both transmedia and transliteracy are going to change the way we perceive learning and professional training, in universities and professional environments. Language and communication skills, necessary to understand and produce useful knowledge, are more and more related to the abilities to create, join, and maintain communities of interest, and build personal digital networks (Rajagopal, 2012).

Nemetics

Where transmedia is the framework for communication, and transliteracy is the skill for interaction, Nemetics is the analytic tool. Nemetics functions as a fractal meta-language that facilitates communication among researchers in different disciplines to debate about complexity. The multilayer nemetics system provides a methodology for connectivist action-research and action-reflection in transmedia, including several meta-codes for visualizing procedures and results.

The essentials of Nemetics can be summarized in a simple mnemonic acrostic, which describes learning in any context at any level. At its most effective it is:

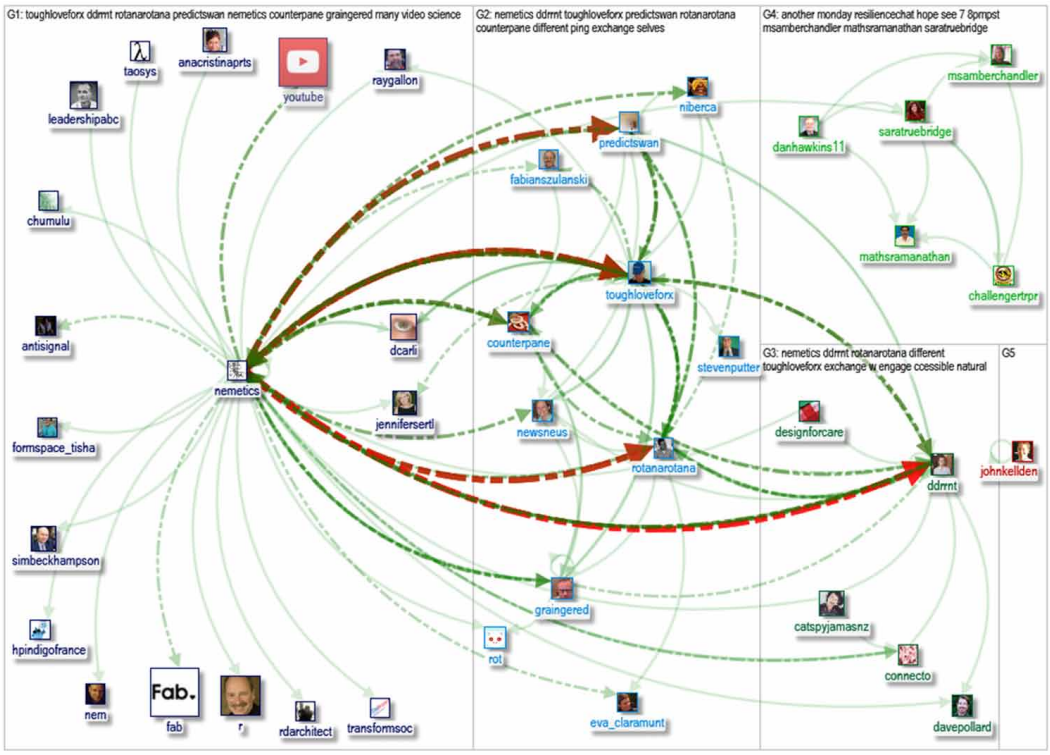
- Notice without preconceptions (N).
- Engage without judgment (E).
- Mull before communicating or acting (M).
- Exchange in the appropriate way and time (E)

This basic path, (Notice. Engage. Mull. Exchange,) recalling the traditional Bloom taxonomy (Anderson et al. 2001), retrieves four action levels that may or may not be performed during interactions (after each verb, add the option, "or not").

The whole conversation is then conceptualized as a single identified process, a NEME that can be seen as a coherent unit, represented visually by the interactions that took place during the debate. The analysis of these nemes shows patterns and waves of exchange that offer extremely rich information (big data) both about the media environment and the participants. The basic initial model is the communicative sociogramme [Figure 1].

At the individual level, a NEME translates as a meta-cognitive routine; at collective levels, the study of NEME patterns can be useful for showing mental models that can serve as universals in further communicative analysis, and in designing debate strategies.

Figure 1. Communicative sociogramme. The graph represents a network of 40 Twitter users whose recent tweets contained "nemetics," or who were replied to or mentioned in those tweets, taken from a data set limited to a maximum of 18,000 tweets. The network was obtained from Twitter on Monday, 06 July 2015 at 22:51 UTC.



Taken as a unit, a NEME routine - that concludes with consensual knowledge - can be the starting point from which new debates can arise. This recursivity had already been studied in The Knowledge Forum, another international Computer Mediated Communication experience (Bereiter & Scardamalia, 2006), and has been identified as a path into high order thinking (HOT) processes (Rehage, 1994).

From routine building to big data analysis, nemetics includes the dimension of self-reflection, professional development, and organizational transformation. The obtained global vision contributes to leadership and resource management, focused on integrated learning - self and collective - and helps expand consciousness and engagement towards complex problem solving.

Nemetics helps express a new way of thinking about human communication that involves co-creation in complex adaptive/creative environments, and is being developed by the International Nemetics Institute: Care is taken not to define the discipline or its boundaries very rigidly. This is because once it is rigidly defined it also rigidly limits the development of the subject, its evolution and expanse it might cover. In short, any rigid definition would limit the discipline's adaptability to future changes in human conceptual understanding and knowledge or application in a different domain than what is envisaged right now. (De, 2012)

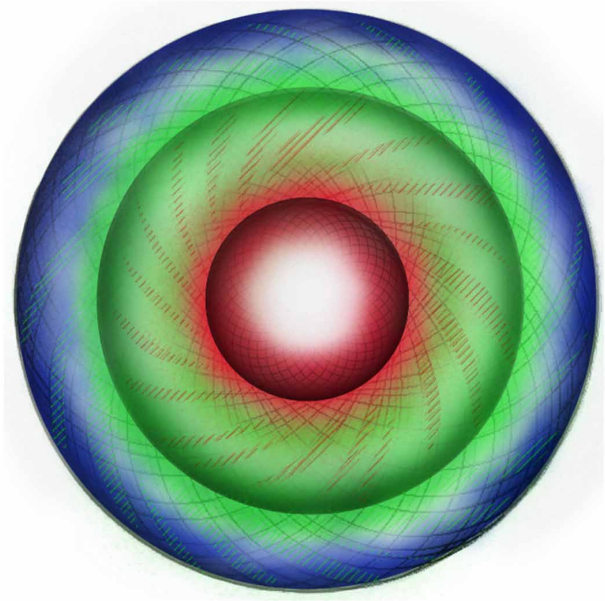
Used as the meta-language for recursive analysis, nemetics shows interactive thinking processes, collaborative debates and a collective cognitive resonance, through debate, discussion, negotiation, and compromise. This nemetical world is hierarchical, in the sense commonly used in complexity discourse, and it is composed of several nested spheres:

- NEMES,
- nemiString,
- nemiTube,
- nemiPlex,
- nemiCell,
- nemiShape.

Avoiding bottom up or top down hierarchies, the nemetic language works as in concentric spheres, from inside to outside, and from outside to inside. Any sphere can be seen as a NEME, where the proximate inner sphere is the source of energy. The proximate outer sphere is the source of constraints [Figure 2]. In addition, there are flows of energy within and between spheres.

This nemetic code can be used as a common language to shape complexity, and the fuzziness of the code is the source of its strength. It has allowed networks to research and exchange about innovation, education, history, political economy, design, or art across the fields of different disciplines, specialities and cultures. Nemetic research itself evolves by reproducing experiences of transliteracy in transmedia spaces.

Figure 2. Spheres of nested complexity



NEMETICS RESEARCH ON TRANSMEDIA AND TRANSLITERACY

Context Analysis

In transmedia, the process is the product. Emerging experiences can be identified on the Internet by studying interaction sequences, exchange paths, and conversational structure, in augmented communication situations.

Nemetics should be understood as an ongoing process that is also a series of products. Context analysis becomes part of the production, and shows the internal process of collective debate and creation:

The power of transmedia is to make collaboration on even serious academic documents simple with almost no strain. No meetings. No phone calls. No schedules. Everyone works in their personal time. Inserts into any number of places. Goes away and waits for a response. (Josefowicz, 2015)

The International Nemetics Institutes provides a collaborative space for debating and exploring complexity from different scientific disciplines, by developing training and learning scenarios for hands-on problem solving in business, education and management fields. The main aim of this initiative is both process and product oriented. The process, begun in 2010, is an emergent intentional learning community that publishes blogs and social media posts, and performs open debates on twitter and other synchronic channels, offering the publication of a print newspaper and presentations in face-to-face training courses. The products include the founding of The International Nemetics Institute (TINI), based in Kolkata, India, and its subsidiary, The Nemetic Institute of Art and Science (NIASK).

Case Study

The creation of the International Nemetics Institute is itself the result of collaborative interaction in the transmedia sphere with proactive intentions. The main aim was to provide a professional environment for Nemetics training and Nemetics community building. With a wide presence on the web, the International Nemetics Institute emerged from debates on Twitter, reflections on Google Plus forums, exchange of visual ideas in PowerPoint presentations, and dynamic groups of interest on LinkedIn. The Institute building process, in itself, is an example of collective transmedia emergence.

Overview

The process that led to the emergence of the Institute is best described by the term synchrodipity (Robertson, 2011), used to express the combination of synchronicity and serendipity that describes the starting sequence.

Main steps and key players:

- It was generated on the *Emergent by Design Blog*.
- It evolved into the Ebdish wiki (Michael Josefowicz, Daniel Durrant & Mark Frazier).
- Planning conversations emerged on twitter, under the hashtag #nemetics, with references to texts, images, sound, and videos.
- The dynamic conversations attracted international experts in Red Deer, Alberta, Canada (Sean Grainger), and Kolkata, India (Dibyendu De), Barcelona, Catalonia (Ray Gallon, Neus Lorenzo), and in Paris, France (Rotana Ty).
- Conversations expanded to Google Plus forums and LinkedIn groups.
- Mashups and image galleries are complementing textual discourse.
- Face to face meetings have taken place in different countries.
- Simultaneous conversations are flowing through different platforms, expanded into mind mapping, wave tank experiments, and 3D modeling.

Transmedia Environments

Nemetics presence can be tracked across several platforms and co-creation spaces:

- **Blog:** http://rgbwaves.com/category/nemetics/
- YouTube Channel (TINI. The International Nemetics Institute): http://www.youtube.com/channel/UCAes2xe3XVYTiaOyCCkdoTA)
- **Google Plus (+RapidInnovationOrg):** https://plus.google.com/+RapidinnovationOrg/about), (+google.com/+NemeticsinstituteGlobal)
- **Twitter:** @NEMETICS
- **LinkedIn:** https://www.linkedin.com/pub/international-nemetics-institute/84/14/3b3
- **Collaborative Organization:** The Transformation Society, http://www.transformationsociety.net/ publishing on Slideshare (http://www.slideshare.net/TransformationSociety/presentations) and on Twitter as @TransformSoc.

Different literacies are being developed in each one of these platforms, and across all of them, resulting in a new collaborative transliteracy.

Results: Analyzing the Behavior of Complex Creative Systems

The process has led to several results:

- From the transmedia debate, a research community has emerged and aggregated.
- The discipline of nemetics has been built across a network of connections, shaping an analytical tool set to engage wicked problems, such as the creation of an International Institute.
- A glossary of nemetic terms has been mapped to the nervous system, using a biomimicry model of communication in the tradition of memetics (Dawkins, 1989). Where a meme is a replicator in the cultural and cognitive context, equivalent to the gene in biology, the NEME is a replicator in the context of Complex Creative System (CCS).
- The same tools used to analyze the complexity of biology, are also used to analyze any other organic complexity. In nemetics, the model is the nervous system. Under this paradigm, a set of fractal analogies can be derived for studying transmedia co-creation and collective resonance:
    - The NEME is like a neuron. (In Transmedia it can be a shared idea, a closed dialogue, a formulated hypothesis...).
    - Bundles of NEMEs, called nemiStrings, are neural networks. (It can be an open debate, teamwork, group action, shared discussion…)
    - Bundles of nemiStrings are nemiTubes, like the nerve bundles found in the spinal column. (Communication exchanged in simultaneous discussions, joined teams from different platforms, augmented information management on several channels...)
    - A nemiShape is the well-bounded interaction of the elements above, like the brain functioning within the skull. (It could be the community engaged in the same disciplinary debate, a social group sharing an aim, a formulated paradigm wherein debates can evolve).
- This structured landscape of neurons generates a complex creative system that is organically evolving, transforming, and reshaping itself, reproducing the recursive evolution of conversations, debates, and concept creation.
- Further results include mathematical representations of this complexity, diversification of narrative, and integration of meaning: mind maps, 3D animations, and visualized fragmented dialogues.

Current Hypothesis

Nemetics analysis provides a common code to researchers in different fields.

The recursive, fractal nature of NEME means that any level of complexity can be categorized as a NEME to clarify analysis. In a different discipline, for example, history, a singular event is a NEME at the level of events. Zooming in, the event devolves to vibrant nemiTubes of a diversity of social consequences, economic resonances, and cultural impacts. Following the fractal principle of self-similarity, an economic consequence is also a NEME on the level of analysis of consequences, and zooming in still further, consequences would have nemiTubes of market fluctuations and policies. In Geography, the metaphor can include trophic layers, like soil, plants, or animals (Provenza et al, 2013).

The concept of "narrative fractal" is transposed, in nemetics, as a "nemiPlex." This nemiPlex is a complex of connected NEMEs that work the way an enzyme works in biology, as a catalyzer of processes. The existence of a nemiPlex in the system catalyzes the process of the emergence of nemiStrings and nemiTubes. Importantly, a nemiPlex is strongest when it results from a diverse collaborative effort.

This is similar to what Lakoff refers to as a "metaphor" that facilitates an actor in "creating meaning." The metaphor is an at-hand "explanation" for a new event (Lakoff, 2003). In nemetics a metaphor is seen as a constellation of concepts that are triggered by the need to interact (Exchange). It points to the fact that knowledge flows in networks of people while information resides in static web resources. Good transliteracy practice in a well-developed nemiPlex can speed up transmedia integration, for example, in High Performance Teams or Intentional Communities.

FUTURE RESEARCH DIRECTIONS

Nemetic Analysis of transmedia spaces helps understand the emerging communication systems in complex environments, and to design formal and informal transliteracy learning. Several action-reflection itineraries can be developed, in formal and informal training, for improved efficiency in identifying leadership, team dynamics, and coordination applied to transmedia communication. The main objective is social action.

Future benefits will come from applying results to personal and professional fields that are now emerging in the hybrid physical-digital environment:

- Interacting with wicked problems (favoring useful and valuable emergences from inherently chaotic systems)
- Designing and planning organizational action (using big data to adapt social behavior)
- Integrating gamification into professional fields (creating new transmedia spaces)
- Aggregating expanded connections and Internet of Things (new kinds of transliteracies)
- Relating personally and professionally to wearables and bionic implants (facing ethical and moral issues in collective debates)
- Developing lifelong learning environments (dynamizing and moderating MOOCs, eLearning platforms and mLearning communities)

These lines of research tend naturally towards the creation of a transformation society, where collaboration and self-emerging initiatives generate and explore transmedia learning environments.

CONCLUSION

Examples such as the creation of The International Nemetics Institute are useful to tell the story of transliteracy emergence and transmedia evolution and develop an academic corpus for integrating both transmedia and transliteracy into the communicative disciplines.

The increasing proliferation of communications platforms and modalities resulting from emerging technologies means that transmedia and transliteracy are going to become ever more important. Nemetics provides a simple model for understanding and integrating both transmedia contexts and transliteracy skills, and for working in complex adaptive/creative systems.

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KEY TERMS AND DEFINITIONS

Intertext: A coherent text that shows a relationship to one or more other texts, where "text" is understood to mean any type of communicative content, typically forming a connected piece of work (includes images, sounds, video, etc.).

NEME: Mnemonic acronym for the fractal learning process of complex creative systems: Notice, Engage, Mull, Exchange.

Nemetics: A fractal code, evolved into a meta-language to facilitate communication among researchers in different disciplines in order to debate about complexity.

Synchrodipity: The compound interaction of synchronicity and serendipity, to produce a sense of discovery, delight, or well-being, and a sense of connectedness between people, ideas and actions, derived from the flow and the interconnectivity of all things.

Transliteracy: The ability to read, write, and interact across a variety of communication tools, media, and platforms, from text, orality, signing, or drawing, through handwriting, print, TV, radio, and films to electronic networks and social media on digital platforms. It is a necessary complex skill for receiving, interiorizing or producing Transmedia.

Transmedia: Complex communication interaction based on multimedia, multimodal, multiplatform, intertextual human communication, in which each medium or platform has a distinct role to play in communicating the complete content. This interaction acquires meaning with each participating element by rebuilding the fragmented discourse.

Wicked Problem: A problem that is difficult or impossible to solve, because of incomplete, contradictory, and changing requirements that are difficult to define, identify, or recognize. It often involves stakeholders who have radically different worldviews. In addition, complex interdependencies make it so that the effort to solve one aspect of a wicked problem may reveal or create new problems.

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Section 5

Social Networking and Computing

Chapter 24
Adolescents' Food Communication in Social Media:

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ABSTRACT

Social media is ubiquitous in the lives of adolescents. Social media permits users to upload and share contents pertinent to health such as food and nutrition communications. Studies show that the dissemination and sharing of food content is prevalent in these channels. Not only do messages of food serve a symbolic purpose in these online platforms, but this communication might also affect adolescents in both positive and negative ways in regards to health. Visual food messages can affect brain areas associated with appetite and influence dietary behaviors among adolescents similar to advertisements. The objective with this chapter is to elucidate the complex and interwoven relationship between food and nutrition, social media, and adolescents from a health communication perspective. The chapter draws upon empirical studies and results, as well as related conceptual literature. Methodological and theoretical explanations are discussed as well as practical implications. Future research directions are also outlined.

INTRODUCTION

Social media is ubiquitous in the lives of adolescents. The Swedish Media Council (2015) reports that 91% of Swedish adolescents between 13 and 16 years old use social media sites such as Facebook or Instagram and similar numbers exist in the US (Lenhart, Smith, Anderson, Duggan, & Perrin, 2015). Social media are usually defined as Internet-based services that permit users to construct personal profiles, generate and access searchable online content (e.g., images, videos), form online connections with other users, and view these social connections (CDC, 2011).

Considering the widespread use of social media, it is no surprise that much of the communication in these networks concern food and nutrition. Previous studies show that the dissemination and sharing of food content is prevalent in many of these channels (Holmberg, Chaplin, Hillman, & Berg, 2016). As Neely, Walton, and Stephens (2014) noted, the communication of food mirrors social and cultural values, and the social aspects of young people's food practices are important components of their wellbeing and

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health. Social media provides a unique opportunity to study adolescents' food communication without interfering with it, and in order to gain a better understanding of what food means to adolescents, it is crucial to study their online food communication.

Adolescents' online food communication is a pressing matter because online food communication affects adolescents in both positive and negative ways with regard to health (Holmberg, 2016). Not only does messages of food in social media platforms and channels serve a symbolic purpose concerning socio-cultural aspects of communication and discourse. A meta-analysis by van Meer et al. (2015) shows that food communication, such as food images, affects brain areas associated with appetite. Other experimental studies show that food communication in social media can affect dietary behaviors among adolescents (Bevelander, Anschutz, Creemers, Kleinjan, & Engels, 2013).

The goal of this chapter is to introduce a promising research direction regarding adolescents' food-related communication in social media. The objective is to elucidate the complex and interwoven relationship between food and nutrition, social media, and adolescents from a health promotion perspective. As such, this article will draw upon empirical studies and results as well as conceptual and methodological research literature.

BACKGROUND

The social nature of food and food practices - that is, the idea that food is a way to interact and connect with others - is crucial to promoting health. To better understand food and its complex relationship with social media, we need to consider how diets and food habits connect people culturally. While food and nutrients are necessary for human survival, they also function as important objects in culture and as rich sources for metaphor (Korthals, 2008). Some sociologists even aver that food is a total social fact (Mauss, 1967). The cultural dimension of food practices has been termed the "omnivore's dilemma" (Korthals, 2008) or "omnivore's paradox" (Fischler, 1988), based on the assumption that humans can eat a wide variety of things. Unlike specialized eaters, omnivores such as humans can thrive on a multitude of diets and lack inherent predilections for foods that are healthy. Culture thus becomes a primary factor that dictates human eating behaviors, which suggests that the social meaning and metaphors of food can affect food choices and implicate which types of food confer social acceptance.

Given that young people are heavy users of social media and that their usage is generally difficult for parents and guardians to monitor (McBride, 2011), it becomes critical to examine health and food messages in those channels. Research demonstrates that the adolescent period is marked by changes in body composition, physical activity, diet habits, and psychological issues. These issues put youths at an increased risk of adapting unhealthy lifestyles (Alberga, Sigal, Goldfield, Prud' homme, & Kenny, 2012). As Vuk Pisk et al. (2012) have documented, adolescence is therefore a critical time for identity formation and a very sensitive period where social ties and relationships with others grow in importance. Since adolescents' social networks function as important influences for their dietary habits, researcher in many fields, such as obesity research, emphasize the importance of further exploring these social network effects.

FOOD CONTENTS IN NUMEROUS SOCIAL MEDIA

Communication includes both the sending and receiving of messages. Online, adolescents are exposed to messages relating to food, but they also act as uploaders of food-related content such as images or videos of food items. Along these lines, there are a growing number of studies highlighting ways in which food communication is perpetuated through different types of social media applications.

Food blogs provide information and inspiration regarding recipes, meal ideas, and food items. As such, they have the capacity to shape adolescents' social norms regarding how, what, and where to eat. Schneider et al. (2013) found that popular American food blogs met energy recommendations but were excessive in saturated fat and sodium. The authors therefore suggested that the public should be aware of the nutritional limitations of common food blogs. Simunaniemi et al. (2011) analyzed how laypeople blogged about fruits and vegetables. The study revealed that the bloggers approached fruit and vegetables through either lived or mediated experiences and that self-expression that aimed to influence others' diets was common in these blogs. There are also examples of how blogs are used to foster controversial dietary practices. Using the spreadable media theory (Jenkins, Ford, & Green, 2013), research has shown that blogs allow for non-conventional experts to circumvent traditional peer-review processes by publishing in the public domain. Holmberg (2015) uses the example of how prominent low-carb high fat diet promoters in Sweden could reach a wide audience and appeal to a like-minded community of dieters by using self-made blogs and websites. Also microblogs such as Twitter have been analyzed in regards to food communication. Hingle et al. (2013) found that Twitter can provide a method for observing real-time food consumption and that this type of data visualization may present a method of identifying relationships between diet and behavior.

Media-sharing sites popular with adolescents, such as YouTube also propagate large amounts of food and diet information. Cerri et al. (2012) showed that a large number of the videos on YouTube labeled with the word "diet" did not contain this information. The researchers also found that a majority of the videos did not contain scientifically sound information and that videos often contained incomplete information. boyd and Ellison (2007) defined social network sites as:

… web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. (p. 211)

Facebook is the world's largest online social network site and it is no surprise that food-and-nutrition related content has been studied on this platform. Lohse (2013) found that Facebook is an effective strategy to recruit participants to nutrition education programs. There are also less healthy occurrences taking place on Facebook. Freeman et al. (2014) found that food companies promoting high calorie low nutrient food items (e.g. Coca-Cola) utilize the interactive aspects of Facebook to market their products. The study showed that these companies capitalize on users' social networks to magnify the reach and personal relevance of their marketing. Young users were particularly prone to this kind of online food marketing. A social network especially popular with younger individuals is Instagram (Pew Research Center, 2015). Studies have investigated both the food-related content on Instagram (Hu, Manikonda, & Kambhampati, 2014) and the overall communication of food images from the perspective of adolescents (Holmberg et al., 2016). Holmberg et al. (2016) found that food images shared on Instagram by adolescents was dominated by foods characterized as high calorie and low nutrient such as sodas and candy.

Why Can It Be Problematic?

As noted in previous examples food marketing transmitted through social media outlets are frequently transmitted by food companies producing less health food items. Montgomery and Chester (2011) outlined five kinds of digital marketing techniques that are used by fast food companies to target adolescents:1) augmented reality; such as online virtual environments that can decrease conscious attention to marketing techniques, 2) methods that include surveillance of users' behaviors online, 3) data gathering and behavioral tailoring intended to distribute individualized marketing, 4) location targeting which follow adolescents' activities and are able to link point of influence to point of purchase, 5) neuro-marketing, which draws on neuroscience methods to design digital marketing techniques intended to activate subconscious and emotional arousal. Many of these intrusive practices are intentionally aimed to draw on unconscious processes, circumventing the rational decision making that is central to the system of just marketing.

These integrated food advertisement campaigns reinforce commercial messages across several online platforms to engage individually with users. These campaigns may have greater impact than that of conventional marketing, especially among adolescent consumers (Kelly, Vandevijvere, Freeman, & Jenkin, 2015). Food brands have been noted to be a key factor in the success of food marketing. The perceptions of brands changes as children become older; children learn how to recognize commercial, supermarket and budget brands and attach different meaning to these brands. Roper and La Niece (2009) found that food brands were important for British schoolchildren, and they also noted that peers become more influential to consumption decisions as children move through the tweens. In their study, peer approval substituted family as the major influence behind consumption behavior.

This behavior seems to be perpetuated in social networking sites. Holmberg et al. (2016) found that labeled food products were highly prevalent in food images uploaded by adolescents on Instagram. Like the British study (Roper & La Niece, 2009), the presentation and display of certain food brands were important to present to peers in the adolescents' social networks. The idea of food as a signifier of status is not novel. Bourdieu (1984) critically discussed that our preferences for certain foods are reflected by our social position, and are themselves acts of social positioning. What is new however, is the pace and means by which food is communicated today. Food is no longer seen just as essential for the body; it has become a currency that can be used online for social status. Adolescents may increase their social capital by sharing desirable meals and food items through social media. In order to understand adolescents' practice of online food communication we need to delve further into the theoretical concepts surrounding adolescents' social food practices. Therefore, this chapter will continue to focus on online social networks which explore social dynamics among adolescents and how they could influence dietary habits and food consumption in different ways.

THEORETICAL FRAMEWORKS THAT CAN ADVISE RESEARCH

It is significant to recognize adolescents' influence on food choices and their active role in conveying family practices and customs. A review of youths' food practices and social relationships showed that food practices play multifaceted roles in adolescents' social lives, and that food communication influence different aspects of their social relationships. Aspects such as caring, sharing, integrating, trusting, interchanging, negotiating, and belonging was some of the features of relationships that were affected

through adolescents' different food practices (Neely et al., 2014). Salvy et al. (2012) sorted the influence of peers on adolescents' eating habits into impression management, and social facilitation and modeling. They also refer to the normative framework, put forth by Herman et al. (2003), while attempting to assimilate research concerning these collective mechanisms.

Impression Management and Social Facilitation

boyd (2007) draws on the work of Goffman (1959) when defining impression management among adolescents in online interaction. According to boyd, adolescents seek to define social situations online by using signs from the context around them. Social norms arise out of situations as adolescents learn to interpret cues from the environment and apprehend what considers appropriate behavior. The management of impressions is a vital social skill that is refined through experience. The adolescents learn how to create meaning out of a situation and others' reactions over time. boyd further argues that adolescents in a sense have more control online as they are able to more deliberately choose what information to put forward, thus reducing impulsive and spontaneous reactions that might have leaked out in everyday interaction. This understanding is important as the adolescents, to varying degrees, have an active choice in what kind of food communication they are transmitting online. Previous research indicates that in the presence of others, individuals tend to eat more than when eating alone. The leading explanation for the social facilitation of eating is the time-extension premise, which claims that the company of others ultimately encourages increased eating by prolonging the duration of the meal (Pliner, Bell, Hirsch, & Kinchla, 2006). However, overweight adolescents in experimental studies eat less snacks in social situations than normal weight adolescents, eat more when alone, and also eat more in the presence of overweight peers than in the presence of leaner peers (Salvy, 2009). For adolescents who are overweight or obese, other processes may overtake social facilitation. For instance, when considering the strong connection between overweight status and social stigma, it is credible to assume that overweight youths are particularly interested in making a successful impression on unacquainted peers. Thus, adolescents might manage their impression online by considering and curating the food messages they transmit to others.

While most studies based in social facilitation theory focuses on the means in which the presence of others influences behavior, researchers have claimed that individuals modify their behavior to that of others; that behavior is learned from the environment in a process of observational learning. This process is often referred to as social modeling (Bandura, 1977; Grusec, 1992). Online social modeling of food consumption has been observed among children and adolescents. Bevelander et al. (2012) showed by means of computer choice task with food pictures, that the use of fictional peers amplified children's inclination to try unfamiliar foods. A review of social modeling studies regarding food choice found that there was near universal support that food selection are influenced by the behaviors of others (Cruwys, Bevelander, & Hermans, 2015). The authors noted that there is indication that social modeling happens both because a), individuals seek information about suitable behaviors, motivated by reducing uncertainty, and b), because individuals want to identify with others, driven by an affiliation motive.

Whereas research on social modeling focus on modifications in persons' behaviors during the presence of others, research in the field of impression management aims to understand peoples' motivations to behave when in the company of others (Salvy et al., 2012). Impression management is often used interchangeably with self-presentation, where an individual seeks to influence the perception of their own image (boyd, 2007). Kümpel Nørgaard et al. (2013) showed that adolescents purchase and consume snacks that support their self-image when socializing with other peers. Krämer and Winter's (2008)

study indicated that self-efficacy with regard to impression management in a social networking site is strongly associated to the number of virtual friends, the level of profile detail, and the style of the profile photo. Eating less seems to be a way to demonstrate a good impression at any age, probably because obesity and overweight is socially stigmatized, and persons are inclined to associate negative characteristics (e.g., physically inactive, overeaters) with persons who eat large quantities of food (Vartanian, Herman, & Polivy, 2007). Nevertheless, significant exceptions do exist: as previously explained; food items have cultural and social implications, and particular types of foods (e.g. desirable food brands or unhealthy snack food) linked with social status may be consumed and presented to others. Researchers have primarily linked this to young individuals' inclination to express a positive impression amongst peers, which is emphasized during adolescence when peer consent becomes progressively important (Roper & La Niece, 2009).

Normative and Social Network Theories

One way to assimilate the mechanisms of social influences of eating is to adhere to Herman et al.'s (2003) normative structure, accounting for the influences of others on eating behavior. According to Aronson et al. (2010), social norms are defined as the procedures within a group for the tolerable behaviors, values, and beliefs of its members. The normative model suggests that, in the company of appetizing food, and when absent of other constrictions, individuals are motivated to eat as much as possible and that the presence of others is what governs when consumption stops. Consequently, social norms mainly function as inhibitory mechanisms, signifying when people should stop eating if they want to be socially appropriate. There are indications that apparent peer norms (descriptive norms; e.g. what the person thinks important others do) are even stronger connected to adolescents' soft drink consumption than the actual behavior of the peer group (Perkins, Perkins, & Craig, 2010). Lally et al. (2011) also showed that descriptive norms were strongly correlated with consumption of fruit and vegetables, soft drinks, and unhealthy snacks. However, the study did not identify an association between injunctive norms (i.e. beliefs about how a person should behave) and dietary intake.

Adolescents are exposed to the food related norms and influences of peers in their extended online networks. Although adolescents will normally add friends and acquaintances as 'friends', they will also add people since it would be socially inelegant to decline friendship requests, because they make the adolescent seem cool, or merely because it would be fascinating to follow their uploads (boyd, 2007). Because 'friends' are displayed on the adolescents' online profile, they also provide meaningful information about that person. This reflection is significant for food communication as eating is usually a highly communal experience (Delormier, Frohlich, & Potvin, 2009). When adolescents share photos of foods they experience, the photos also becomes a confirmation of the larger event experience with other individuals; they want people to know who they participated with. A desirable lifestyle therefore includes the opportunity to share exclusive foods via one's online social networks. Facebook users can for example see food-related pages that members of their online social network have endorsed (e.g. 'liked'), and also food content they post. This may establish social norms around certain foods high in social status.

Stok et al. (2013) investigated whether communicating health-promoting descriptive and injunctive norms influences adolescents' intended and actual fruit consumption. The researchers distributed booklets with informational text regarding the consumption of fruit and vegetables to the students. They found that booklets containing descriptive norms influenced consumption but not intentions. The researchers also found that the injunctive norms not only had no positive effect, but that they could potentially decrease

fruit intake. The authors discussed that injunctive norms could lead persons to feel like they were being pushed in a certain track by the source distributing the norm, particularly when the norm was not in line with their personal beliefs. Conversely, the researchers thought that descriptive norms could motivate by indicating what would be effective and adaptive behavior in a particular situation.

The normative structure is particularly useful when interpreting recent evidence that obesity and obesogenic behaviors tend to cluster in adolescents' social networks (Salvy et al., 2012). Research conducted in the field of social psychology has showed that adolescents' consumption of snacks and soft drinks was related with their peers' intake (Wouters, Larsen, Kremers, Dagnelie, & Geenen, 2010). The researchers also found that the correlations between individual and peer snack intake was particularly strong among boys and youths with lower body weights. Food intake is often underreported in adolescents as well as adults with obesity, compared with their normal weight peers. Bevelander et al. (2011) showed that not only are adolescents' influenced by their peers when it comes to consuming foods, teenagers also influence each other when it comes to food purchases; girls' higher calorie food purchases are correlated with their peers' food purchases. Since friends share their snacking behaviors, education and interventions need to address both the individual snacking practice as well as the social component of snacking.

FUTURE RESEARCH DIRECTIONS

Considering the widespread use of social media applications among adolescents, future experimental studies are needed to examine whether social media networks such as Instagram, blogs, and Facebook actually influence adolescents' food habits. Specifically, research is needed to explore how the content and delivery of information on social media appeals and engages adolescents, stimulates behavior change, sustains behavior change, and how social media impact obesity risks in adolescents. This literature review also emphasize that there are theoretical underpinnings that need to be explored and developed further, especially concerning their usability in social media studies involving adolescents.

CONCLUSION

This chapter employs different theoretical and analytic frameworks that suggest social media as an evolving setting for social influence on adolescents' dietary habits, which also have contiguous impacts on children's health risks such as obesity. Social modeling, normative theory, and network theory are all relevant frameworks that can be used to explore how social media influences adolescents' food practices.

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KEY TERMS AND DEFINITIONS

Impression Management: Conscious or subconscious procedure in which adolescents attempt to influence the perceptions of themselves. This is done by regulating and adjusting information in social interaction.

Online Social Networks: Online services that permits individuals to construct a public or semi-public profile within a network, and specify other users with whom they share a connection.

Social Facilitation: A theory that suggests that there is an improvement in performance produced by the actual, imagined or implied presence of others.

Social Media: Umbrella term for Internet-based services and applications that permit its users to construct individual personal profiles, generate and access searchable online content (e.g., images, videos), form online connections with other users, and view these social connections.

Social Modeling: A theory that stipulates that we learn to imitate others by observing their behavior and that we learn to behave in certain ways by watching others do what they do.

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Chapter 25
Agent-Based Social Networks

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ABSTRACT

Social networking sites have deeply changed the face of the web in the last years. Although the current approach to build social networking systems is to create huge centralized systems owned by a single company. Such a strategy has many drawbacks (e.g., lack of privacy, lack of anonymity, risks of censorship, and operating costs). Therefore, a decentralized architecture may offer several advantages, but it may involve some security and design issues that are not present in traditional social networks. This chapter has the goal of introducing social networks and how they can take advantages of a decentralized architecture and how the use of multi-agent technologies help to cope with its security and design issues and, in addition, to support the creation of innovative services for its users.

INTRODUCTION

Social networking sites have deeply changed the face of the web in the last decade. Social web sites have attracted users with very weak interest in technology, including people that before the social networking revolution were not even regular users of other popular Internet services and computers in general (Stroud, 2008). The phenomenon is so widespread that many people started using social networking systems to ask questions directly to people instead of querying search engines (Morris et al., 2010) and in place of regular email. Moreover, some of the largest social networking sites constitute a separate and closed network (Sabbag, 2011). After the huge success of the early social networking systems, many other players came in the social networking market and nowadays hundreds of different social networking systems exist. Even if the social networking systems are greatly dissimilar in their user base and functionality, they are almost always centralized systems. The centralized nature allows a simple browser-based user

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experience and, moreover, many algorithms, e.g., friend suggestion, are far easier and more efficient to implement in this setting. However, such a solution has many drawbacks, e.g., lack of privacy, lack of anonymity, risks of censorship and operating costs. Therefore, a decentralized architecture may offer several advantages, but it may involve some security and design issues that are not present in traditional social networks. This chapter has the goal of introducing social networks and how they can take advantages of a decentralized architecture and how the use of multi agent technologies help to cope with its security and design issues and, in addition, to support the creation of innovative services for its users.

BACKGROUND

Social networks can be defined as structures consisting of a finite set of actors and the relation or relations defined on them, where an actor is simply a discrete individual or a social unit (Wasserman & Faust, 1994). Social networking system are implemented as web-sites allowing users to have a profile and managing their online social network, i.e., such systems allow them to: (i) construct a profile which represents them in the system; (ii) create a list of users with whom they share a connection and (iii) navigate their list of connections and that of their friends (Ellison, 2007).

Although we agree that self-presentation and social network management are extremely important and necessary components of a social networking system, we believe that the social networking revolution is far more related to the paradigm shift that transformed most people from mere consumers of information to full-fledged information producers. Most people create information which is essentially personal and, then, it is mainly of interest for friends and acquaintances. Before the social web revolution such information used to be essentially lost in the web, while, nowadays social networking systems are able to deliver the information to the "right" people.

After the huge success of the early social networking systems, many other players came in the social networking market and nowadays hundreds of different social networking systems exist. Even if the social networking systems are greatly dissimilar in their user base and functionality, they are almost always centralized systems because of the access and implementation advantages.

A minor drawback is that scaling centralized systems to tens or hundreds of million of users is not an easy task. At any rate, we consider this drawback as a minor one, since the problem can be solved providing enough resources. However, the huge operative costs of supporting the infrastructure necessary to provide the service to millions of users can only be justified with robust business plans. While some social networking services have extremely differentiated business models (McGrath 2010), for most of them the primary source of income is advertisement and consequently they have a strong motive for: (i) using user provided data to increase performance for that purpose and (ii) even giving access to authorized commercial third parties to the raw data. This behavior poses serious threats to privacy and data protection issues, especially considering that there is no clear legislation on what uses of the user data are legitimate, and regarding the conditions for disclosing the data to third parties, especially when the subjects involved are from different countries.

Another problem is that social networking systems have terms of service that their users give to the system operators a non-exclusive, transferable, sub-licensable, royalty-free, worldwide license to the submitted content (Facebook, 2016; Twitter, 2016). Such terms are needed for legal reasons: in order to serve webpages containing the users' data (e.g., their profile page) the service provider needs some rights over that data; it is nonetheless true that users are essentially allowing the service providers to do

with the data whatever they want for free. Moreover, most of the times, the users themselves have not easy and streamlined ways to obtain all the data they inserted in the system in a semantically meaningful or at least in a structured way; this (i) is a serious lock-in problem in its own right and (ii) hinders users' trust in the platform. Most social networking platforms do not provide their users with easy and standard ways to export user submitted contents in a structured way. According to Fitzpatrick and Lueck (2010) this issue (i) is similar to a serious lock-in problem in its own right, and (ii) it hinders users' trust in the platform.

The last problem with centralized social networking system is that service providers are in the position to effectively perform a-priori or a-posteriori censorship, or to disclose all the information they have, no matter how private, to other entities. They can perform such actions either motivated by selfish interests or forced under legal terms and other forms of pressure.

DECENTRALIZED SOCIAL NETWORKS

Peer-to-Peer (P2P) technologies are the most suitable mean to build decentralized social networks. In fact, P2P technologies allow the definition of open and decentralized overlay networks on top of the Internet that users can use for directly communicating to find and share resources, often music and movie files (Schollmeier, 2001). Such networks are one of the few largest distributed computing systems ever, and more surprisingly, they can run with great stability and resilient performance in face of possibly the most ferocious dynamics (Qiu & Srikant, 2004).

Thus, the use of P2P technologies for the development of social network is not only viable, but also highly desirable (Wang et al, 2006). First of all, P2P systems essentially achieve automatic resource scalability, in the sense that the availability of resources is proportional to the number of users. This property is especially desirable for media sharing social networking systems, considering the exceptionally high amount of resources needed. Secondly, the popularity over time of most content on such systems exhibits either a power-law or an exponential behavior and is consequently well suited for P2P distribution (Zink et al., 2009), possibly with fallback strategies for less popular content.

Regarding censorship issues, a P2P system essentially solves them by design. Without a central entity, nobody is in the position of censoring data systematically nor may be held legally responsible for the diffusion of censurable data: the sole owners and responsible of the data are the users themselves. Unfortunately, P2P systems, and especially Distributed Hash Table (DHT) based ones, may be still liable to attacks meant to disrupt the system functionality (Urdaneta et al., 2011), often based on the introduction of a large number of Sybil nodes and the diffusion of bogus information. However, the most popular DHT systems are significantly robust because of the high redundancy they achieve by using data replication and a redundant routing mechanism. Usually, the countermeasures are based on the embedding of the identity notion into the overlay level (Aiello & Ruffo, 2010), and on the use of some notion of "trust", based on either certification authorities or some reputation mechanism (Aiello & Ruffo, 2012). Common consensus algorithms, including Byzantine agreement, have also been proposed and applied (Balfe et al., 2005; Anceaume et al, 2008).

Although peer-to-peer systems overcome the weakness of a single point of failure, there are some well-known and important vulnerabilities, including (i) Sybil attacks, or node insertion attacks, where multiple nodes are created in the network, each of them representing fictitious identities but all belonging to a single user; and (ii) publish attacks, based on index poisoning, where essentially some bogus

content is deliberately spread to the index nodes responsible for other files or keywords. The presence of Sybil nodes allows other attacks, e.g. routing attacks, eclipse attacks, storage attacks. Also publish attacks may exploit the presence of Sybil nodes, if available. Many of the proposed countermeasures to securing peer-to-peer networks are based on some notion of "trust" among peers. Depending on the approach they use to evaluate and manage trust relationships among peers, those countermeasures can be divided in two main groups: (i) credential and policy based, (ii) reputation based. Urdaneta et al. (2011) provide a detailed analysis of threats to DHTs, together with some proposed countermeasures. While underlining the existing vulnerability to Sybil attacks, authors conclude that "Current DHT deployments are not specifically designed to tolerate the presence of malicious nodes. However, most of them are based on Kademlia, which provides relative security by using data replication and a redundant routing mechanism similar to wide paths".

Eventually, the lack of a central entity which has, or believes to have, interests in hindering interoperability (Shankland, 2011), creates the opportunity to design the system so that heterogeneous units can interoperate, typically providing a semantic common setting for the data.

Various solutions are being proposed to overcome the centralized architecture of the most widespread social networking platforms. Many of these proposals follow a federated approach, allowing users registered on a certain server to create relationships with users of other servers. Others are full-fledged peer-to-peer systems, usually based on a DHT.

Among the federated social networking systems, two of the best known are Diaspora (Bielenberg et al, 2012) and StatusNet (StatusNet, 2016). Diaspora servers communicate by means of an ad-hoc federation protocol and the standard Salmon protocol for comments. Users can (i) participate in the network by setting up their own server, which is named a "pod", or (ii) exploit already existing pods. Using a number of existing protocols, StatusNet shows quite strong interoperability with other networks. With regards to the completely distributed solutions, their origin can be traced back to Freenet (Charke et al., 2001), which is meant as a distributed, cooperative, uncensored and secure file system. It uses a "best-effort" unreliable routing algorithm to find content and namespaces, over both "OpenNet" and "DarkNet" connections. Various quite popular uncensored forums are built on Freenet, but they usually suffer a large amount of spam coming from anonymous sources. Similarly to other more recent systems.

Specifically in the field of social networking, various systems are being developed on the basis of peer-to-peer communications and DHT indexing. Among them, Maze (Chen et al., 2004), TRIBLER (Pouwelse et al., 2008), PeerSoN (Buchegger et al., 2009), Persona (Baden et al., 2009), Safebook (Cutillo et al., 2009) and DECENT (Jahid et al., 2012) are the most interesting.

Maze (Chen et al., 2004) supports a peer-to-peer social network through the use of some centralized services. It uses a ticketing server which issues tickets to all peers to identify them. This ticket is then served as a form of legitimate communication/transaction between peers. The ticket is valid for a single communication. For further communication, all peers need to contact the ticketing server for a ticket. Maze also uses another centralized server which, apart from holding a directory of peers, also checks online status of each of them.

TRIBLER (Pouwelse et al., 2008) is a P2P social-based file sharing network which is built on top of the Bittorrent protocol (Cohen, 2003). Tribler is based on the generation and maintenance of social networks in order to improve content discovery, searching and download performance. In particular, it proposes a decentralized recommendation mechanism based on standard collaborative filtering techniques and that takes advantage of the concepts of friends, friends-of-friends and tastes communities.

PeerSoN (Buchegger et al., 2009) is a system designed to provide encryption, decentralization and direct data exchange in the field of social networks. The first prototype of PeerSoN is designed around a PKI, though some studies are being conducted for weakening this assumption. Each user has a unique ID, possibly computed as a hash of the user's email. The DHT is used to trace the user's network presence. An index file, containing a list of new content generated by the user, is also registered in the DHT.

Persona (Baden et al., 2009) is designed as a set of social networking services. It uses an interesting attribute-based encryption protocol for protecting access to users' content. It allows each user to create various groups of "friends", by assigning proper attribute credentials. Content can then be associated with a publication policy and made available only to a restricted audience.

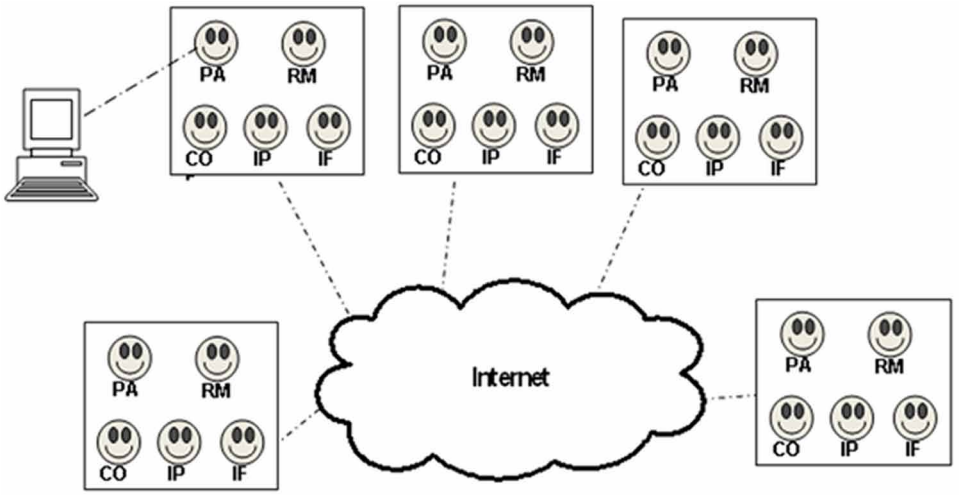
Safebook (Cutillo et al., 2009) is based on a DHT and a network of socially close peers, defined Matryoshka. Peers in a user's Matryoshka are trusted and support the user by anonymizing communications and replicating content and profile information. Safebook exploits a more traditional certification authority. In fact, a user's public key cannot be calculated from his identity, and all public/private key pairs are generated locally by the peers.

DECENT (Jahid et al., 2012) is a decentralized architecture for social networks that uses a distributed hash table to store user data, and offers cryptographic protections for confidentiality and integrity, as well as support for flexible attribute policies and fast revocation. DECENT ensures that neither data nor social relationships are visible to unauthorized users and provides availability through replication and authentication of updates.

AGENT-BASED SOCIAL NETWORKS

Agents and multi-agent systems are an interesting areas in software research that contributed to the development of the theory and the practice of complex distributed systems (Jennings et al., 1995). In particular, a multi-agent system offers the right abstraction for representing a decentralized and peer-to-peer system (Moro et al., 2002) and may provide an appropriate framework for developing peer-to-peer applications (Koubarakis, 2003). Moreover, multi-agent systems share with social networks both the structure and the scope, since they are composed of individuals connected with some kinds of relationship and they are realized for accomplishing individual and/or common goals (Franchi & Poggi, 2012). Therefore, it is natural to think about synergies between social network and multi-agent system research and application and about the use of multi-agent coordination algorithms for the development of typical social network services. In fact, multi-agent technologies and techniques offer the necessary functions to the users of a social network such as security and trust supports (Yu & Singh, 2000; Franchi et al., 2013) and collaborative and organizational supports (Hattori et al., 1999; Yoshida et al., 2003). In particular, in an agent-based social network a user can take advantage of a set of agents that can help or even replace the user in her/his actions in the social network. For example, Figure 1 shows an example of architecture of agent-based social network; in particular, in such an architecture, each user can take advantage of a set of different personal agents: a personal assistant (PA) agent helps the user in the interaction with the other users and with the other personal agents; a resource manager (RM) agent supports the management and sharing of resources with other users; the information filtering (IF) and information pushing (IP) agents help the user to find the relevant information and to exchange messages when she/he is offline; finally, the collaborative and organizational agent supports the coordination with the other users.

Figure 1. An example of architecture of agent-based social network



Several interesting works demonstrate how multi-agent systems are a suitable means for implementing social networks and their services. ReferralWeb (Kautz et al., 1997), Yenta (Foner, 1997), Community Organizer (Hattori et al., 1999), Shine (Yoshida et al., 2003), MARS (Yu & Singh, 2003), Blogracy (Franchi et al., 2013) and MASCRM (Olszak, 2013) are the most interesting.

ReferralWeb is an agent based interactive system for reconstructing, visualizing, and searching social networks on the World-Wide Web, whose main focus is selecting an expert of a given field in one's (extended) social network (Kautz et al., 1997). In ReferralWeb a social network is modeled by a graph, where the nodes represent individuals, and an edge between nodes indicates that a direct relationship between the individuals has been discovered. For ReferralWeb a direct relationship is implied when the names are in close proximity in any documents publicly available on the Web, e.g., home pages, co-authorship in published papers or organization charts in institutional websites. The constructed network is then used to guide the search for people or documents in response to user queries; a person can: i) ask to find the chain between himself/herself and a named individual; ii) search for an expert in a given topic and providing a maximum social radius (the number of "links" in the chain connecting the person performing the query with the expert); iii) request a list of documents written by people "close" to a given expert.

Yenta is a matchmaking system that helps people with similar interests to get in touch (Foner, 1997). Yenta agents do not query the web; instead, they scan user's emails, Usenet posts and (possibly) documents in order to discover their users' interests and hobbies. The idea is that many potentially interesting people do not publicly write and are consequently invisible to tools relying on public data. Collected data are then used to introduce users' to each other. Considering that in the nineties web communities were built around the idea of common interests rather than personal acquaintance, the system was a truly distributed social networking system for the time.

Community Organizer is a system where agents help the users by gathering and exchanging information, visualizing contexts, and recommending or assisting their users in making a choice (Hattori et al., 1999). Each user has a personal agent and a set of additional community agents have the function of providing shared information, knowledge, or contexts within the community and act as mediators for informal communications between people. In particular, each personal agent acquires the user profile

and visualizes potential communities around the user. The community agent collects the user profiles and maintains information on potential communities. Upon a request from a personal agent, the community agent first computes potential communities around the owner of the personal agent, and then sends the necessary data (users in the potential communities and their relevance) to the personal agent.

Shine is a fully peer-to-peer framework for network community support (Yoshida et al., 2003). The framework also provides design guidelines and enables different applications to share program components and cooperate and features a peer-to-peer architecture through which personal agents can flexibly form communities where users can exchange information with peer agents. Essentially Shine is a middleware for collaborative workspaces especially tailored to implement various collaborative workspaces. Agents in Shine are goal-driven through plans: a plan is description of agent action rules. Multiple plans are executed concurrently in the plan execution module of each agent. Some plans are prepared to perform services of applications while other plans are provided by Shine to do fundamental or common tasks. A plan acts in response to external events, such as receiving a message from another agent, user input or notification about a change in the community.

MARS is a multi-agent referral system that finds experts on the basis of personal agents able to learns the user's preferences and interests and able to build an expertise model of the other users on the basis of their responses (Yu & Singh, 2003). The expertise model is captured through a classical vector space model (Salton & McGill, 1983) and each personal agent maintains the models of its neighbors. In particular, the model is updates by a personal agent on the basis of the responses of its neighbors. The response can be an answer of its user or a referral: if the agent is reasonably confident about the expertise of its user matches the query, it directly answers; otherwise, it suggests a referral to another personal agent. Since the number of neighbors is bounded, some of them will be discarded to make place for new ones.

Blogracy is a peer-to-peer, anonymous and uncensorable social networking platform (Franchi et al., 2013). The architecture of the platform is modular and is built around a module for basic file sharing and DHT operations, possibly exploiting an existing implementation, and another module providing a set of social services to the local user through a Web interface. Moreover, the platform provides two additional agent based modules respectively providing a set of pervasive services and a set of information retrieval and pushing services. In particular, the current prototype of Blogracy takes advantage of; i) Vuze (Vuze, 2016), a popular BitTorrent client implemented in Java and available as open source software, for implementing the file sharing and DHT operations, ii) Open Social (OpenSocial and Gadgets Specification Group, 2016), a set of APIs supporting the sharing of social data, for implementing the social services, and iii) JADE (Bellifemine et al., 2008), probably the most known agent development environment enabling the integration of agents and both knowledge and Internet-oriented technologies, for implementing the agent-based services.

MASCRM (Olszak, 2013) is a system based on a group of agents that independently acquire a number of important data necessary to manage the customer relationship by working on the top with a variety of social networks. Agents are able to communicate with each other and activate mutually. In particular there are able to collect a lot of data on the behaviour of the customers, their purchase preferences, etc. A prototype of the system has been experiment on the Facebook network a showed how agents work supports organizations to quickly respond to the opinions and attitudes of their current and future customers, and also to quickly assess the relevance of their marketing actions and decisions.

FURTHER RESEARCH DIRECTIONS

As illustrated above, while decentralized architectures can help in overcoming some of the problems of the most widespread centralized social networking platforms, multi-agent systems can be used for providing advanced social services on such a architectures. In particular, multi-agent systems might become one of the most important means for the development of intelligent services for social networks and for coordinating the activities of its users. However, a lot of work is necessary for updating and experiment the coordination, knowledge management, and learning capabilities provided by multi-agent systems for the development of distributed services for helping the members in their activities and for, when will be necessary, using agents as delegate of some members for exchanging information and performing tasks.

CONCLUSION

Social networking sites are deeply changing the face of the Web, but their architecture might be improved. In fact, such systems utilize a traditional client-server architecture that relegates all the information in central servers. Although this approach supports highly mobile user access since users can log-in from any web browser, it also presents many drawbacks, e.g., lack of privacy, lack of anonymity, risks of censorship and operating costs. The integration between peer-to-peer technologies and multi-agent systems may be used for developing social networks that do not present the previous drawbacks. Moreover, the use of m multi-agent systems is the right solution to offer strong coordination techniques to the users of social networks and provide them more sophisticated and usable services.

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KEY TERMS AND DEFINITIONS

Anonymity: State of being unknown or unacknowledged to the others.

Censorship: Modification or suppression of speech or other public communication which may be considered objectionable, harmful, sensitive, or inconvenient as determined by a controlling body.

Multi-Agent System: A loosely coupled network of software agents that interact to solve problems that are beyond the individual capacities or knowledge of each software agent.

Peer-to-Peer System: A network based system in which each node can act as both client and server for the other ones of the system.

Privacy: The right to be secluded from the presence or view of others.

Social Networking System: A network based system facilitating the building of social networks.

Software Agent: A computer program that is situated in some environment and capable of autonomous action in order to meet its design objectives.

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Chapter 26
Aspects of Various Community Detection Algorithms in Social Network Analysis

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ABSTRACT

One of the most important aspects of social network analysis is community detection, which is used to categorize related individuals in a social network into groups or communities. The approach is quite similar to graph partitioning, and in fact, most detection algorithms rely on concepts from graph theory and sociology. The aim of this chapter is to aid a novice in the field of community detection by providing a wider perspective on some of the different detection algorithms available, including the more recent developments in this field. Five popular algorithms have been studied and explained, and a recent novel approach that was proposed by the authors has also been included. The chapter concludes by highlighting areas suitable for further research, specifically targeting overlapping community detection algorithms.

INTRODUCTION

The 21st century is dominated by social media. Social networking websites like Facebook, Twitter and Myspace connect millions of people from all corners of the world. As a result, the global community is growing at a fast pace with new connections being forged every second. Businesses, government corporations and other organizations are relying increasingly on online networking in order to promote products, conduct surveys and target specific audiences. The immense importance of social media has catalyzed research in social network analysis, a field that had gained prominence in the mid '90s. Social network analysis involves the detection of communities or closely connected groups of individuals, studying the characteristic patterns associated with these communities, identifying important "key" actors in these networks and finally studying the overall behavior associated with people in the network.

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BACKGROUND

Community detection in social networks is one of the most important areas of social network analysis. The most widely accepted definition of a community is a closely connected group of individuals with sparse connections to individuals belonging to other communities. With this definition in mind several algorithms have been implemented which serve to identify community structure in social networks.

Algorithms such as those proposed by Kernighan (1970) are traditional graph partitioning algorithms which use clustering techniques like *k*-means (MacQueen, 1967) to form graph clusters and can, therefore, be applied on social networks. The problem with these algorithms is that they can only find either a fixed number of communities or community clusters of a certain size, both of which may not really be the best case for real-world scenarios.

A very popular algorithm was developed by Girvan and Newman (2002) and uses a divisive technique in which edges are constantly removed to split a social network into smaller and smaller component networks. This technique gives rise to the natural community structure inherent in the network which can be represented through a community hierarchy. However, certain issues such as time complexity prompted one of the authors to devise an entirely new approach to detect community structure by optimizing a function known as *modularity* (Newman, 2004). This technique paved the way for a number of subsequent algorithms that collectively constitute the class of modularity-optimization algorithms. These include an improvement on Newman's fast algorithm (Clauset, Newman, & Moore, 2004) and an effort to improve community quality by balancing the communities detected by the CNM method (Wakita, & Tsurumi, 2007). The Louvain method (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008) is, perhaps, one of the most popular greedy modularity-optimization algorithms which is modelled on Newman's original modularity-based algorithm.

Further research developments led to the idea that community structure may not consist of just well-defined "crisp" clusters; rather, most real-world social networks contain communities that naturally overlap to a certain extent. Overlapping community detection algorithms serve to identify this natural community structure and either allocate the overlapping nodes to a single "best-fit" community through modularity optimization (Berti, Sperduti, & Burattin, 2014) or preserve the overlapping structure through the use of fuzzy membership functions (Kundu & Pal, 2015b).

COMMUNITY DETECTION ALGORITHMS: NEW AND OLD

Traditional View of Communities in Social Networks

Most community detection algorithms consider a model in which each individual in a network belongs to a single community. The individuals in this community will have many connections with each other but will have a minimal number of connections to individuals belonging to other communities. In fact, this very phenomenon is exploited by nearly all of the community detection algorithms prevalent in social network analysis.

Overlapping Communities in Social Networks

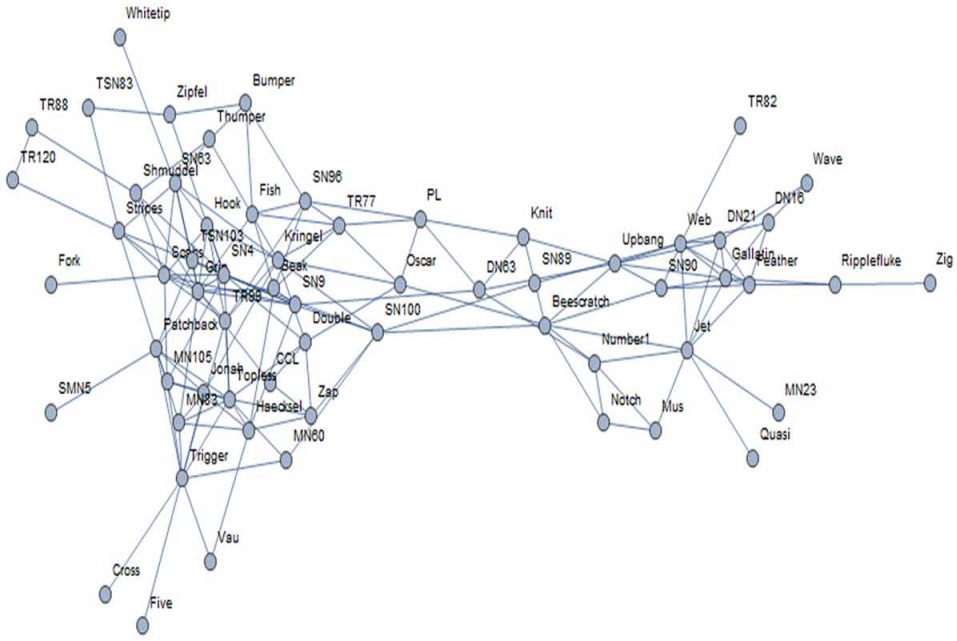
Contrary to the traditional community model mentioned above, many recent research developments deal with more realistic models in which multiple communities may be assigned to an individual. In real world social networks, it is only natural for an individual to be a part of several communities simultaneously. For example, a student may be part of his/her study group consisting of close friends, and at the same time belong to the school's debate team which is an entirely different community. Many community detection algorithms fail to take this relevant aspect into consideration and are, hence, limited in their approach. The newer models, therefore, describe what are known as "overlapping" communities.

Algorithms pertaining to both the models described above will be discussed shortly, but first some terminology that will be used throughout this article, along with their formal definitions, will be described below.

Terminology

1. **Graph:** A graph is a network of nodes and their interconnections. Each node in the graph is known as a vertex and each connection between two vertices is known as an edge (or link).
2. **Social Network:** A social network is a set of individuals that are interconnected in some manner. The criteria for the interconnections may vary: for example, a link in one network may be formed between two individuals if they are friends, while in another network a link may constitute the presence of a common interest or activity. Formally, a social network may be represented by a graph $G(V, E)$, where V is the set of vertices (individuals) and E is the set of edges. Figure 1 depicts a social network represented by a graph.

Figure 1. A graph representing the Dolphin Social Network: lines indicate edges and circles indicate vertices



3. **Community:** A community is a subset of nodes in a social network that have dense connections between them and which are sparsely connected to nodes belonging to other communities.
4. **Edge Betweenness:** The betweenness of an edge (Girvan & Newman, 2002) is the number of shortest paths between vertices that contain the edge.
5. **Modularity:** Modularity (Newman, 2004) is a measure of the quality of community partitions formed by an algorithm. It is the difference between the actual density of intra-community edges and the corresponding connections in a random network possessing the same degree distribution as that of the actual network. The measure was given by:

$$Q = \sum_{i} \left(e_{ii} - a_i^2 \right) \tag{1}$$

where, e_{ij} is the number of edges connecting nodes in community *i* to those in community *j*, and a_i is the total number of edges that have one end in community *i*.

Equation 1 was extended to accommodate weighted graphs in (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008):

$$Q = \frac{1}{2m} \sum_{i,j} \left[A_{ij} - \frac{k_i k_j}{2m} \right] \delta(c_i, c_j) \tag{2}$$

where, A_{ij} is the weight of the edge between vertices *i* and *j*, k_i is the total weight of all edges linked to *i*, c_i is the community to which *i* is assigned and $\delta(c_i, c_j)$ is 1 when both *i* and *j* belong to the same community and is 0 otherwise. The total weight of all edges in the network is *m*, where $m = \frac{1}{2} \sum_{i,j} A_{ij}$.

6. **Role Players:** Role players are important nodes in a social network. They perform unique functions such as connecting individuals belonging to different communities or being a central player in an important activity.
7. **Granule:** A granule (Zadeh, 1997) is a collection of similar, indistinguishable objects that can be treated as an independent unit. In a social network, a granule may be denoted by A_c indicating that it is represented by a center vertex *c*. A node's membership in the granule is given by its relationship with *c* which is usually a distance function. The set of all granules may be represented as:

$$Gr = \left\{ A_c \mid \forall c \in C, \sum_{v \in V} \widetilde{\mu_c}(v) \,/\, v \right\} \tag{3}$$

where, $\widetilde{\mu_c}(v) = \dfrac{\mu_c(v)}{\sum_{i \in C} \mu_i(v)}$ and $\mu_c(v)$ is the membership function of node *v* in the granule represented by *c*.

8. **Embeddedness:** Embeddedness (Kundu & Pal, 2015a) is the extent to which a pair of granules overlap. If the granules are represented by centers *a* and *b* respectively, then the embeddedness is denoted by $\varepsilon(a,b)$ and is nothing but the cardinality of the intersection of the granules:

$$\varepsilon(a,b) = \left|A_a \cap A_b\right| = \sum_{v \in V} \min\left(\left(\widetilde{\mu}_a(v), \widetilde{\mu}_b(v)\right)\right) \tag{4}$$

The Girvan-Newman Algorithm

The Girvan-Newman algorithm (Girvan & Newman, 2002) is one of the oldest and most popular community detection algorithms that have been developed. It had, at its core, the concept of betweenness which was used to partition the graph, i.e. the social network, into several communities. The algorithm consists of three simple steps:

1. **Look for the Edge with the Highest Betweenness:** As defined in the previous section, betweenness measures the importance of an edge in terms of the highest volume of 'traffic' it conducts. An edge with high betweenness indicates that the edge serves as an important bridge between nodes of different communities. Therefore, removing this edge would most probably separate the communities that it connects or 'bridges'. With this concept in mind, Girvan and Newman proposed to detect the edge with the highest betweenness and remove it. If multiple edges have the same highest betweenness, all of them are removed. This step results in a possible partition of the graph into a number of initial communities.
2. **Recalculating the Betweenness:** After the first step the betweenness of all the remaining edges in the partitioned graph are recalculated. This is due to the fact that the removal of edges in the previous step will obviously alter the flow of traffic among the newly formed graph components.
3. **Repeat:** With the new partitioned graph and betweenness values, repeat steps 1 and 2. The repeated application of these steps will break the graph into smaller and smaller components. This process is carried out until no further edges remain in the graph.

The Girvan-Newman algorithm decomposes the social network into a hierarchical structure with each level of the structure containing a set of communities nested within the community set of the previous level. Therefore, with this algorithm, one can observe the structural breakdown of the social network at each point of an iteration of the algorithm. The Girvan-Newman method works well for moderately sized graphs containing up to a few thousand nodes (Newman, 2004) but is less effective for larger networks due to the large computational complexity involved in re-computing the betweenness values during each iteration.

NEWMAN'S FAST ALGORITHM

In 2003, Newman (2004) proposed a more time-efficient method for detecting communities. His algorithm made use of his original concept of modularity which is defined in Equation 1. Newman's algorithm is an entirely greedy approach that is implemented to address the pitfalls of the Girvan-Newman algorithm. Apart from the computational complexity involved in the Girvan-Newman algorithm, another aspect that the authors had failed to address was the formation of *meaningful* communities. While it is true that the algorithm detects community structure effectively, it does not include any metric for measuring the actual quality of the detected communities. In order to address this issue, Newman proposed to use modularity both as a qualitative measure as well as to find the communities faster. Newman argued that the modularity could be optimized over all possible community divisions in order to obtain the best fit. Furthermore, the optimization could be done using a greedy approach to reduce the time complexity involved.

Initially, each node in the graph belongs to its own community, i.e. if there are n nodes then the number of communities will also be n. Communities are then joined together in pairs and the pairs that produce the greatest increase or smallest decrease in modularity are finally merged together. This process continues until all the nodes are eventually merged into a single community. The result is a hierarchical structure of communities in which each level contains a larger set of communities than its parent level. An important point to remember is that, when joining communities, only those pairs that have edges between themselves are to be considered as communities that are not connected by edges will never increase the modularity. Again, the change in modularity can always be calculated in constant time making the algorithm much faster than the previous one. Newman acknowledged that the local optimization feature could possibly lead to a decrease in the quality of communities detected as opposed to the non-local nature of the Girvan-Newman algorithm but emphasized the fact that while the latter algorithm is computationally very expensive for large networks, the former would be able to provide a decent community structure in considerably less time.

THE LOUVAIN ALGORITHM

The Louvain community detection algorithm (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008) is a heuristic algorithm that uses modularity (as defined in Equation 2) as a metric for gauging the effectiveness of the detected communities. The algorithm is primarily aimed at detecting communities in large social networks in a relatively short span of time. The Louvain algorithm consists of a greedy "iterative stage" and a "coarse graining" stage.

1. **Iterative Stage:** In this stage, the change in modularity is noted when a particular node i is moved out of its own community and into the community of one of its neighbors. The changes are observed for each neighbor of i. Node i is finally moved into that community for which the change is maximum as well as positive. In the event that the maximum modularity change is negative or 0, the node i will remain confined to its own community. The process is repeated for every other node in the network. After all the nodes have been considered, the entire stage is applied iteratively to the network until no further modularity change is possible. In this manner, the iterative stage seeks to find the local maxima of the modularity obtainable in the network.

2. **Coarse Graining:** In the coarse graining stage, a new network is constructed by taking each community detected in the iterative stage as a single node. For the sake of clarity, the nodes in the old network will be referred to as vertices. An edge between two nodes in this new network is the sum of weights of the interconnections between vertices belonging to the community represented by the first node and those belonging to the community represented by the second node. Of course, by this same logic, there will also exist self-loops whose weights are equal to the sum of the *intra*-connections between vertices belonging to the respective communities represented by the nodes in the new network. The newly constructed network is then passed through the iterative stage which will detect a set of communities pertaining to the new network information.

The iterative and coarse graining stages are repeated until no further modularity change is possible. One can easily see by now that the size of data being processed during the iterative stage drastically reduces with each coarse graining process. Thus, this algorithm is extremely effective when applied to large network datasets consisting of more than a million nodes. As in the algorithm developed by Newman (2004), one can visualize the community hierarchy detected by the two stages.

OVERLAPPING NODE DETECTION TO IMPROVE COMMUNITY CLUSTERING

Berti, Sperduti, and Burattin (2014) believed that the detection of overlapping nodes that belong to multiple communities is the key to detecting important role players in the network. These nodes bridge communities together and may, therefore, be strong "communicators" that connect individuals belonging to diverse groups. To achieve this end the authors proposed a new measure known as *cuttability* which helps in determining whether a node is an overlapping one or not. If we consider an edge (*i, j*), the cuttability of this edge can be defined as follows:

$$cut(i,j) = \min \left\{ \begin{matrix} \sum\limits_{(i,k)\in E, C(i)=C(k)} w_{i,k} - \sum\limits_{(i,k)\in E, C(j)=C(k)} w_{i,k}, \\ \sum\limits_{(j,k)\in E, C(j)=C(k)} w_{j,k} - \sum\limits_{(j,k)\in E, C(i)=C(k)} w_{j,k} \end{matrix} \right\} \tag{5}$$

From the formula above, it can be easily seen that if both nodes *i* and *j* of a given edge belong to the same community, then the cuttability of the edge will be 0. If the nodes belong to distinct communities, the cuttability will increase. As a result, the cuttability will indicate the extent to which a node lies between two communities and is, hence, likely to be an overlapping node. The term "cuttability" arises from the fact that overlapping nodes can be "cut away" or removed from the graph without affecting the overall consistency of the clustering. The cuttability of the entire graph is the sum of the cuttability of all its edges. The algorithm proposed by the authors consists of the following four steps:

1. **Initial Clustering:** Here, the fast Louvain algorithm (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008) is used to detect an initial set of community clusters in the network.
2. **Detecting the Overlapping Nodes:** Once the initial set of clusters is obtained, the overlapping nodes are detected. Each node is checked by considering its actual community and the set of its adjacent

communities. The node is assigned to each of its adjacent communities in turn and the change in cuttability is measured; at any point, if the change is positive then the node is an overlapping node.

3. **Re-clustering on Removal of Overlapping Nodes:** The set of detected overlapping nodes is then removed from the graph and another set of clusters is obtained from the reduced graph. This step once again uses the Louvain algorithm to quickly detect the clusters and the final modularity is measured.
4. **Adding back the Nodes to Maximize Modularity:** Finally, the overlapping nodes are added back to the reduced graph in such a way as to maximize the modularity. Steps 2 – 4 can be iterated until the modularity cannot be increased any further.

Through this approach, it may so happen that nodes which were overlapping nodes in a previous step cease to overlap in a later step due to formation of a better community structure. On the other hand, subsequent iterations may give rise to new overlapping nodes and, even more interestingly, some nodes may be persistent and remain as overlapping nodes throughout the process. These nodes may be regarded as truly overlapping in that they actually do belong to multiple communities even though they are finally assigned to a single community.

FUZZY – ROUGH COMMUNITIES IN FUZZY GRANULAR SOCIAL NETWORKS (FRC – FGSN)

The FRC – FGSN (Kundu & Pal, 2015b) model is a new approach towards detecting communities in overlapping networks. It considers the possibility that nodes may belong to a number of communities with varying degrees of membership. Furthermore, some nodes may not belong to any community at all and will thus be considered as 'orphan nodes'. The model may be described in two parts:

1. **Fuzzy Granular Social Networks:** The Fuzzy Granular Social Network (FGSN) model (Kundu & Pal, 2015a) represents a social network in terms of 'granules'. The concept of granularity helps model large-scale social networks in terms of a much smaller number of granules. Each node in the network will have a membership value associated with each granule. Of course, the value is dictated by a membership function that results in a value ranging from 0 (not a member) to 1 (completely a member). Any number in the interval (0, 1) signifies partial membership in a granule. This is, thus, a 'fuzzy' membership (Zadeh, 1965) as opposed to the 'crisp' membership values of 0 and 1 that are normally encountered. Furthermore, the membership values are normalized so as to gain a better idea of the 'degree' of membership of a node to a particular granule.
2. 2. **Fuzzy Rough Communities:** The FGSN model is then analyzed for the detection of communities. There are two concepts that come into play here: embeddedness (defined in Equation 4) and $\theta-\text{cores}$. $\theta-\text{cores}$ are merely those granules whose granular degree is greater than a certain constant θ. This value is generally set equal to the average granular degree in the FGSN. In the Fuzzy Rough Community (FRC) detection method, all $\theta-\text{cores}$ are initially computed. Next, all community-reachable $\theta-\text{cores}$ are grouped together, and separated from the $\theta-\text{core}$ pool, to form individual communities (community-reachable $\theta-\text{cores}$ are those $\theta-\text{cores}$ for which the granule representative of one $\theta-\text{core}$ lies in the neighborhood (or support set) of the other). Also, all $\theta-\text{cores}$ of a community must have a mutual normalized embeddedness greater than a certain

pre-defined constant $\in$. The communities that have so far been detected are merely in terms of granules. What is required, however, are communities that consists of only vertices and it is here that the concept of Rough Sets (Pawlak, 1982) comes into play. Since the communities are not well-defined, they can be represented as rough sets, each with their own lower and upper approximations. The lower approximation of a community will contain all those nodes which definitely belong only to that community and no other community. The upper approximation contains the lower approximation as well as nodes that belong to both the community in question as well as to other communities:

$$L(C_i) = \left\{ x \mid x \in Support(A_p) \; and \; x \notin Support(A_q) \right\}; \\ \forall A_p \in C_i, A_q \in C_j \;\; i \neq j \tag{6}$$

$$U(C_i) = \left\{ x \mid x \in Support\,(A_p); \forall A_p \in C_i \right\} \tag{7}$$

Thus, the membership function for a node in a community C_i is defined as:

$$\delta_{C_i}(x,r) = \begin{cases} 1 & if \; x \in C_i \\ \sum_{c \in C_i} \widetilde{\mu_c}(x,r) & if \; x \in L(C_i) \setminus U(C_i) \\ 0 & otherwise \end{cases} \tag{8}$$

GRANLOUV: A PROPOSED COMMUNITY DETECTION ALGORITHM

In a previous work (Dillen & Chakraborty, 2015), the authors had proposed a novel algorithm for community detection. This algorithm, coined as *GranLouv,* was inspired by two of the algorithms mentioned above, namely, the Louvain method of community detection and the Fuzzy Granular Social Network model. There are three basic features associated with this algorithm:

1. **Formation of a Granular Adjacency Matrix:** The network is initially modeled in the FGSN domain by considering a set of granule centers and assigning the node memberships to these granules. The centers considered are those nodes in the original network whose degree is greater than the average degree of the network. The granule radius is taken to be equal to the network diameter. Once the FGSN is constructed, a new granular adjacency matrix is formed. An edge between two granules in this network bears a weight equal to the embeddedness (Equation 4) between the said granules. This would, thus, imply the existence of self-loops in the new network as well. In this case, the self-loop's weight will be the same as the cardinality of the granule with which it is associated.

2. **Applying the Louvain Algorithm on the Granular Matrix:** The granular adjacency matrix thus formed is then fed as input to the Louvain algorithm. The algorithm will detect communities in this 'network' which will be referred to as granular communities. These communities serve as a basis for the final step.
3. **Final Community Detection:** In the final detection stage, fuzzy rough communities are first detected in the network using the properties of lower and upper approximation in FGSN networks described in Equation 8. After this, all vertices are assigned to their final communities: each vertex will possess a membership of 1 (i.e. complete membership) in the community for which its fuzzy membership is maximum. It will possess a membership of 0 in all the other remaining communities.

Application of *GranLouv*

The GranLouv algorithm was tested on three real-world social networks: the Dolphin Social Network (Lusseau, Schneider, Boisseau, Haase, Slooten, & Dawson, 2003), the Les Miserables Social Network (Knuth, 1994) and the American College Football Social Network (Girvan & Newman, 2002). The algorithm achieved a modularity of 0.509, 0.534 and 0.599 respectively in each of the three cases which is quite comparable to other algorithms employing the use of modularity. The results are depicted graphically in Figure 2, Figure 3, and Figure 4 as well as in Table 1, Table 2 and Table 3 respectively.

Figure 2. Communities detected in the Dolphin Social Network using the GranLouv

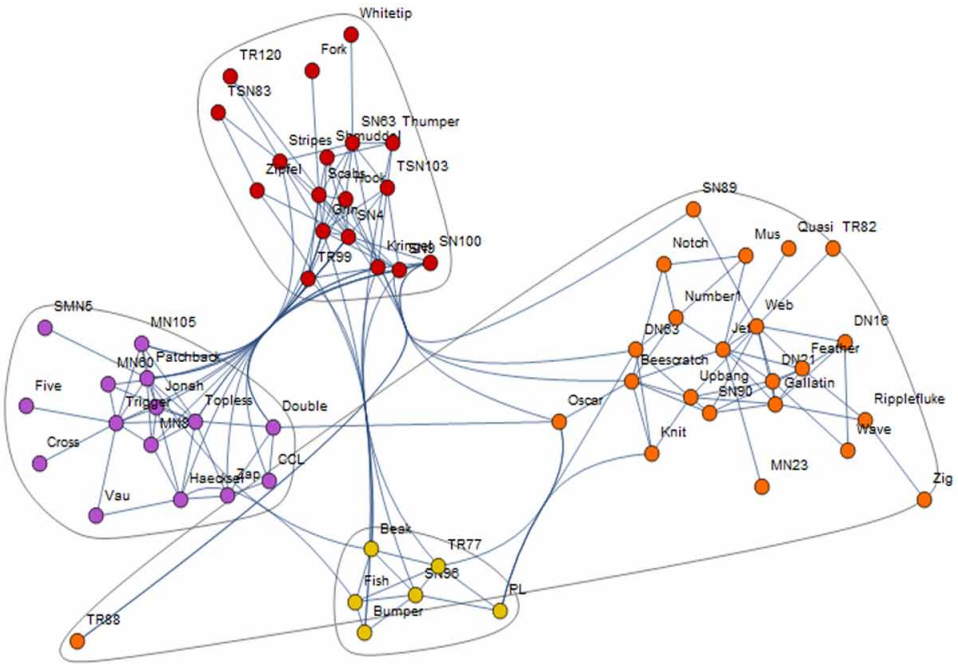


Table 1. Modularity detected by algorithms on the Dolphin Social Network

Serial No.	Algorithm	Modularity
1.	Louvain	0.518
2.	GranLouv	0.509

Figure 3. Communities detected in the Les Miserables Social Network using the GranLouv algorithm

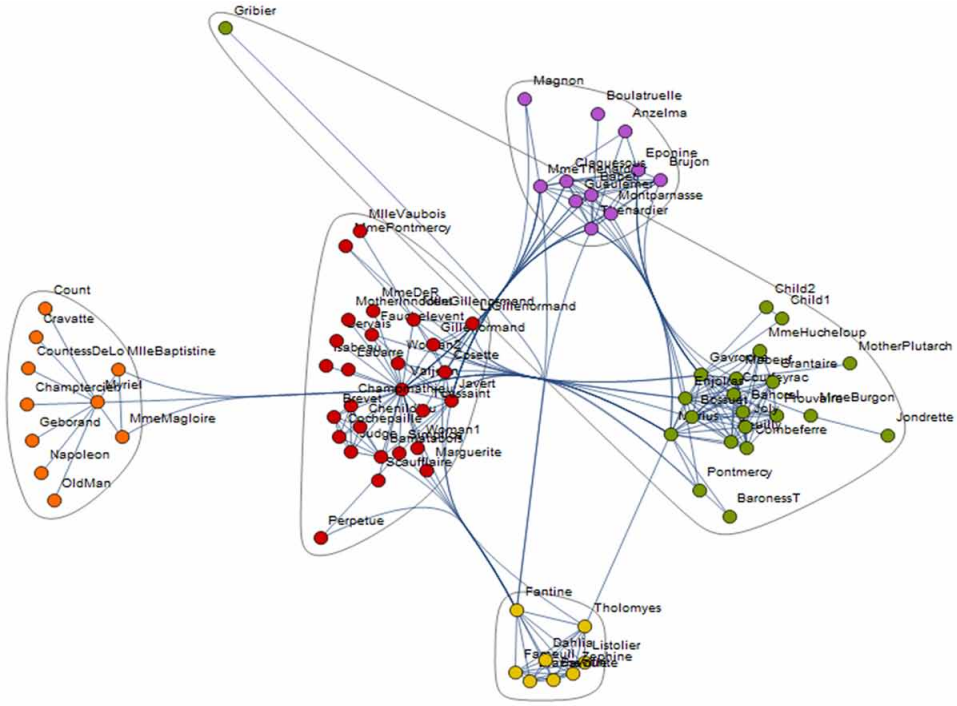


Table 2. Modularity detected by algorithms on the Les Miserables Social Network

Serial No.	Algorithm	Modularity
1.	Newman and Girvan (2004)	0.540
2.	Louvain	0.555
3.	GranLouv	0.534

FUTURE RESEARCH DIRECTIONS

Although the granule centers in GranLouv are chosen on the basis of vertex degree, this practice may not necessarily be the best way to do so as it takes only one factor into consideration, i.e. the degree, and so fails to properly and holistically select the nodes which have a higher tendency to form clusters or granules around themselves. This problem must be addressed effectively as granule center selection poses a level of difficulty when the networks consist of a very large number of nodes. It is definitely

Figure 4. Communities detected in the American College Football Social Network using the GranLouv algorithm

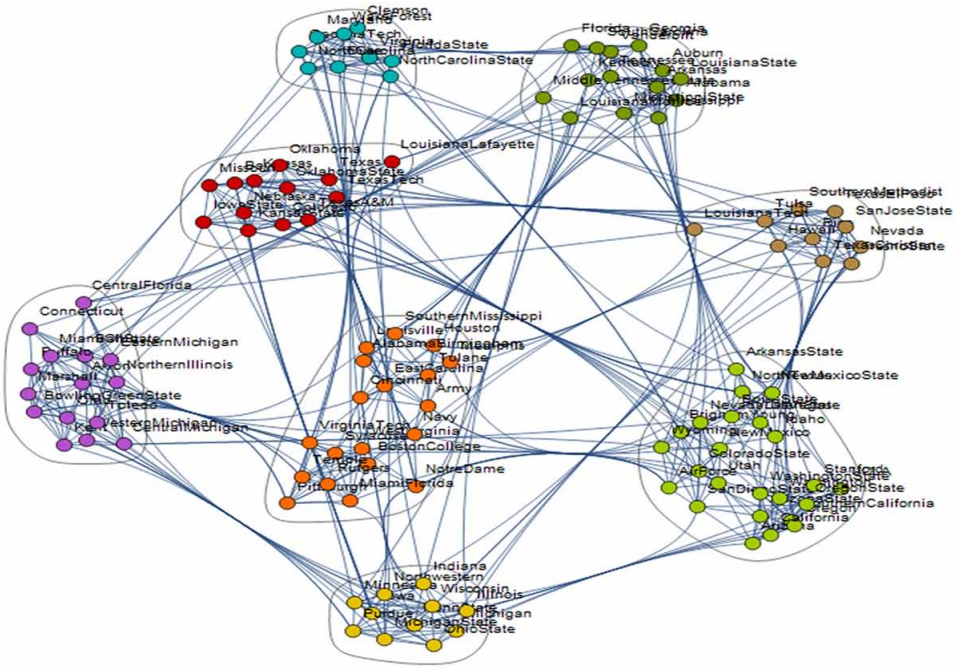


Table 3. Modularity detected by algorithms on the American College Football Social Network

Serial No.	Algorithm	Modularity
1.	Girvan and Newman (2002)	0.601
2.	Louvain	0.604
3.	GranLouv	0.599

not feasible to select all nodes in the network as centers as this would go against the actual idea behind using a granular model in the first place, which is to reduce the amount of redundant information in the network and ease the computation process.

Another aspect that must be taken into consideration is the absence of overlapping communities using GranLouv. This problem may be addressed by changing the modularity function to account for overlapping communities as well instead of only crisp community sets.

Finally, attention must be drawn to the fact that granules are assumed to be circular in nature with a predefined radius set by the programmer. However, a granule should be allowed to assume any arbitrary shape in order to realistically capture information in the network. Therefore, there is much scope for research work which can properly and efficiently consider granules with any shape as opposed to the strict and inflexible one that has been proposed.

CONCLUSION

Social network analysis, and especially community detection, has a multitude of benefits. Through community detection, business organizations can use social network data to determine appropriate target audiences for their products and selectively advertise to the target audience, thus increasing the probability of attracting potential buyers. Law enforcement agencies may also use social network analysis to identify potential or existing criminal organizations based on the connections of known criminals. Furthermore, "important" players in social networks may also be identified with a higher degree of accuracy through detection factors such as popularity (number of connections), behavior, and other pertinent features. Thus social network analysis plays an important role in economics, business intelligence and law enforcement, as well as other areas ranging from politics to information science. Research in this field could, therefore, significantly address a number of problems in a world that is becoming increasingly globalized and interconnected at a rapid pace.

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KEY TERMS AND DEFINITIONS

Community: A community is a subset of nodes in a social network that have dense connections between them and which are sparsely connected to nodes belonging to other communities.

Edge Betweenness: The betweenness of an edge is the number of shortest paths between vertices that contain the edge.

Embeddedness: Embeddedness is the extent to which a pair of granules overlap.

Granule: A granule is a collection of similar, indistinguishable objects that can be treated as an independent unit.

Graph: A graph is a network of nodes, or vertices, and their interconnections, or edges.

Modularity: Modularity measures the quality of community partitions formed by an algorithm. It is the difference between the actual density of intra-community edges and the corresponding connections in a random network possessing the same degree distribution as that of the actual network.

Role Players: Role players are important nodes performing unique functions in a social network.

Social Network: A social network is a set of individuals that are interconnected through some relationship.

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Chapter 27
Classification of Traffic Events Notified in Social Networks' Texts

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ABSTRACT

It is interesting to exploit the user-generated content (UGC) and to use it with a view to infer new data; volunteered geographic information (VGI) is a concept derived from UGC, whose main importance lies in its continuously updated data. The present approach tries to explode the use of VGI by collecting data from a social network and a RSS service; the short texts collected from the social network are written in Spanish language; text mining and a recovery information processes are applied over the data in order to remove special characters on text and to extract relevant information about the traffic events on the study area; then data are geocoded. The texts are classified by using a machine learning algorithm into five classes, each of them represents a specific traffic event or situation.

INTRODUCTION

Many researching works implement procedures to use web data and users generated content on critical situations management, or to notify relevant events (Wakefield, 2013). Every day millions of publications, where people describe their environment, and ideas about many interesting topics are done at social networks. From such publications, it is possible to acquire data related to the urban factors that concern most citizens, in order to improve the people's activities and conditions, and with a view to structure smart cities. Web publications that have coordinates or provide geographic information, can be considered as VGI.

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The main purpose of this work, is to obtain useful information for a further traffic prediction procedure, by integrating and processing VGI and authoritative data. The VGI data is collected from a social network, where participants are considered as intelligent sensors, which constantly communicate the environment changes they perceive; such reports are influenced by the people context.

Two of the main advantages of VGI, are its continuously updated data, and the easily data consultation. Such kind of source has not been deeply studied, most of the time its social characteristics have been analyzed over its technological usages.

The present approach makes use of VGI and authoritative data sources, to extract, analyze, classify and geocode data related to the traffic in the study area. The case of study is Mexico City, the largest metropolitan area in America, and the largest Spanish-speaking city in the world (Zimmerman, 2015).

The social network consulted is Twitter, also a RSS service is considered. In the analysis stage, a text mining and a recovery information processes are applied over the short texts, extracted from the social network and from the rss service, with a view to identify the traffic events described on the posts; on the classification stage, a Naïve Bayes algorithm is trained to classify the traffic events. The geocoding process is done through the use of the methodology proposed by Salazar et al. (2016). The events and the authoritative data, are related with the purpose to establish links, between the streets and the business located on the area where the traffic is presented; also a probabilistic analysis is applied. Finally, the events and the authoritative data are mapped to visualize the traffic distribution.

The paper is organized as follows: first the background of the work is shown, below the data treatment is described; then, solutions and recommendations are done; after the future research directions and conclusions are presented; finally, the additional readings are mentioned.

BACKGROUND

User generated content (UGC) is any publication on internet, done by users of web services such as blogs, wikis, forums, social networks, podcast and chats. It is used in many applications, including: researches, information and news spread, problems processing, disaster management, and collaborative mapping. UGC has originated some other concepts, volunteered geographic information (VGI) and crowdsourcing are two of them (Chard, 2015).

Crowdsourcing is the process of getting ideas, information, or work done, from a group of interested people; it has been a recurrent data and services source for some businesses and researches (Chard, 2015). Mobile devices as smartphones, mobile GPS, cartographic applications and social networks, make crowdsourcing possible.

According to Wen Lin (2013), VGI is composed of volunteered information generated by users, who have not a geographic specialized knowledge, but are interested on provide data with geographic characteristics; such data are employed on many web services as Open Street Map (OSM), WikiMapia, Google Maps, among others. This association between VGI and web services are the GeoWeb basis.

VGI makes possible the generation of new spatial information usages, such as collaborative mapping, georeferenced content, network vectorization, and collective ranking of places (Gouveia & Fonseca, 2008; Elwood, 2013; Sui, 2012; Goodchild, 2007). There exist web services that invite people to provide personal information, their location, or some other geospatial information, such as landmarks, points of interest (POI), and street segments; with the purpose to increment their data repositories, and

make them available for further analysis. OSM, Foursquare, and Twitter are some of those web services (Kunze, 2015).

Kunze (2015), proposes a VGI integration process, to generate estimation models of dwelling occupancy. In his approach, OSM and topographic data from Dresden city are used. When working with data from many spatial data sources, it is needed to correctly integrate such data on a GIS environment, and to consider some specific features, as the data precision, and the reference system applied over them (Flowerdew, 1991).

Most of the internet users, are part of the social networks; according with previous investigations 70% of them, access to internet by using mobile devices; and 73.4% do it through a computer (Castells, 2010).

Nowadays, internet users are interested on describe their environment, or give information about the events they perceive; on their publications people describe physical aspects of their surroundings, as the traffic or pollution situation, the security degree they consider appropriate for their neighborhood, socio-politic events, and some other topics of interest; also, they provide metadata such as coordinates, URL's, among others (Fleming, 2014).

User generated content published on social networks and VGI sources, has an explicit semantic value, since the content has been produced by people interested on provide their data for further analysis, unlike the other web content generated by people without a specific purpose (Resch, 2015).

Considering people as sensors, gives a wide variety of heterogeneous data, to researches that study the human behavior or the city dynamics, through the analysis of VGI and UGC data. The people's point of view is different from one person to another, and it is influenced by the person's living conditions, activities, education, ideas, and the geographic area where he or she lives (Resch, 2015).

DATA TREATMENT TO DETECT TRAFFIC EVENTS ON TEXTS

The present approach has been designed to obtain information about the traffic situation in the study area, by analyzing and processing VGI data. The proposed methodology, consist on 5 stages: the first, is the data acquisition; the second, are a text mining and a recovery process, to obtain data related to traffic events; the third, is the data classification; the fourth, is the data geocoding; and the fifth, is a statistical analysis. On Figure 1, a diagram shows the methodology stages.

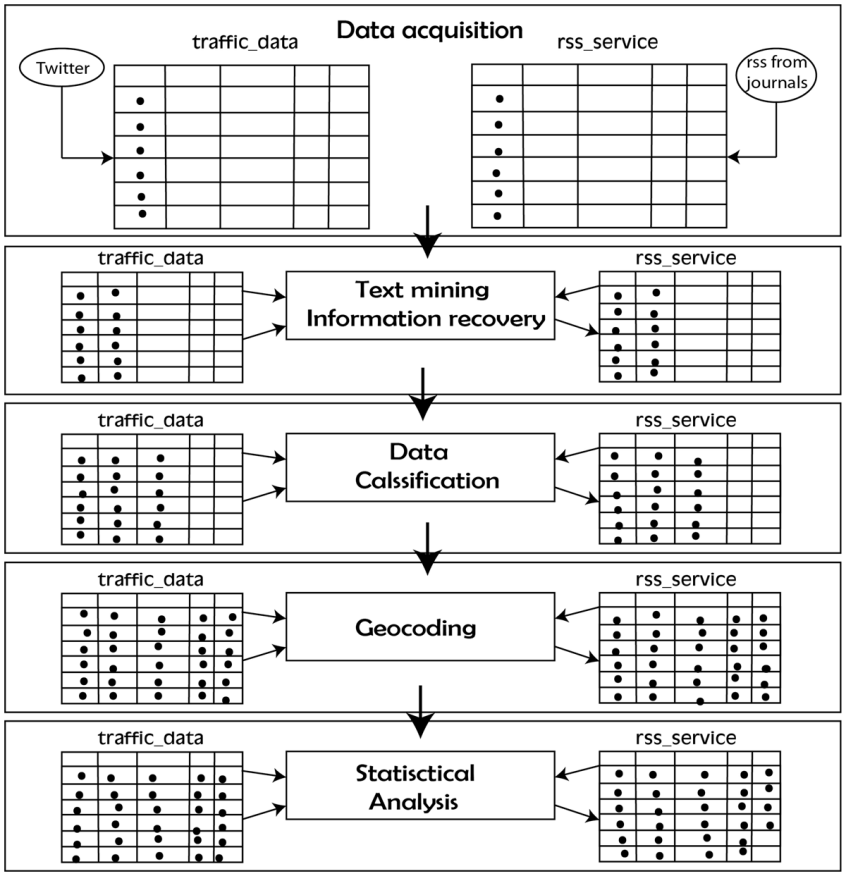
The social network consulted for this research is Twitter; it is one of the most used micro blog services, at present has more than 500 million users. On its web site, people post their ideas, on short texts called tweets, which have a limit of 180 characters (Bernstein, 2013). The tweets considered as relevant for this approach, are those which describe the traffic situation or traffic events occurred on the study area.

This work has been oriented to detect traffic information published by people; an advantage of the approach is its flexibility, since it could be used to extract information related to some other urban topics, in order to improve human life.

Data Acquisition

To extract the short texts from Twitter, an API of basic transmission is used on a code script to randomly extract, the 1% of tweets published on the study area. The tweets are continuously extracted, since the API can not to have access to tweets published one week before the consultation date.

Figure 1. Data acquisition from a social network to describe the urban traffic situation methodology stages



The short texts, are obtained from specific Twitter accounts, which main purpose is to notify the traffic on the study area. The Twitter profiles monitored are *@trafico889, @dftrafico* and *@MexicoTrafico.*

The collected tweets and their metadata, are stored on a table named *traffic_data*; the features considered are the tweet's publication date and time, its text, and its coordinates (in case they have been published). Some Twitter service studies, have shown that only 3% of the tweets have the coordinates of the the place where they were posted, and only 17% of the short texts have relevant information about the place of publication (Burton, 2012).

To extract the information from the rss service, a PHP script was developed to collect the news related to traffic on the study area, that have been published by some of the most important local journals: *Reforma*, *El Universal* and *La Jornada*. The text, date and time of publication, were extracted from the news collected, and then stored on a table named *rss_service*. Both *rss_service* and *traffic_data* tables belong to the *traffic_situation* database.

Information Recovery

Once the tweets and rss texts have been collected, is needed to extract from the texts, the information related to the traffic situation and to the traffic events. The texts stored on the *rss_service* and *traffic_data*

tables, are written in Spanish language. In order to manipulate such texts it is necessary to apply a text mining process and a recovery information procedure.

The stop words, are all the common words on a language, such as prepositions, connectors, and articles, that do not provide relevant information to the texts (Sidorov, 2014).

On the text mining process, it is necessary to remove the stop words from the texts; also, the special characters used on the Spanish language (*':,;.#$``!¿?¡/*...,*) are deleted. After this process, texts are ready to be treated by more complex computing procedures.

The information recovery process, consist on identify the words related to the traffic on texts; this is done by a programmed script, that identifies on each tweet or rss text, the words related to the traffic and the number of times that they appear.

The identified words are grouped, according to the event to which they refer, into five classes: *favorable* and *traffic,* define the situation of the vehicles movement through the streets; *accident* and *closure*, describe traffic events; *rule*, when the text has information about road rules; and *unidentified*, when none of the text's words are related to traffic events.

Data Classification

On this section, the rss texts, and the tweets text are indistinctly called *texts*, in order to simplify the explanation. The classification process described below, is independently applied over the *rss_service* and *traffic_data* table's registries.

To classify the texts, the Naïve Bayes algorithm has been chosen; it is a machine learning algorithm based on the Bayes conditional probability theorem, which main purpose is, to calculate the probability for a document, to belong to a determined class, in case that it contains a specific word (Scharkow, 2013). Naive Bayes, assumes that a feature´s presence or absence, is not related to any other feature's presence or absence. The algorithm, has been used as a standard for text classification and spam filters; its main advantage is, that it is good working with big amounts of data, and needs few data to determine class parameters (Lantz, 2013).

Naïve Bayes requires a training process, where the algorithm is applied over a training dataset, to create probabilistic tables that let it know the differences between the proposed classes, and the kind of element that is being treating.

To create the training corpus, the third part of the texts was classified, by using an algorithm that searches on each registries' text, the words related to each proposed class, and assigns to the registry a class label according to the major number of class' words founded. The class label is stored on the field *event_class* of the *rss_service* and *traffic_data* tables. The third part of the texts with a defined label class are named *training corpus*, meanwhile the two third parts without label are called *test corpus*.

The Naïve Bayes algorithm develops the following steps; first, from the training corpus extracts the *event_class* label of each registry and factorizes it, it means that represents such class label with a number; and then, a data dictionary is created to save all the words that compose the texts. Each word, acts as a key on the dictionary, and its value is the number of times the word was founded on the entirely training corpus, this is done by comparing each registry's text of the *rss_service* and *traffic_data* tables, with the words in the dictionary; if there is a word on a text that does not appear on the data dictionary, it is added as a new key.

Since texts have different lengths, it is needed to homogenize their longitudes, to make them useful for the machine learning's training. For that purpose, a vector is created for each text, each vector's position represents a dictionary's word, catalogued in the same way as in the dictionary; the value of each position, is the number of times the word appears on the treated text. In case that a word does not belongs to the text, its value is zero. Every text (from the tweets or the rss messages), has a representing vector.

Once the vectors have been structured and the classes have been defined, the Naïve Bayes, algorithm calculates the probability for each dictionary's word to belong to any of the defined classes, by counting the times that an specific word appeared on each class, and dividing that number, between the total words on the class $P\left(B\right)$. Then, it calculates the probability that the training registries have been correctly classified, based on the words present in them, and the calculated words' probabilities. The process is related to the Bayes theorem shown on Equation 1, where B is the word founded on the registry, A_i is the dependent event (the label of the class we are analyzing), $P\left(B\right)$ is the marginal probability of the word, $P\left(A_i\right)$ is the prior probability of the class A_i, $P(B\ |A_i)$ is the likelihood of word B in the class A_i, and $P(A_i|B)$ is the posterior probability of classify the registry on the A_i class, given that the founded word was B.

$$P(A_i|B) = \frac{P(B\ |A_i)P\left(A_i\right)}{P\left(B\right)} \tag{1}$$

After the training process, is time to Naïve Bayes learning. When a new registry is being analyzed, the algorithm calculates its posterior probability, in order to determine the appropriate class for it, taking into account the values stored on the text's vector. The *posterior probability* for a vector to belong to each of the classes, is calculated considering the presence probability computed on the training stage for each vector's word (*marginal probability*), and the words absence probability. Then, the *posterior probabilities* are added, the result is called *class probabilities*, as shown in Equation 2; the probability for the vector to belong to a certain class, is calculated by dividing the *conditional probability* between the *class probabilities* calculated previously, as shown in Equation 3. The number of classes is 5, as defined on the information recovery process.

$$class\ probabilities = \sum_{j=1}^{5} P\begin{pmatrix} Class\ j\ |-\ probability\ of\ words \\ presence\ or\ abscense\ - \end{pmatrix} \tag{2}$$

$$P\left(vector \in Class\ i\right) =$$

$$\frac{P\begin{pmatrix} Class\ i\ |-probability\ of\ words \\ presence\ or\ abscense\ - \end{pmatrix}}{class\ probabilities}, \forall i \in \left[1,5\right] \tag{3}$$

The class chosen for the vector is the one with the highest numeric value. After the learning process, Naïve Bayes is ready to classify the test data. The classification process follows the next sequence: first, the texts of the test corpus are tokenized to search for new words to be added on the data dictionary, and to identify the number of each word repetitions in the corpus; then the words frequencies are calculated. After that, a vector with the same length as the dictionary is created for each text; the conditional and class probabilities for each vector are calculated; and finally, the highest probability for each vector to be part of a class is selected, in order to assign it a correct class label. The class labels are stored on the *event_class* field, for any of the registries of the tables analyzed.

Data Geocoding

For the data geocoding, a gazetteer based on the methodology proposed by Salazar et al. (2016) has been used; the gazetteer is derived from *GeoNames*, and has 36,236 elements that represent Mexico City's streets with names written in Spanish, and abbreviations that describe the hierarchy of the roads. The gazetteer works with spatial dictionaries that represent the location of transport stations with points, the streets with lines, and the location of monuments, buildings and some other landmarks with polygons.

On the geocoding methodology the text is analyzed, by identifying words which make reference to monuments, buildings, streets and avenues through the use of n-grams, bi-grams and tri-grams on it, by applying a recovery information process (Sidorov, 2014); once that the elements have been identified, a geospatial representation (point, line or polygon) defined on the spatial dictionaries, is assigned to them. By calculating the possible combinations of the geometric elements, the spatial relations between the detected elements are calculated ((line, line), (line, polygon), (line, point), (point, line), (point, point)), when the resultant relation is possible, the coordinates of the elements intersection, are chosen as the coordinates for the event described.

What the proposed approach does on this stage, is to apply the geocoding methodology of Salazar (2016) over the registries texts stored on the *rss_service* and *traffic_data* tables, in order to obtain its coordinates. The resultant coordinates are stocked on the fields *x_coordinate* and *y_coordinate* of the mentioned tables.

The *traffic_situation* database, has been structured on *Postgresql*, as shown on Figure 2. By using the spatial extension *Postgis*, the texts coordinates, are transformed into geometric points, to represent the events they describe, in the study area's map; such transformation is possible by applying the Postgis function *ST_GeomFromText*.

Statistical Analysis and Results

To make a better analysis of the classification and geocoding results, a statistical analysis was applied over the 5000 tweets and rss texts treated.

It was found that 32% of the processed texts, have information about accidents occurred on the roads; 62.98% describe the traffic situation, and from them, 14.24% describe a good circulation situation, meanwhile the 48.74% show problems for vehicles to move through the streets; 4.0% refer to streets closures; and only 1.02% of the texts, had not enough information to be classified. On Figure 3, a circle graph shows the events proportion.

Figure 2. Tables from traffic_situation database

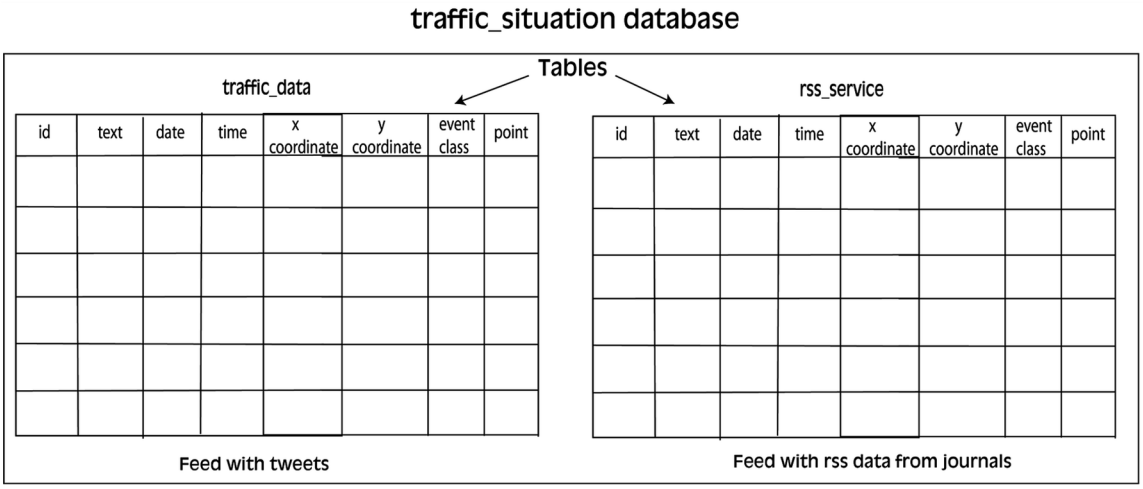
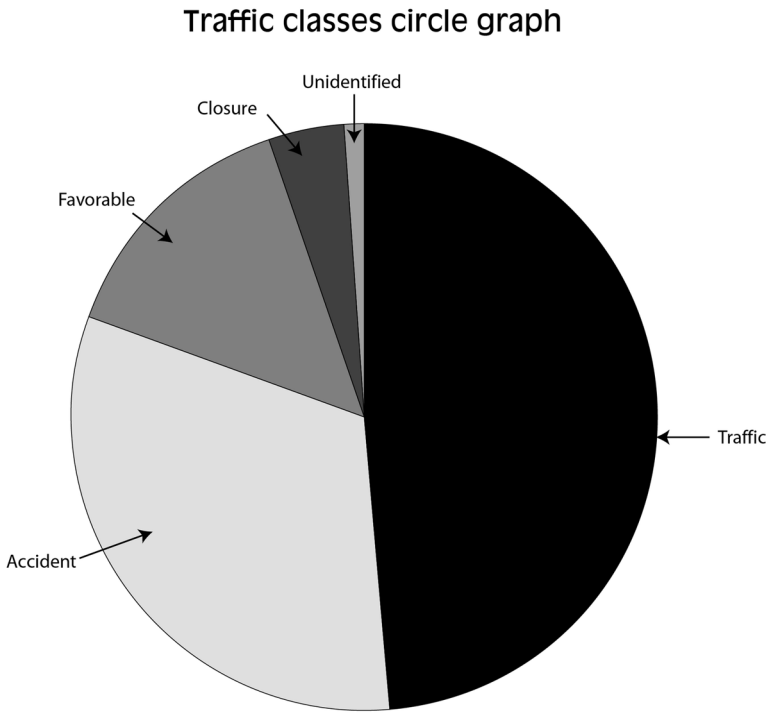


Figure 3. Circle graph that shows the classified events proportions



To have a better event's visualization, the points of each class were mapped on the study area. Here the authoritative data is used, to relate the classified and georeferenced traffic events, with the location of commercial businesses of the study area. The authoritative data is a shape file from the geography and statistics department in Mexico, each point in the shapefile, represents a commercial entity in the city, and provides information such as the business schedule, commercial activity, and number of workers.

The used cartography belongs to Open Street Map; which lets to this approach make a relation between the VGI data from a mapping platform, and the VGI data from a social network. On Figure 4, a map with the OSM cartography shows the authoritative data (points), and buffers of 100 meters round the businesses, to detect the traffic events reported by citizens near to them. The information from the businesses makes possible to relate its commercial activity, and the number of traffic events detected.

SOLUTIONS AND RECOMMENDATIONS

The first problem this approach presented, was the texts geocoding. Since a few part of the short texts from the social network have coordinates, and most of the rss texts recovered have not the coordinates of the place where they were published, or of the event they describe, it was necessary to implement a geocoding process. One solution proposed, was using a basic gazetteer to search for the streets names on texts; the issue with this solution is, that it does not exists a complete Mexico's gazetteer, and that there are streets names in Mexico City, related with names of people and places from other countries, such as Liverpool, Zurich, Benjamin Franklin, among others. When using this proposal, many short texts were geocoded at some other latitudes far from Mexico, as represented on Figure 5, where the street named *Berlin* in Mexico City was geocoded in Germany.

Looking for another solution, it was found that many researches use annotators to geocode tweets manually, this is one of the most accurate ways to geocode, but it is not easily scalable and requires more time and participants. The methodology proposed by Salazar (2016), was the most efficient for this investigation, since by an automatic process, the coordinates for the text were obtained with a good precision level.

Figure 4. Buffers created round authoritative data, to evaluate the number of traffic events, and its relation to the commercial activity of the represented place

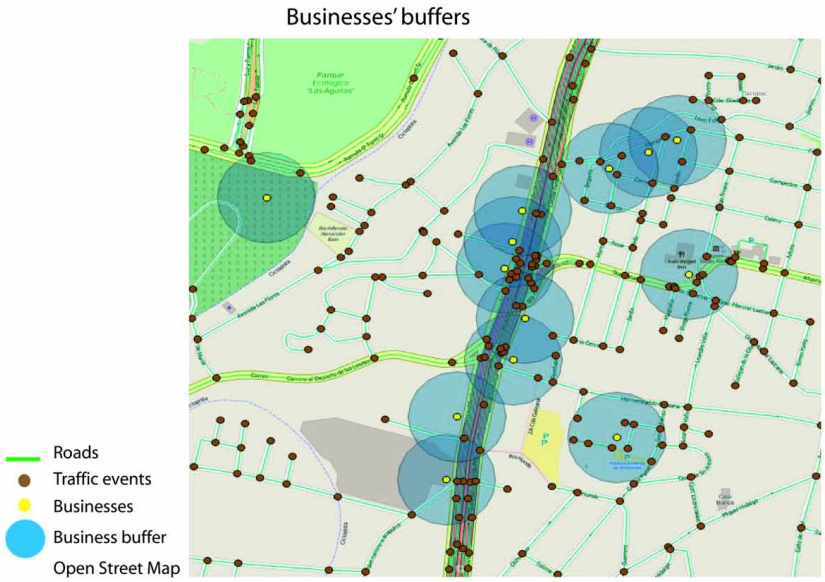
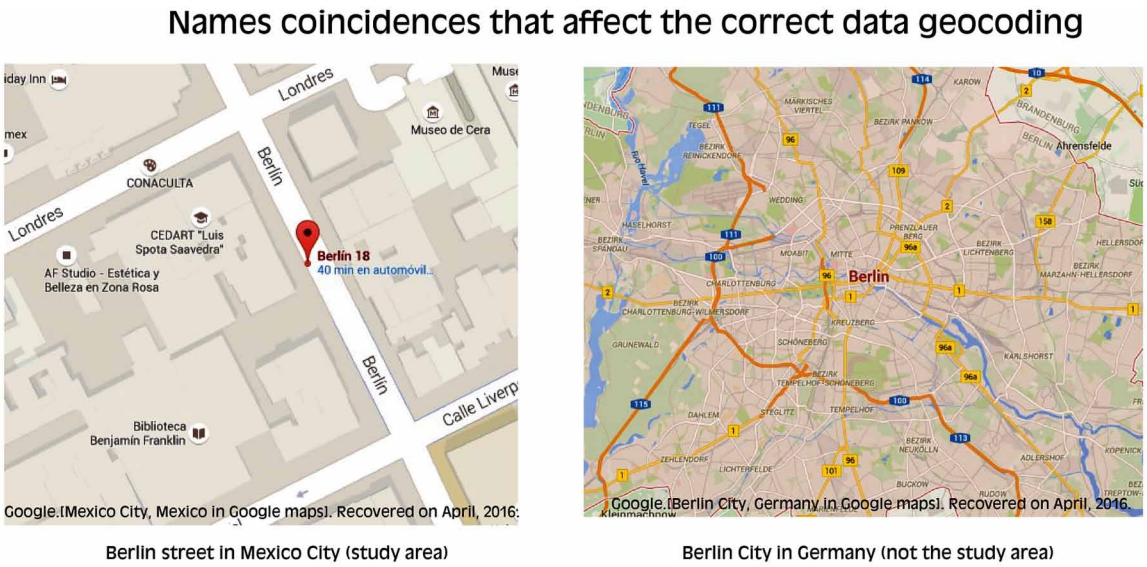


Figure 5. Coincidence between Mexico City streets names, and places out of the study area with the same name



Another issue, was the classification model election. Our approach was designed to use a machine learning algorithm, and by studying many tools, it was decided to apply the Naïve Bayes classification algorithm, due to the good results that it has reached by classifying texts such as e-mails and SMS. Naïve Bayes requires a training data set, to learn patterns and to be useful for further data classifications; such data set was classified manually. A recommendation for this approach is to use some other semi-classified machine learning algorithms, to classify the test corpus created by the present research, and make comparisons between the new results and the Naïve Bayes ones.

FUTURE RESEARCH DIRECTIONS

This methodology has been proved to extract information about the traffic on urban areas, with the study case in Mexico City, but it can be used to extract information about some other urban topics, as well as air pollution, floods, robbery, among others; the changes needed on the procedures, to treat other topics, must be done on the relevant words to be considered on the text mining and recovery information processes, and in the classification of the data from the training corpus. On the machine learning stage, the update is not necessary since the algorithm learns the interesting words from the texts, by calculating their probabilities of presence and absence.

The analysis of traffic has been done on this approach, with a view to provide classified traffic events descriptions with their coordinates to a further research, that studies the relation between traffic events in a city and models the behavior of traffic in urban areas by regression models.

CONCLUSION

The present approach, makes use of VGI and authoritative data, to represent and classify the traffic events on an urban area. The authoritative data are geometric points that represent the commercial businesses on the study area; the VGI information is acquired from Twitter messages and from rss services. The social network Twitter has been chosen because of its large number of members and the facility to extract information from it, by using a Twitter API.

The study area is Mexico City, one of the most populated and with more demographic density in America. Since the collected tweets belong to Mexican Twitter accounts, the short texts are written in Spanish language. After the extraction from tweets and rss, texts are stored on a database named *traffic_situation,* into two tables; then a text mining procedure, and an information recovery process are applied over the data to eliminate special Spanish characters, and to extract the words that describe events or situations related to the traffic on the study area.

The data set of tweets and rss texts, are partitioned into three. The identified traffic words in Spanish, such as *lento, accidente, cierre, avance* among others, are used to classify one data set partition, into five classes: *traffic, favorable, closure, accident* and *unidentified*; by using a words comparison method. Such classified partition is called training corpus.

To classify the other two partitions which compound the test corpus, Naïve Bayes a semi-supervised machine learning algorithm is used. The algorithm is trained with the classified texts, and calculates probability tables, in order to learn how to classify new texts based on the words that they contain or not; after the training process, the algorithm classifies the test corpus into the same five classes defined on the information recovery stage.

Despite some of the short texts from such microblogging service have the coordinates of the place where they were published, it is necessary to apply a geocoding process over the data, in order to know the coordinates of the place where the classified traffic event is being described.

When the classification and coordinates of the texts are known, geographic points are created to represent the events on the area's map, with a view to identify the places with more traffic, and its relation with the commercial businesses; a statistical analysis is also done, to know the proportion of each defined class.

The present approach collects, classifies and geocodes traffic events information, nevertheless, it could be useful in the acquisition and data treatment of many topics, or to analyze traffic on some other study areas.

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KEY TERMS AND DEFINITIONS

Gazetteer: A geographical dictionary that contains information about socio-economic statistics and physical features of a geographic area.

Geocoding: The process to obtain coordinates from spatial reference data on texts, such as street names or landmarks.

Metadata: The data that contains some other data or labels it, to describe its content, such as coordinates or URL information.

Microblogging Service: A service to distribute content to a group of members by internet, such content could be short texts, small audios or video links.

RSS Service: A document used to publish frequently updated information, which includes text and metadata.

Social Network: A web platform where people shares interests, activities and stablish social relations by virtual connections.

Traffic: The movement of people, vehicles or merchandise through the roads, it can be fluent or congested.

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Chapter 28
Communication Privacy Management and Mediated Communication

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ABSTRACT

Communication privacy management theory (CPM) was originally developed to explain how individuals control and reveal private information in traditional social interactions. It has since been extended to a number of contexts, most recently to evolving communication technologies and social networking sites. CPM provides a set of theoretical tools to explore the intersection of technology and individual privacy in relationship management. This chapter introduces CPM; privacy is defined, the three primary components and eight axioms of CPM are reviewed, and their application to mediated communication contexts are outlined. Areas for future research are presented.

INTRODUCTION

Sandra Petronio (1991) introduced communication privacy management theory (CPM) to explain how individuals control and reveal private information. While it was originally developed as an organizing principle for understanding disclosure in traditional social interactions, it has since been extended to a number of contexts, most recently to evolving communication technologies and social networking sites, including online blogging (e.g., Child & Agyeman-Budu, 2010; Child, Petronio, Agyeman-Budu, & Westermann, 2011), Facebook usage (e.g., De Wolf, Willaert & Pierson, 2014; Waters & Ackerman, 2011), and Twitter and Short Message Service (SMS) (e.g., Cho & Hung, 2011; Jin, 2013; Patil & Kobsa, 2004). CPM provides a set of theoretical tools to explore the intersection of technology and individual privacy in relationship management. Below privacy is defined, components of communication privacy

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management theory and their application to mediated communication are outlined, and areas of future research are presented.

BACKGROUND

Both a dynamic and dialectic process, the notion of privacy suggests that individuals regulate boundaries of disclosure, personal identity, and temporality (Palen & Dourish, 2003). More specifically, it refers to our ability to manage when, how, and the extent to which our personal information is revealed to others (Westin, 1967).

When discussing the intersection of technology and privacy, people often focus on technical issues associated with technology use (see, for example, Boyles, Smith, & Madden, 2012). In reality, individuals focus significant attention on managing privacy in their online digital lives. CPM provides a means to better understand and explain how individuals use and communicate in online and mediated communication contexts (Child & Petronio, 2011).

COMMUNICATION PRIVACY MANAGEMENT THEORY

Originally developed for interpersonal contexts (Petronio, 1991), research associated with CPM initially focused on social and interpersonal interactions in areas such as family and health communication. (e.g., Petronio, 2006; Petronio & Caughlin, 2005; Petronio, Jones, Morr, 2003).

Petronio (2007) describes CPM theory as "an evidenced-based, applied theory construct to be translatable into practices" (p. 219). The CPM system rests on three elements – privacy ownership, privacy control and privacy turbulence. Eight axioms predict privacy practices (Petronio, 2013). The first two axioms are associated with privacy and the ownership of personal information. Axiom 1 proposes that individuals believe in private ownership of their personal information and in their ability and right to share or protect that information from others. Axiom 2 predicts that when access to private information is granted to others, those gaining access become co-owners of the information, taking on the trust and responsibility that comes with co-ownership.

Axioms 3 – 6 are associated with privacy control. Petronio (2013) described privacy control as the regulating engine for determining the conditions of providing or denying access to private information. Thus, not only do individuals believe they are sole owners of their personal information (i.e., Axiom 1), but they also believe they alone control their personal privacy, even when that information is shared with others (Axiom 3). At the same time, how information is shared is based on the privacy rules individuals develop (Axiom 4). Core and catalyst criteria influence decisions on how and when rules are invoked. Core criteria are the most stable and predictable guidelines for privacy choices, while catalyst criteria result in privacy rule changes based on motivation and risk assessments.

Axiom 5 addresses how, once access to private information is shared with others, the original owner continues to maintain control by continued coordination and negotiation of privacy rules associated with third-party access (Petronio, 2013). However, ownership rights can be challenged when individuals manage multiple, often inter-related, privacy boundaries (e.g., can information revealed by a friend be shared with another mutual friend) (Petronio, 2002). Confidants fall into two categories – deliberate confidants purposely ask for information (e.g., bank employee and customer), while reluctant confidants receive

unwanted private information (e.g., a third party present during a mobile phone exchange). Reluctant confidants may experience unwanted feelings of obligation and responsibility (Petronio & Reierson, 2009). If the parties can reach a consensus about privacy rules, and accept the means by which they became deliberate confidants, then the confidant relationship can be effectively regulated.

The complications of collective co-ownership are seen in Axioms 6 and 7. Co-ownership leads to mutually agreed upon and practiced privacy boundaries where all members of the group can engage in sharing private information (Axiom 6, Petronio, 2013, p. 10). These group held privacy boundaries are regulated by decisions about who may divulge what information to whom and when. (Axiom 7, Petronio, 2013, p. 11). Thicker boundaries suggest that the coordinated rules of those collectively holding private information are relatively closed, while thinner boundaries are more permeable, resulting in information that is more accessible and open to third parties (Petronio & Reierson, 2009). The original owner of the information and the confidant negotiate the level of access third parties may have, including the scope and extent of private information that can be shared.

The purpose of these boundaries is to govern who has control of and access to information as well as how to protect that information (Petronio, Sargent, Andea, Reganis, & Cichocki, 2004). People manage or coordinate privacy boundaries based on negotiation of privacy rules related to linkages, boundary permeability, and information ownership (Petronio, 2002). Privacy rules are both normative and situational and affected by a number of factors, including cultural expectations, individual motivations, risk-benefit assessments, gender, and the needs of the situation (Petronio, 2009). Importantly, multiple rules may be used during the boundary management process.

The final axiom, Axiom 8, addresses the area of privacy turbulence, and acknowledges that privacy regulation does, at times, fail and rules are broken. Privacy boundary turbulence often results from confidentiality breaches (i.e., privacy expectations of the original owner of information are not met by co-owners) (Petronio & Reierson, 2009). Violations of confidentiality – discrepancy breaches of privacy, privacy ownership violations, and preemptive privacy control – can negatively affect the relationship of those involved.

APPLYING CPM TO MEDIATED COMMUNICATION CONTEXTS

The principles of CPM have been used to explain how individuals use social networking sites as well as emerging communication technologies. This section illustrates how CPM's principles and axioms can be and have been applied in these areas. The first principle of CPM asserts that individuals own their private information. In many ways, this norm was strengthened with the advent of mobile technology (Bergvik, 2004). For example, mobile phones have shifted from a location-based technology to person-linked devices. Today, they are viewed as a central element to individual identity and public presentation (Arminen, 2007; Campbell, 2008), and subsequently as private and personal property (Rosen, 2004; Häkkilä & Chatfield, 2005). This norm has become so well established that few individuals will answer another's cell phone in recognition that calls and texts are private belonging to the owner of the phone. The result is that incoming calls are viewed as private communication with the phone's owner even when the caller or receiver is in a public setting. Mobile phone users can manage privacy concerns by strategically choosing their method of communication (e.g., instant messaging, SMS, voice, etc.) (Worthington, Valikoski, Fitch-Hauser, Imhof, & Kim, 2012). Each means of communication comes with its own set of privacy concerns with some mediums implying greater ownership and having thicker boundaries than

others. For example, Häkkilä and Chatfield (2005) found SMS messages are assigned greater privacy, and are seen as more confidential, than voice calls.

In online communication, individuals will sometimes treat public domain space as if it is private (Child & Agyeman-Budu, 2010; Child & Petronio, 2011). One consequence may be posting, tweeting, blogging or otherwise sharing information that results in follow-up measures to manage privacy (Axioms 3 & 7). Bloggers who remove or "scrub" a message from their blog have reevaluated the risk-benefit ratio of retaining a message on their blog (Child, et al., 2011). Thus, blog scrubbing results from the recognition of potential privacy turbulence (Axiom 8) that may result from privacy violations. A number of factors may lead bloggers to change their regular privacy rules, among them impression management, safety, and relationship considerations (Child et al., 2011). Blogger perceptions of privacy appear to fall along a continuum ranging from those who are highly aware of privacy issues and proactively weigh the risks (the cautious blogger) to those who never worry about their privacy (high risk-taking bloggers). In these two cases, blog scrubbing will rarely occur. However, the normative blogger is cognizant of triggers and will adjust privacy rules to situational demands.

Axiom 2 predicts that when access to private information is granted to others, these gaining accesses become co-owners of the information, taking on the trust and responsibility that comes with co-ownership. Facebook postings are an example of information that individuals move across their privacy boundary to become collectively co-owned with Facebook friends (Child & Petronio, 2011). In such cases, there is a loss of individual control in favor of being social and interacting with others in their network (Bateman, Pike, & Butler, 2011; Child et al., 2011). These friends become authorized co-owners of the information. However, users who are more protective of their privacy may engage in a variety of strategies, including providing less information, making vague postings, and using coded language (Axiom 4; Child & Starcher, 2016; Child, Duck, Andrews, Butauski, & Petronio, 2015). There are a number of reasons for increased privacy concerns with Facebook and similar social networking sites. Users may be concerned with who they are interacting with or be worried about family members, romantic interests, colleagues, employers and others who may be engaging in mediated lurking (Child & Westermann, 2013; Child et al., 2015; Frampton & Child, 2013). Of course, users can reclaim privacy by deleting postings. Notably, they can also refuse to accept responsibility for disclosures placed on them by others. This refusal can be seen when individuals delete comments or other information posted on their personal site by others (i.e., reluctant confidents, Axiom 5).

Related to social networking sites, De Wolf and colleagues (2014) suggest that just as individuals create personal boundaries, they also create group boundaries with others with whom they share information. Adequate feelings of control and privacy management reside with the group. Their study supports Pertonio (2002) assertion that individuals must establish both individual and group privacy norms in order to have adequate management of privacy issues.

Finally, privacy perceptions differ across cultures and countries. For example, in a Malaysian study, Mohamed and Ahmad (2012) identified several reasons individuals are concerned with information privacy associated with technology, communication, and social networking sites. They note that a user's perception of the gravity of losing any kind of personal information leads to increased privacy behaviors. They also report that protective behavior use will increase when users find it easy to use security settings. In a study of the effect of cultural differences on mobile phone usage, Worthington et al. (2012) reported differences in user privacy concerns across the four countries they studied (Finland, Germany, South Korea, and the U.S.). For example, Finnish and U.S. respondents were more sensitive to the interaction between conversational topic and public location than South Korean and German participants.

FUTURE RESEARCH DIRECTIONS

Arguably, one of the strongest concerns individuals have with communication technology is how to manage and control privacy. Privacy, however, goes beyond how to protect financial information or individual passwords to include how to manage personal disclosures. Applying the theoretical framework of Communication Privacy Management to current and emerging technology provides insight into communication behaviors of its users as they balance privacy issues against their daily communicative needs. No matter the means of communication, receivers make choices on what to disclose and what will remain private when communicating with others. Decision criteria aid in the development and employment of underlying privacy rules (Petronio, 2002; Petronio & Durham, 2008). A better understanding of the criteria used to make privacy decisions when using emerging communication technology and social networking sites will enable researchers to better predict communication behaviors.

Decision criteria are affected by a number of factors, including cultural and individual differences. Like many areas of communication studies, comparisons across cultures are relatively rare (for an exception, see Worthington et al., 2012). Such studies would allow for the identification of commonalities as well as cultural differences in how individuals manage privacy, assess co-ownership, and develop privacy rules. Along with studies exploring cultural differences, research into individual differences is needed. How might differences in self-consciousness, interaction-involvement, communication apprehension, compulsive communication, and related psycho-social constructs impact privacy management decisions and rule development?

While a number of studies have focused on Facebook users (e.g., De Wolf, Willaert & Pierson, 2014; Waters & Ackerman, 2011), few have addressed CPM by users of other sites (e.g., LinkedIn, MySpace, Meetup, VK, etc.). Such studies may provide a better understanding of underlying factors associated with boundary permeability and turbulence, particularly as related to areas such as the effect of privacy breakdowns on social relationships, self-disclosure, and privacy management practice.

Finally, the intersection of communicative affordance and CPM provide another potential area of study. An affordance describes the "mutuality of actor intentions and technology capabilities that provide the potential for a particular action" (Majchrzak, Faraj, Kane, & Azad, 2013, p. 39). Schrock (2015) argues that communication has been inherent in many explanations of social affordances, particularly those that highlight the role of perceptual cues on individual perception and social networks. This approach to affordance goes beyond design features (e.g., apps, screens, etc.) to include the impact of a technology on human communication processes, such as communication privacy management. How might perceptions of technology and communication affordance be informed by user concerns of personal privacy?

CONCLUSION

Emerging communication technologies and social networking sites have significantly impacted how individuals and groups communicate with one another. However, while the methods of communication have changed and while they certainly can affect communication processes, at their center are people communicating with other people. Communication Privacy Management theory represents one of many human communication theories that may provide insight into how individuals use technology to communicate with one another. Through its application, researchers may ultimately find that while the means of communication change, individual privacy concerns remain the same.

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KEY TERMS AND DEFINITIONS

Boundary Permeability: The level of access, scope, and extent of private information an individual is willing to share with others.

Boundary Turbulence: Occurs when privacy expectations of the original owner of information are not met and a confidentiality breach occurs.

Communication Privacy Management Theory: A theory addressing the tension people experience when choosing what personal information to reveal and what will remain private when interacting with others.

Confidants: Individuals who are given access to private information.

Confidentiality Breaches: Occur when privacy expectations of the original owner of information are not met by co-owners of information.

Deliberate Confidants: Individuals who are purposely given private information and readily take on obligations and responsibility associated with co-owning the information.

Information Co-Ownership: Occurs when access to private information is granted to others, who then take on the trust and responsibility that comes with co-ownership of previously private information.

Privacy Boundaries: Personal boundaries separating public and private information. They govern who has control of and access to personal information.

Private Information Ownership: The belief that individuals own their personal information and have the ability and right to share or protect that information from others.

Reluctant Confidants: Individuals who receive unwanted private information and may experience unwanted feelings of obligation and responsibility.

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Chapter 29
The Dual Nature of Participatory Web and How Misinformation Seemingly Travels

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ABSTRACT

Web 2.0 is an internet technology that facilitates collaboration on the world wide web (WWW). As a direct product of people's freedom of expression, Web 2.0 technology has given birth to a new media – the social media that is redefining the way people collaborate and express themselves. By studying surveys in three specific aspects of its impact—social service, politics, and as a vehicle of misinformation and through content analysis of some online comments—the author argues that social media is capable of transmitting both good and bad information. In the chapter, an illustration of how misinformation through video seemingly travels is also presented.

INTRODUCTION

Social media is called 'social' as it is primarily 'produced' by people (user-generated) and there is less or no commercial aspect involved. The platform lets people to communicate in horizontal using multimedia (text, photos, videos, music, etc.), thus, also making them reporters and publishers in the process. Social media has brought in a revolution in the way people express their views and share their likes and dislikes (Asur, Huberman, Szabo, & Wang, 2011; Ellison, 2007; Kumar & Jan, 2011, 2012). This media sits on Web 2.0 technology. In this article the author argues that the web is a neutral medium which could be used from transmitting good and bad information. A hypothetical model of how misinformation travels is also presented.

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BACKGROUND

Web 2.0 does not refer to the update in the technical specification, but rather new applications and technology that makes web experience more interactive. While talking of Web 2.0 the applications such as Ajax or Openlaszlo are stated, which make the web as a 'Participatory Web'. This is in contrast to the earlier version Web 1.0 which was essentially an 'Information Web'. The main features of Web 2.0 are user-interaction, dynamic content, meta data and scalability (Best, 2006). Social media sites such as Facebook and Flickr make use of Web 2.0 technology in order to give interactivity to their sites. McAfee (2006) refers to the following technological features of Web 2.0, acronymed as SLATES – Search, Links, Authoring, Tags, Extension, Signals. Search enables keyword search, Links helps in linking to other documents within the page or elsewhere on the Net, Authoring refers to the ability to update, iterate and cumulate content, Tags help in searching and helping to avoid category rigidity, Extensions help in leveraging the Web as both document server and application platform, and finally, Signals that help to inform users of changes in the social media content. In more technical terms, Web 2.0 technology is based on two sides – Web browser side (client) and Web server side (server), and they utilize softwares like Ajax, JavaScript, Flash etc. to fetch data to and from the Web server and to carry on instant updates. Flash software technology is also used in music and video sites. YouTube is a good example of Flash technology. The popularity of Web 2.0 has encouraged all web allocations with collaborative and interactive functionality to append the term 2.0 to it – interestingly these name are, for example, Library 2.0, Publishing 2.0, Social Work 2.0, Travel 2.0, and the list goes on. Essentially all these Web applications use Web 2.0 technologies to provide better functionality in their domain of business.

In this article that author argues that although these new technologies are making Web even more popular and accessible, they are also making people spend long hours on seemingly unimportant and irrelevant conversations, dialogues, reviews and opinions. According to Andrew Keen, writer of '*Cult of the Amateur*', Web 2.0 has "created a cult of digital narcissism and amateurism, which undermines the notion of expertise" ("Web 2.0 has created a cult of digital narcissism and amateurism?," 2010). Just as a river, that carries everything – good or bad – as it flows, social media makes no discrimination between what is carries. Some people use it for a good cause, some as a campaign tool, while others use it to spread hatred and false news.

Through surveys and content analysis of some comments of Social Media, which includes blogs, discussion forums, newscasts, market research studies and traditional websites, on three determinants – 1) social service, 2) politics and 3) misinformation – we do a critical examination to see if social media is a double-edged sword – a technology which could be used to transmit both good and bad information.

A Great Vehicle for Political Propaganda

In politics, people elect their representatives. These representatives then govern a county or a country. Political news have always captured the front pages of our newspapers. A country is more secured and safe if its political climate is stable. The way people elect their representatives and the way representatives campaign during the elections, differ from place to place and from country to country. Let us take the example of two biggest democracies in the world – India and USA. In India, a large percentage of people who cast their votes are still farmers, low income group people and the elderly. Political parties

in India, thus, go all out in wooing the farmers and it's the farmers who actually bring a candidate to power. Unfortunately, most of the farmers are either illiterate or semi-literate who have almost nothing to do with Computers or latest online technologies. One can forget about how Social media would ever affect their voting decisions. In contrast, USA is a country where most of the voters are literate and have access to internet and other latest electronic gadgetries. The way social networking is bringing people together, its communicating power and speed, its "peer to peer" and "word of mouth" potency have been understood quite well and quite early in the game of politics in America.

Social media based videos in particular are becoming a popular medium for political propaganda (Noguera & Correyero, 2010). This was clearly evident in the last major US presidential elections (year 2008) which remained in the news for over 2 years – first the elections between Hillary Clinton and Barack Obama within the party and then the fight to the finish between the Democrats and the Republicans. Both McCain and Obama used Social media technologies to the hilt. We particularly know Obama for his Social media savoir-faire. Barack Obama appointed Scott Goodstein as External Online director ("How Obama used social networking tools to win," 2009) for *Obama for America*. According to Scott, there were three main factors instrumental in the effectiveness of the campaign – 1) using deadlines to test new ideas, 2) allowing consumers to engage and, 3) validate and moving with the marketplace. There's lot happening on the Net which one can either ignore or engage in it. Scott believed that they were able to successfully engage and move with the marketplace, which helped them win the elections. His social media strategies helped attract 1.7 million supporters on Twitter, 6.5 million on Facebook and over 2 million supporters on MySpace. Speaking in Singapore, he stated that Social Media put Obama's slogan 'Change you can believe in', front and centre. Obama, himself an exceptional communicator, needed the right messenger and social media proved to be just that right one. It helped Barack Obama's message to clearly reach the audience. People were talking and discussing about him in Facebook, MySpace, Twitter and everywhere.

US has been seeing a shift in media consumption. There are lesser and lesser number of people interested in TV or newspaper. More and more people have been reaching out to Internet for news and entertainment. Understanding this, the online campaign team of Obama meticulously handled social networking campaign platforms, including those that were catering to the ethnic communities. Obama's willingness to experiment with new communication tools gave the initial fillip. In the present times, the competitiveness in elections is intense and just 5% votes shift can make a candidate lose or win elections. Propaganda through social media coupled with good support from ethnic groups - such as Indian-americans, Afro-americans, etc, probably gave Obama the vital vote shift.

However, if Social Media could give positive results, it could also do the opposite. This is what happened with Sarah Palin and McCain lost the US presidential elections.

One of the bloggers ("The Perils of Modern Communication," 2009) comments and writes about what he read in WaPro:

The difference is that now the masses are technologically enabled, amplified by a twillion tweets. Everybody's got a megaphone, bless democracy's heart.

But when a protest of one (or a few) can instantly morph into a babble of thousands, rabble-rousing becomes a hobby -- and rational debate becomes an oxymoron.

The comment speaks about how a protest can amplify manifold.

In the case of Barack Obama one saw how Twitter updates, Facebook and Myspace communities helped him gather funds, volunteers and publicity. A dedicated social networking site mybarackobama.com, powered by 'six apart' company, was extensively used. However, after the campaign was over, his twitter stream went silent for weeks and there was little to no engagement directly by the Obama camp on other sites as well. Probably, politicians have not yet realized that it is not just enough to make social media as a campaign tool but also to use as an effective tool to connect to its faithful voters post-election results. It may also be true that political parties are scared that the power of social media would soon make them unpopular, if unpopular policies are enacted (i.e increase in taxes), and hence are not comfortable at engaging with people post elections, as yet.

We, thus, are seeing that successful experiment with Social Media in politics has now made politicians and political parties to stand up and take notice. It also reminds them that it is not just sufficient to win elections but live up to their manifesto. Because the users of Social Media are no bovines – they will write, share and speak-up about any topic or issue. If they do not perform while in power, the same people who voted for them would bring them down, when they stand up for the next term. For political parties and politicians, writings and feedback on social media are a nice way to gauge what people are thinking about them.

A Platform for Social Service

In day-to-day context, the word 'social service' often means 'caring for humanity'. When we hear that certain organization is doing social service, we understand that they are providing humanitarian service. So how can this Social media work for social service or cause? Can it help in social entrepreneurship?

Late C.K. Prahalad, the management Guru, said that it is important to target the BoP (Bottom of Pyramid), in order to eradicate poverty (Prahalad, 2010). Half of the people in the world are living under $2.5 a day. As commercial companies are more and more targeting people who have money, there is a widening gap between the have and have-nots. This gap could be targeted by social entrepreneurs. It is a huge untapped market that could be harnessed both for profit and eradication of poverty. Melting of borders has also made social entrepreneurs bring their innovations to different parts of the world. The success of Grameen Bank's micro-credit model, for example, is now being implemented in other parts of Asia, Africa and even Europe, with varying degree of success.

Social entrepreneurs in the west are leveraging the power of social media to reach out to the developing world. Yonus's Grameen bank in Bangladesh is one of the earliest successful examples of social entrepreneurship. Grameen bank's unique lending model went on to prove that people would pay back their loans even when they are given without co-laterals. Grameen bank had a 99% loan return rate which is much higher than commercial banks. The same micro-finance concept is taken up of kiva.com that works as a connector between the people willing to lend money to people in need. People who need money are first verified by the regional field partners and once verified, their profile is posted on the kiva website. By remitting as low as 25$, one can contribute to one or multiple loan-requesters. People who lend money are satisfied that it is going for the right cause. Once the borrower starts repaying, the money is repatriated to the lenders in a phased manner,. Field partners keep the interest to defray their expenses. The default rate is near zero and the success is huge, so much so, that kiva.com as of 2013 had helped people with about half a billion US$ of loans. A loan request is fulfilled in just 15 hours, on an average.

The question remains whether globalization has created a new breed to social entrepreneurs with fire in their belly to do something transformational and bring about a social improvement. The internet has brought the awareness of social entrepreneurship. For example, many people have come to know about this kind of entrepreneurship by visiting the asoka.org or kiva.com websites.

Improvement in the level of education is another area where social entrepreneurs have been working on. Negroponte's one-laptop-per-child (http://laptop.org/en/) is a wonderful example of this. One laptop per child is MIT's project that has developed a laptop for school children and it costs under US$200. The project has plans to bring it down to US$100 eventually. It is a major project that it being implemented in association with the governments of both the developing and the developed worlds. India too is working to come out with an ultra-cheap laptop for school children that some say would well cost below US$ 100. It is important here to know that these projects help students to have access to latest digital technologies. Better access to information over social media and learning material undoubtedly improves their knowledge level and grasping power. It the Social media that spreads the word of mouth. You one has something worthwhile to sell or give and if people like it, it will spread like wildfire over the internet. One-laptop-per-child would not have become known across the world had it not been discussed in blogs and other niche networking sites. It is important to understand that Social Media is not only about sites like Facebook and Youtube. It is also about such sites like Kiva.com that are able to provide direct help thousands and thousands of needy individuals.

One of the bloggers ("The Humanitarian Power of Social Media," 2009) a recent impact of social media in motivating people to donate blood. The bloggers decided to donate blood in Austin, Texas, and they had just three days to spread the message. To promote the event, the bloggers used blogs and asked other bloggers to write about the event. The result was satisfying – over 100 people turned up to donate blood at a centre that gets on an average 40 people donating blood on a given day. Among the donors were people who were donating blood for the first time. In another example ("Capital Area Food Bank of Texas," 2009) of how social media could benefit humanity – a company TysonFoods decided to donate 100 pounds of food (limited to a maximum of 35,000 pounds) for every comment they receive on the website. This message was twitted across (through microblogging site Twitter.com) and within 6 hours the limit was reached. The company got over 350 comments and the donation of 35,000 pound of food was made to Capital Area Food Bank of Texas's HAM-up event. Social media tools like weblogs, social networks and video chats are used in both large and small hospitals which are 'reengineering' the way patients and doctors interact (Hawn, 2009)

The consumer to consumer communications have been greatly expedited due to the viral nature of social media (Mangold & Faulds, 2009). This can send good message very fast. If one have a blood camp in his neighborhood or there is sudden need to help someone in dire need information could be circulated through Facebook. Twitter, the micro blogging network, is making this even faster. Just one twit and all followers of the individual on Twitter are immediately informed.

But Also a Vehicle for Misinformation

Social Media is a popular opinion sharing platform. It is to everybody's benefit if these opinions and views are constructive. Such an endeavour, for example, can help a child in need of blood of a rare blood group. However, what happens if the same platform is used for spreading hate or some other kind of misinformation? Social Media is only a medium - it carries everything and carries it fast. So if someone wants to spread rumour about a UFO or Michael Jackson rising from the dead, just posting a grainy

video footage on Youtube can make the rumour spread like wildfire. It will be carried forward in other blogs, copied, Digged, Reddited, Stumbledupon and Twitted in no time. Harmful rumors spread and cause people to panic (Hashimoto, Kuboyama, Shirota, & Ieee, 2011) To prove this point, RTL carried out an experiment to show how fast rumours could travel on the social media. They posted a fake video of Michael Jackson (now no more alive) on Youtube. Within a matter of just one day it was viewed over 7,00,000 times and many believed that the video was true. The video was removed from YouTube the next day.

SOLUTIONS AND RECOMMENDATIONS

In social Media, a person is credible if he has a popular blog or if he active in the forums. For example, Sarah Palin, the vice presidential candidate of the US 2008 elections, was the governor of Alaska, enjoying over 93% popularity, when she was chosen by McCain, in the run-up to the US Presidential elections. However, in the social media there was grapewine that Sarah Palin's daughter Bristol was infact the mother of her (Palin's) last child ("Governor Palin Babygate Debunked!," 2008). The source that spread this news went blow-by-blow giving reasons and proof of why this was true. Palin camp did not take the initiative to clear the clouds till the time it became a very hot topic in the formal and informal media. Infact, the formal media (newspaper and TV) took cues from what was circulating in social media and made the topic hotter. McCain Camp tried to douse the fire by doing some unusual things like even carrying out *Adwords* advertisement and driving that traffic to their election website. Palin did come up later to tell that her teen-aged daughter was pregnant with her boyfriend Levi Johnston ("Bristol Palin," 2009). However, the damage was so huge that, some say that this issue was one of the contributors to McCain's loss in the elections. Furthermore, once immensely popular Sarah had her popularity hugely diminished. In 2009, she resigned as the Governor of Alaska. Fig. 1 shows a way rumour through video seemingly spreads.

Misinformation is part of Social Media. Not only for popular persons, it could also happen to products or companies. There have been several cases, especially small companies, who have suffered heavily in the hands of this social media con-artists. Those who only have internet business are always at a risk to suffer the maximum damage if false information gets around. They are picked up by search engines, which keep it indexed for ever (blog posts never die). Someone determined to cause brand damage to a company or product could set-up blogs, join forum and post false information. Depending how influential the blogger is, he could make a serious dent in the popularity of the product or company. So the question again arises, how to do the damage control? Here I present a few steps, in Figure 2 that could be taken when misinformation is being spread and the individual/company is made aware of it.

Microblogging with Twitter is increasing the speed of information and misinformation dissemination over the social Media. 80% of Twitter's 140 characters-or-less messages are delivered through the mobile phones or PDA. Suppose some popular Twitter user has 30,000 followers, in one instant he could influence that many followers. Additionally, followers of this popular person may have their own following. If the information is worth transmitting these followers twit to their followers, creating a dizzy chain effect. Millions of people are made aware of information – false or true, in just a few hours or may be a few minutes. One of the bloggers ("Social media diseases," 2009) writes:

Figure 1. How a rumor or misinformation seemingly travels through video in YouTube

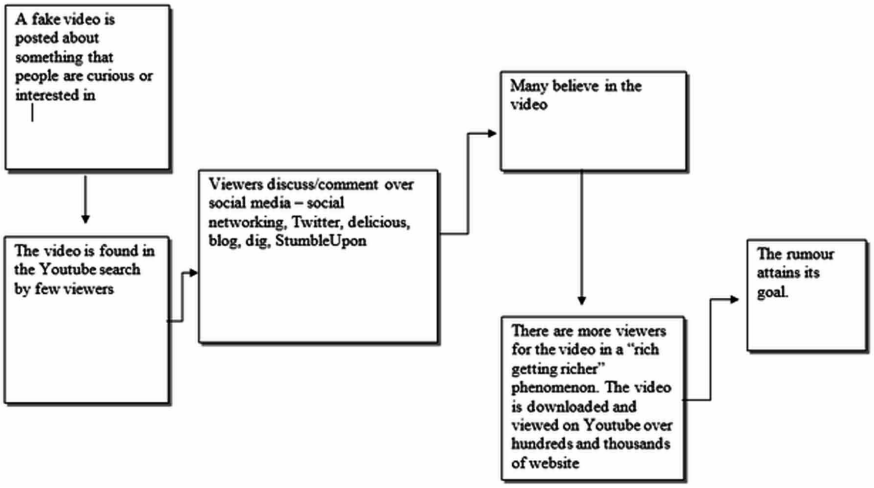
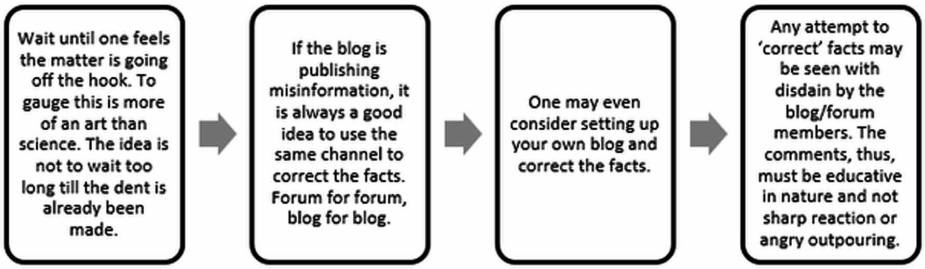


Figure 2. Possible steps to control misinformation damage on social media



24. Art Says:
August 12th, 2009 at 1:58 pm
@IVAN3MAN:

"FALSE beliefs are everywhere. Eighteen percent of Americans think the Sun revolves around the Earth, one poll has found. Thus it seems slightly less egregious that, according to another poll, 10 percent of us think that Senator Barack Obama, a Christian, is instead a Muslim. The Obama campaign has created a Web-site to dispel misinformation. But this effort may be more difficult than it seems, thanks to the quirky way in which our brains store memories — and mislead us along the way."

Who did they survey and why am I not surprised?

In Twitter such misinformation is becoming common. The originator of this misinformation may be doing it for fun or may himself think it is true. However, once it goes few layers down, the information is modified, changed and believed even more. After traveling a few layers, the 'node' does not know where it originated from and thus, either believes or disbelieves it.

Information over a network travels fast and when the network is made of people who give credibility to the word of mouth, it travels even faster. It is pertinent to note that misinformation, rumors and negative news travels even faster. As the old adage goes "if you bite a dog it is news". Because of the

nature of humans to give importance to negative news, there is lot of false news circulating and being believed by the people.

Satirical sites such as Onion.com do not deliberately circulate misinformation (visitors know that these news are meant to entertain) hence must not be confused with sites, news or videos that pose themselves as true but in reality may be just hoaxes. One of the possible ways to reduce the harmful repercussions of incorrect and malicious information is to be informed if the information being transmitted is really true nor not. Those news that unbelievable are in the first category to be checked for its truthfulness. There are several sites that debunk misinformation, rumors, myths, etc – snopes.com (Mikkelson, 2016), being among the most popular. With the US election season (2015-16) now in US, lot of political misinformation is floating around. To get to the bottom of truth, political fact checking could be done by visiting the sites like, politifact.com.

FUTURE RESEARCH DIRECTIONS

Although spread of misinformation is a topic that needs immediate scientific scrutiny, the research in this area has been laggard so far. In the wake of the recent Paris attacks (NBCNews, 2016) at a deluge of misinformation that also flooded the social media, there is an urgent need to conduct studies on how false and fabricated information. A hypothetical model is presented in the article. The spread of misinformation of which social media is the primary carrier nowadays, needs to be understood and checked so that people are aware that not everything that they see or hear on social media would be true. Scientific community too is under its grips where only certain portions of a scientific study for example is used to influence the idea. 'Echo chambers' bring about confirmation bias leading to misinformation such as conspiracy theories (Feldman, Myers, Hmielowski, & Leiserowitz, 2014; Harvey, 2016). Hence the future research could look into other models of how misinformation travels and the ways of limiting the spread of fabricated information of social media. Social network theory, for example, is a powerful way to understanding these mechanisms where a "influence limitation" could aid in restraining 'bad' information with 'good' information (Budak, Agrawal, & El Abbadi, 2011).

CONCLUSION

Unlike traditional media which has an editorial board to oversee what is published and what is not, social media is free for all – there are no editors and one could publish whatever he or she wanted. In Social Media there is no formal filter. The person receiving it has to use his/her judgment to separate misinformation from true information.

Here an attempt was made to understand the impact of Social media on Society. Social media is rapidly evolving, hence it is impossible to gauge its real impact. We learn that politicians in developed countries, like US, are using Social Media for the purpose of election campaign. However, there is lack of engagement with voters after the campaign. SM is being used for Social Entrepreneurship, esp. Microfinancing. Volatile and viral nature of SM is carrying both information and misinformation at extremely fast pace. It may be rightly concluded that Social media is a medium, which could be a double-edged sword, capable of both good and harm.

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KEY TERMS AND DEFINITIONS

BoP: In an acronym of 'Bottom of Pyramid' that refers to the poorest, yet largest strata of people. The poorest are usually defined by those group of people having earning of under USD 2.5/day.

Echo Chambers: the area of the virtual media where ideas and beliefs are reinforced through repetitive broadcast.

Influence Limitation: A process where misinformation (or 'bad') is diluted or replaced with correct ('good') information. Such an endeavor potentially reduces the harmful repercussions of misinformation.

Misinformation: False information, rumors, etc. circulating through the online social media.

Social Media Sites: Websites like Facebook, YouTube, Twitter, Instagram, etc, where people access the Internet to interact (chat, share photos and videos, communicate, etc.) with other people online.

Social Network Theory (SNT): SNT theory looks at associations in terms of ties and nodes, where nodes form a tie if there is some kind of relationship between them.

Web 2.0: Often referred to as the second version of World Wide Web (or simply 'Web') that has interactivity. The earlier version of Web had static pages with little or no interactivity.

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Chapter 30
Effective Cultural Communication via Information and Communication Technologies and Social Media Use

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ABSTRACT

Cultural organizations need to adopt contemporary methods and ways of communication for heritage management. Raising people's interest for cultural heritage may take place via the implementation of innovative communication tools that allow for engagement to take place. Research though has shown that cultural organizations are more reluctant than firms are to implement a two-way communication process with new technologies and social media. Do cultural organizations employ information and communication technologies (ICTs) and social media in an interactive approach? This chapter aims to illustrate the significance that should be attributed to innovation through the use of technology for communication purposes by cultural organizations. The way communication trends take place in the field of cultural management and communication is presented, along with an overview of the technological outlook that can be invaluable. The use of innovative communication tools that are employed by cultural organizations for their communication strategies has been little researched as a topic. This study aims to add to the literature on the use of social media, mobile devices, and ICTs by cultural organizations.

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INTRODUCTION

Cultural organizations need to adopt contemporary methods and ways of communication for heritage management. Raising people's interest for cultural heritage may take place via the implementation of innovative communication tools that allow for engagement to take place. Research though has shown that cultural organizations are more reluctant than firms are to implement a two-way communication process with new technologies and social media. Do cultural organizations employ Information and Communication Technologies (ICTs) and social media in an interactive approach? This chapter aims to illustrate the significance that should be attributed to innovation through the use of technology for communication purposes by cultural organizations. The way communication trends take place in the field of cultural management and communication is presented, along with an overview of the technological outlook that can be invaluable. The use of innovative communication tools that are employed by cultural organizations for their communication strategies has been little researched as a topic. This study aims to add to the literature on the use of social media, mobile devices and ICTs by cultural organizations.

Technological advances have enabled a dynamic and effective communication of cultural organizations with their audiences and made more attractive. ICTs are used to enrich, transform and enhance the cultural experience. They can become a powerful communication channel that may be a virtual 'direct' experience. They can disrupt linear sequences and provide usable and accessible in technology, content, navigation solutions for all people, irrespective of their age or abilities. Furthermore, the ICTs may permit exploration of cultural information, learning-by- doing in game-like environments that foster creativity and innovation.

The motivation for this chapter was the examination of the reasons why cultural organizations should use ICTs and social media in the cultural communication process with their public. The aim of this chapter to present the most popular communicative media that can be used by cultural managers to promote their cultural activities and organizations. The implementation of innovative and emerging technologies by cultural organizations has a role to play at their management and communication level of the organization. The chapter describes new applications employed by cultural managers that take into account the needs, preferences and expectations of the public and encourage them to interact with the cultural content and context. This may allow a more holistic approach to take place in regard to the trends and future outlook on the adoption of ICTs.

The adoption and implementation of innovative communication technologies may bring the visitor closer and connect him/her with the cultural organization. Curators and professionals who are in charge of media communication strategies in cultural organizations may also find this study useful, because it illustrates innovative ways to incorporate web technologies in the promotion of the organizations and in the identification of visitors' needs and preferences.

However, the cultural messages shall use the appropriate medium and communication models to be transmitted via contemporary communication models. The use of innovative communication tools that are employed by cultural organizations for their communication strategies has been little researched as a topic (Padilla-Melendez & del Aguilla-Obra, 2013) where geographical and temporal boundaries are minimized (Bilton, 2015; Jeffres, 2015) and the co-creation of information via social media allows people to create content and post information online to like minded people.

BACKGROUND OF RESEARCH: CULTURAL ORGANIZATIONS, CULTURAL MARKETING, AND ICTS

This chapter presents (a) both the implementation of innovative communication technologies with the use of ICTs via computers, mobile phones, telephone lines to access and manage electronic data on the web from the cultural organizations' point of view in order to illustrate the possibilities on offer for managing and promoting their services and (b) the implementation of social media that are internet-based innovative communication tools that bring people together through the use of user-generated cultural content. In doing so, a two way communication and engagement between cultural organizations, art and audiences can be promoted and cultural managers may more fully adopt both ICTs and social media.

There is a tendency of cultural organizations to overall ignore competition as part of the marketing approach; when they do so, they attend those cultural organizations that they are in their immediate whereabouts (Bennett, 2015). Cultural organizations need to embrace new strategies of marketing and use marketing tools and techniques, as well as of social media, to disseminate their content and promote their activities to reach and communicate with new audiences (Fletcher & Lee, 2012), to increase their visitors and build stronger relationships and loyalty.

Cultural organizations are interested in developing relationships with different categories of the wide public. Firstly, simple promotional techniques were enough to achieve their goals. Nowadays, due to the economic crisis they needed to adopt a more sophisticated approach to marketing (Kolb, 2013). Furthermore, the explosion of ICTs and the extensive use of social media by cultural organizations suggested a 'transformation in cultural communication' (Russo, 2011) and an adaptation to users' changing usage behavior and expectations related to technological development and cultural changes (Shyam Sundar, Go, Hyang-Sook, & Zhang, 2015). Furthermore, they provided opportunities for user-generated content and co-creation (Holdgaard, & Klastrup, 2014; Sylaiou, Basiouka, Patias, & Stylianidis, 2013), education, enjoyment and entertainment (Charitonos, 2011; Hou, Wu, Lin, Sung, Lin, & Chang, 2014; Katz & Halpern, 2015; Kellner & Kim, 2010; Russo, Watkins, & Groundwater-Smith, 2009; Selwyn, 2009; Vavoula, Sharples, Rudman, Meek, & Lonsdale, 2009), and social utility for online communities (Allen-Greil & MacArthur, 2010).

In a continuously changing environment social media are a major challenge for cultural organizations, since they change the ways cultural meaning is perceived and the cultural products are consumed. They have become a part of everyday life and it is expected that cultural organizations adopt them to communicate with the wide public. Their use and growth have led to significant changes in cultural communication and the marketing strategies need to get updated and become adjusted to the new conditions. Social media can make cultural organizations' aims and scope attractive to a broader audience and include not traditional audiences and provoke their visit not only to their digital extension, but also to the physical site. Furthermore, they permit the interaction with the wide public and they may collect valuable information about their preferences and opinions. They create new and novel ways for communicating, understanding and experiencing culture. Social media promote innovation, the creation of online communities and participatory culture.

The economic crisis and the budget cuts and the reduction of the state grants changed dramatically the cultural landscape and have led cultural organizations to a shrinkage in their activities, or even to closure. Technological advances have emerged as areas of crucial interest, since they are making it possible to

use sophisticated tools to provide solutions to problems created by economic crisis. ICTs may have a multi-faceted contribution to the relationship between culture and the public and can play a decisive role in making cultural content and context available, in enhancing experience through meaningful and constructive interaction between culture and the public.

HOW ARE ICTs AND SOCIAL MEDIA EMPLOYED WITHIN THE CULTURAL COMMUNICATION PROCESS

ICTs and social media are slowly implemented by cultural organizations in order to connect with their public and engage with the users informing them about the activities organized by cultural professionals and interacting with them in a reciprocal relation that allows the co-creation and exchange of experiences. The next sections present innovative ways with which ICTS and social media are implemented by cultural organizations and thus, how they can be further employed by cultural organizations.

Innovative and Emerging Technologies and Challenges of Cultural Organizations

There is an ongoing research that has taken place in regard to the potential of ICTs implementation to cultural organizations (Gonzalez, 2015; Kéfi, & Pallud, 2011; Royston & Delafond, 2015; Scoffield & Liu, 2014; Sylaiou, Economou, Karoulis, & White, 2008; Sylaiou, Liarokapis, Kotsakis, & Patias, 2009). ICTs have made the content and context of museum collections more accessible and attractive to the wide public and have enriched the museum experience.

The implementation of innovative technologies by cultural organizations allows for the provision of customers with improved services since visitors may have a holistic approach in regard to the exhibits of the organization and be able to interact with them. In addition, the public can be informed at any time about the events and procedures of the organization with the latest technologies and the way cultural heritage is approached and managed. Furthermore, emerging technologies allow for the collection of data as far as cultural preservation and cultural management is concerned of rare collections and archives that may become available to the public with the adoption of new technologies. The following section presents the different purposes of use of emerging technologies and ICTs.

According to Bakhshi & Throsby (2012) have identified four categories of ICT innovation in cultural organizations:

- Innovation in audience reach in terms of engagement with audiences.
- Innovation in artform development in terms of encouragement of new and experimental work and incorporation in their programming.
- Innovation in value creation in terms of new ways to measure the economic and cultural value and to translate these into terms that policymakers, funding agencies, donors and private investors can relate to.
- Innovation in business management and governance in terms of organizations' business models review and of a search for innovative financing strategies.

Web 2.0, the second generation of the Web, or the 'participative Web has revolutionized the way of interaction and participation of the users. Web 2.0 technologies support and advance the information and knowledge dissemination in a social way. More specifically, crowdsourcing technologies make use of the "wisdom of the crowd" and aim at integrating many different audiences, raising public awareness, encourage active participation in the preservation and presentation of cultural heritage, which leads to the creation of a participatory culture and the democratization of knowledge (Sylaiou, Basiouka, Patias, & Stylianidis, 2013).

Interaction of multiple channels from the social media networks can be combined complementarily with real life events that the cultural organization manages that aim to engage with the user in an interactive and expressive way and not with the traditional one way of communication (Lazzeretti, Sartori, & Innocenti, 2015). Social media's proliferation and extensive use have transformed the cultural experience and provide many opportunities for learning, active participation and creativity. However, the main contribution of ICT is to involve communities and promote public dialogue and collaborative frameworks, create the sense of community and provide more transparency. They have sought to become the vehicle for fulfilling the public's expectations and change in the relationship between cultural organizations and the public.

ICTs may have a multi-faceted contribution to the relation between cultural organizations and the wide public. More specifically, Internet technologies have the tremendous potential of offering virtual visitors ubiquitous access via the WWW. The Internet combined with:

- Virtual Reality (VR), a simulation of a real or imaginary environment generated in 3D by digital technologies that is experienced visually and provides the illusion of reality.
- Augmented Reality (AR) is considered as an extension of VR. AR tools present a view of the real-world environment whose elements are augmented in real time by computer-generated sensory input, such as video, graphics, GPS data or sound (Promoter, 2015).
- Augmented reality and holograms systems that 'augment' reality with holographic displays (Mavridis & Hanson, 2009, Kim & Wohn, 2014).

Geographic Information Systems (GIS) that store, manage, analyze, visualize and present all types of spatial and geographical data have already transformed the cultural experience through their ability to document, organize, visualize, preserve and disseminate a plethora of types and vast amounts of cultural data. As a result, ICT have been extensively used by cultural organizations and have evolved into a discrete hybrid disciplinary field with its own especially dedicated conferences, such as the Computer Applications and Quantitative Methods in Archaeology (CAA), the Virtual Systems and Multimedia Society (VSMM) and the Virtual Reality, Archaeology and Cultural Heritage (VAST), Digital Strategies for Heritage (DISH) conference, 'Art and Interaction' as integral part of the Special Interest Group on Computer–Human Interaction (SIGCHI) Creativity and Cognition series, Digital Arts in Association for Computing Machinery's Special Interest Group on Computer Graphics and Interactive Techniques (ACM SIGGraph), the Conference on Transdisciplinary Imaging at the Intersections of Art, Science and Culture and many more.

Nowadays, emerging ICTs help cultural organizations to face challenges concerning connections between heterogeneous data from different sources and enhance visitor experience. Some of these emerging technologies are mentioned below:

- Linked Open Data (LOD) linking content among cultural heritage collections and between those collections and collections created for other purposes by Libraries, Archives, and Museums (LAM) (Oard, Levi, Punzalan, & Warren, 2014).
- Internet of Things (IOT), a network environment of things, or everyday physical objects with unique identifiers will be connected to the Internet, able to identify each other as devices and interact in an intelligent way with each other. Its application to arts and culture (Senior, Moreton, & Dovey, 2015) and its interaction with wearable and mobile devices, contents retrieval from the Cloud and services in culture provision to internal and external users (Mighali et al., 2015) are still under exploration. Emerging Radio Frequency Identification Detection (RFID) technologies will connect things between them, objects, places, people, will apply in cultural spaces to help users to get the correct information which is better than traditional guides (Karimi, Nanopoulos, & Schmidt-Thieme, 2012; Sen, Roy, & Sarkar, 2014).
- Mobile apps that can be used for:
  - Learning in the framework of formal (Maher 2015) and informal learning (Katz & Halpern, 2015).
  - Cultural experiences enhanced with Augmented Reality (Damala, Marchal, & Houlier, 2007; De Angeli & O' Neil, 2015).
  - Digital storytelling (Negrini & Di Blas, 2015; Hart & Brownbill, 2015).
  - User-generated content and co-creation (Mason, 2012).

The next section presents the implementation of social media from cultural organizations in their communication activities.

The Implementation of Social Media From Cultural Organizations

This section presents the most important social media that can be employed by cultural organizations in their communication activities. Various online applications facilitate the "sharing of information, experiences, and perspectives throughout community-oriented websites" (Weinberg, 2009, p. 1). Social media consist of "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" (Kaplan & Heinlein, 2010, p. 61) that help cultural organizations to reach new audiences, increase participants' engagement and the likelihood of a visit (Theocharidis, Nerantzaki, Vrana, & Paschaloudis, 2014).

Among the most commonly used social networks user-driven channels that are employed by cultural organizations, such as museums, are Facebook, Twitter, Blogs, TripAdvisor, Flickr and YouTube.

- **Facebook:** Facebook can be used as a Public Relations' tool for promotional and communicational purposes (Kelly, 2014; Kotzaivazoglou, Paschaloudis, Sylaiou, Nerantzaki, & Mantzirtzi, 2016; Proctor, 2010; Russo, 2011, 2012; Trembach, & Deng, 2015). It also may be used to promote a cultural organization's events and announce important but it may also receive participants' feedback to get their comments regarding their experience allowing the cultural organization to improve its services based on visitors' comments made. The real case is that cultural organizations do not usually see Facebook as an interactive environment limiting its potential (Lazzeretti et al., 2015).

The social networking site of Facebook can be implemented to create an interactive communication with the target group of the cultural organizations.

- **Twitter:** Micro-blog is a type of blog that lets users publish short text updates while the act of using these services is called micro-blogging. For example, Twitter is a free micro-blogging service where users publish short messages which contain 140 characters or less, the so called tweets on the Twitter website or they may use their mobile phones to send sms text-messages in real time to their connected environment of this network based on the retweets that will take place and based on how big the social network is (Bastos, Galdini Raimundo, & Travitzki, 2013). In that way, information sharing may be accomplished online and many people even if they have never met may participate.
- **Blogs:** Blogs are websites that contain comments, forums for conversations, news and quite often hyperlinks provided by the cultural organizations. They create a friendly space for discussions, they connect people with organizations; blogs provide a valuable engagement tool for interacting the public and forming communities. They can also be considered as educational content platforms. Blogs offer cultural organizations a valuable way to reach a wider audience through search engine optimization and through the blog's inclusion in Google search (Bomboy & Sherman, 2014).
- **TripAdvisor:** TripAdvisor allows for the collection of user generated content in regard to a cultural organization located in a specific area. Available reviews are there for the potential visitor to see and comment on. The possibility of geographically collecting information about the cultural organizations of the region and user generated content under reputation management facilities (Ntalianis, Kavoura, Tomaras, & Drivas, 2015), allow the cultural manager to have feedback for his/her organization. Information that is created by other users about a cultural organization and provides good material and recommendations about it while at the same time, it is free advertisement for the organization.
- **Flickr:** Flickr is a photo sharing site. As such, it is very much associated with photographs taken when on holidays where cultural tourism and visiting of cultural organizations may be the case. In fact, it has been found that visitors pay attention to Flickr advertisements but also employ it as a communication tool to upload the photos taken from their trips (Kavoura & Stavrianeas, 2015).

User generated content is created on Flickr and Dotan & Zaphiris (2010) found the existence of patterns on language and tagging in regard to specific countries and uploads on Flickr. Lazzeretti et al. (2015) on the other hand, found that the use of Flickr from cultural organizations had little success as a two way communication since there was a lack of interest by users. The use of a specific language in this communication's technological tool may attract visitors and users of cultural organizations that may gather on Flickr based on specific tags that are of interest to them and thus, make it more atttractive.

- **YouTube:** YouTube, another technological instrument can be used to broadcast interviews with curators as suggested by Lazzeretti et al. (2015).

Significant exhibits in the room of a museum or the organization of a cultural festival at a well equipped venue, for example, can be briefly presented on You Tube employing narration, sound and image and thus, creating a rich media result.

RECOMMENDATIONS AND FUTURE RESEARCH DIRECTIONS

The implementation of innovative communication tools by cultural managers allows for engagement to take place between the cultural organization and the users. The use of technology for management and communication purposes by cultural organizations allows for a two way communication with their audiences that may bring the visitor closer and connect him/her with the cultural organization. Cultural managers may use the above mentioned innovative communication technologies presented in this chapter in order to manage and communicate their organizations and services. There is a long way before all cultural organizations adopt such innovative platforms and tools, thus, enhancing their communication strategies.

Cultural organizations need to open their virtual doors to the world and use ICTs in a more two way oriented approach than the way they do it nowadays. New technologies and social media need to be further adopted in the cultural communication process for creating meaningful experiences. In order for this to be better employed, cultural managers need to realize the value of marketing. In fact, Wymer, Boenigk, & Mohlmann (2015) have created a construct for nonprofit organizations as a guide for nonprofit marketing orientation that incorporates services, supporters, the creation of a brand of the cultural organization and commercial aspects for it. It would be thus, interesting to examine from a holistic communication and management perspective the services on offer by the cultural organization, its supporters and the identification of their needs and their characteristics, the elements that can create its brand that will make it well known to the public and commercial aspects. Social media and information technologies have a role to play at the management and communication level of the organization.

Another future research opportunity can be associated with human resources, cultural organizations and the implementation of information and communication technologies. Are cultural organizations willing to correspond with users on the online level? Little research has illustrated so far that on the one hand that there is low involvement from the user in the cultural organizations' accounts of social media, while cultural organizations do not correspond with their users, thus creating a two way communication with them is in need to be further examined (Lazzeretti et al., 2015). In that way, a vicious circle is created. Which is the case when employees of the cultural organization are devoted to manage this online information directed to and from the cultural organization and interact with the users?

Mobile technologies allow for the interactive participation between the real and virtual worlds and this is where future research and cultural organizations should focus. They should be further researched in regard to their use as communication and promotional tools by cultural organizations but also in regard to their geographic implementation (Lee, Chung, & Jung, 2015; Thompson, Purcell, & Rainie, 2013) since research mainly takes place for the USA while results should be offered for other continents and countries.

CONCLUSION

ICTs that have brought forth the emergence of social media should adopt individually and within a specific framework social networks employing the best elements each one has on offer. Social media is growing rapidly and provide great opportunities for cultural organizations to enhance and reinforce the experiences they offer. However, the simple use of social media is not enough (Effing & Spil, 2016). They should organize and apply social media strategically to benefit (DiStaso & McCorkindale, 2013).

According to social media strategy' definition, it is "a goal-directed planning process for creating user generated content, driven by a group of Internet applications, to create a unique and valuable competitive position" (Effing & Spil, 2016, pp. 2). These new applications are taking into account the needs, preferences and expectations of various categories of public and encourage them to interact with the cultural content and context, as well as with other people, to share their experiences and memories, giving to community the sense of 'ownership' over culture. Fostering innovations with the implementation of the above mentioned technologies described in the chapter may allow for effective and efficient cultural management and cultural communication. Cultural managers but also users may benefit from the implementation of emerging technologies towards a closer interaction with each other.

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KEY TERMS AND DEFINITIONS

Cultural Communication: The application/adaptation of communication theories, mechanisms, methods and tools in cultural organizations.

Cultural Organization: A not for profit network that aims to promote culture and the arts.

Culture: The capacity of human beings to classify, codify, and communicate their experiences symbolically so that they can be available to future generations.

Mobile Media Technologies: Interactive use of computing devices such as smartphones or tablets that allow the user to communicate, interact, share and download material with the use of applications.

Social Media: Applications that engage people in sharing user-generated content employing online communication.

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Chapter 31
From the Psychoanalyst's Couch to Social Networks

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ABSTRACT

Given the important role that psychoanalysis has played in the field of intervention on mental health for many years and the controversial debate that as therapeutical practice has been always originated and recently reactivated, it is of particular interest to discusses the actuality of the SRT 50 years later in the era of social networks. It does so by exploring the dynamics of the interchange between scientific and lay knowledge regarding psychoanalysis, psychiatry, and mental health in light of a corpus of spontaneous conversations among Facebook, Twitter, and Yahoo! Answers users from France and Italy compiled over a one-year period. The study enlarges psycho-social research on social networks, currently under the hegemony of sociometrics and computer science research. Briefly, in this new communicative scenario, the results of the study show how different target groups use new practices, showing their positioning: users act as "infomediaries" of expert knowledge, providing informal help and suggestions online; experts open the doors of their "physical rooms" to "cyber rooms."

INTRODUCTION

The rise of information technologies and the Internet have dramatically changed the ways in which people interact, communicate and represent themselves and the world that they live in (Edwards et Al., 2013). In particular, the recent appearance of social network sites (SNS) is challenging mainstream social psychological research and it requires social psychologists to question their earmarking theoretical tools.

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To date, social psychological research has mainly focused on the application of existing theories to explain the use and impact of SNS (de Rosa, 2012). Nevertheless, the convergence of social evolution and information technologies is laying a new basis for the performance of activities throughout the social structure (Castells, 1996:470-471), so that social psychologists must revise their theoretical traditions in its investigation.

Although research in the past decade has focused on the study of new phenomena generated by online social interactions, the underlying symbolic universe of meanings, products and contents of such interactions is still partially unknown.

Exploration of this semantic production can draw fruitfully on Social Representations Theory (SRT) (Moscovici, 1961/1976; 1995; Farr & Moscovici, 1984). In his classic study on the image of psychoanalysis Moscovici investigated how different forms of knowledge encounter and cross-fertilize. His specific interest was in how scientific theories circulate within common sense and what happens to those theories when they are elaborated upon the laboratory of society. Moscovici identified the product of this encounter in social representations (SR), defined as common sense theories on key aspects of the world that allow individuals and groups to represent it and master it (Farr & Moscovici, 1984).

In this paper, we present and discuss the results of research on spontaneous conversations in SNS in two cultural contexts, France and Italy, which followed up on Moscovici's classic study on psychoanalysis. This research is part of a broader research project (de Rosa, 2011; 2012; 2013) comprising: a field study, content analysis of the online press and content analysis of spontaneous conversations on SN.

BACKGROUND

It is important to recall here that the conventional approach of social sciences to the study of SN has been rooted in the field of sociometry since the introduction and diffusion in the late 1960s of such well-known theories as the *six degrees of separation* and the *small world phenomenon* (Travers & Milgram, 1969). These theories have influenced generations of social scientists intent on extending mathematical models to the study of social relationships in terms of network theory and relying on concepts such as nodes (individual actors within the network) and ties (relationships between those actors). Social network analysis (SNA) is the modern sociological evolution of this trend (Carrington, Scott & Wasserman, 2005; Scott, 2004). Thanks to the recent affirmation and visibility of the Web, this approach has become hegemonic in the study of SN (Catanese et Al., 2012; De Meo et Al., 2012).

On the one hand, this trend can be seen as the consequence of the increasing interest of social sciences in computationally intense methods with which to analyse and model social phenomena (Williford & Henry, 2012) leading to the reproduction of "'habitual practices' employed by quantitative researchers using the procedures which they are comfortable and familiar with" (Stoneman, Sturgis & Allum, 2012:854). On the other hand, it is possible to identify a significant lack of theory in the study of "what lies beneath" the massive and multiform production of social interaction in new online communication channels, especially from a semantic perspective (de Rosa, 2012).

Research on SR investigated via interpersonal exchanges on SNS may be a valid response to this theoretical challenge. In fact, in the 1990s, Moscovici (1995; 1997:7) provided an anticipatory proposal; he emphasised the importance of investigating new communication phenomena by studying "how common sense, the language exchanged, groups themselves are shaped in this cyber-communication".

We accordingly assumed that exploration of the representational fields underlying the 'social discourse' would provide track of the new type of common sense emerging from SN, as well as the social positioning of different actors and groups.

Although there is no single definition of SNS (Boyd and Ellison, 2007; Nadkarni & Hofmann, 2011) we highlight a growing interest in their role in the social construction of knowledge (de Rosa, 2013; Mazzara, 2008). Briefly, recent decades have seen a structural transformation of the traditional communication channels whereby tele-communication is used to connect people in a new pattern of "connected-presence" (Licoppe & Smoreda, 2005; Castells, Fernandez-Ardevol, Qiu & Sey, 2007), providing interactive commitment of the actors involved, be they scientists, trainees, or simply laypersons in the sharing of knowledge. In fact, 'Science 2.0' (Jankowski, 2002), along the lines of the recent web revolution (O'Reilly, 2005) implies a "coupling between science and ICT", providing new ways "for accessing scientific knowledge and […] participation" (Ponte & Simon, 2011:150).

The development in the knowledge building through technological innovation enlarges the discourse to relevant issues already developed in the literature like: the digital divide (Castells, 1996/2000) the ethical implications (Drude et al., 2008) the effects of online psychotherapies (Andersson et al., 2009; Shingleton et al., 2013). Regarding these issues, through the SN, the experts have the opportunity to open the doors of their rooms and meet laypersons, establishing social relationships and, most of all, a "familiarity" effect, generating "trust" (Markovà, 2009).

In the SN, the traditional view of media as a 'dirty mirror' of scientific theories is completely reversed. Not only can the public elaboration and understanding of science no longer be compared to traditional top-down communication flows (Castells, 1996/2000; Moscovici, 1961/1976), but it also gives way to a new form of coexistence, "whose transgression launches a process of creation of profane knowledge from what was originally a concept elaborated in the midst of a small group of researchers. Thus uprooted from its original context, the concept is appropriated by the different media and thrown around, discussed, amplified, acclaimed, distorted, disproved, discredited, forgotten and rediscovered, circulating in the process among all conceivable factions of society, serving each and every one in turn" (Bangerter, 1995:8).

In this sense, the choice of psychoanalysis is strategic. As suggested by Jesuino (2008:393) the investigation "would be much more problematic if the study focused on a hard science such as physics, which is more distant to daily concerns of common citizens. Psychoanalysis had, and still has, a rather ambiguous status within the scientific community." In fact, although in 1961 Moscovici described psychoanalysis as "a cultural event that was no longer confined to the limited circle of the sciences, affecting the whole of society" (Moscovici, 1976/2008:xxix), its scientific status and therapeutic validity are still subject to discussion worldwide (Mecacci, 2000; Meyer, 2005; Onfray, 2010; Rowland Smith, 2010).

SPONTANEOUS CONVERSATIONS

Objectives and Hypotheses

In accordance with our theoretical perspective we present and discuss results from the analysis of spontaneous conversations collected from three SNS: *Facebook*, *Twitter* and *Yahoo! Answers,* in the French and Italian contexts. The SNS were selected on the basis of their distinctive aggregative characteristics and communication constraints reflected in the members' modalities of affiliation and segmentation, as

documented in the literature (Greitemeyer, & Kunz, 2013; Ryan & Xenos, 2011; Nadkarni & Hofmann, 2011).

Free conversations among members of SN have been analysed from an ecological perspective of non-intrusive research in natural contexts. It is our conviction that a psycho-social approach, oriented to the investigation of semantic aspects (and not only the formal structure of relations among members), aiming to capture and analyse significant conversational excerpts from conversational co-production among SN' users, allow to go over the present sociological supremacy (influenced by mathematical and computer-science-based contributes) to the study of the structure and content of social networking (vs. the paradigm of SNA).

In particular, we explored:

1. The SR of psychoanalysis, psychiatry and mental-health emerging as interrelated systems of representations from online conversations on SNS;
2. The positioning of social actors, groups and communities on the basis of the SR shared;
3. The communication systems emerging from the user-generated content analysed according to different constraints characterizing each of the SNS considered.

In light of the main assumption – that the dynamic relation between SR and public issues in the new 'social arena' of SNS is likely to determine the symbolic positioning of groups with similar or conflicting interests and visions of the world (de Rosa, 2013) – the following hypotheses may be summarized in the capacity to identify:

1. Evidence of the co-existence of expert and everyday knowledge, science and common sense, 'reified universes' and 'consensual universes' with their specific processes and functions, that positions different user groups and styles of communication in specific SNS. These spaces give voice to and negotiate competing definitions of roles, forms of knowledge, practices and/or personal experience related to the domain of mental-health, among actors characterized by different levels of access and proximity to the objects of representations investigated, namely lay users, experts and experts in training;
2. The occurrence of different SR of the target objects (psychoanalysis vs psychiatry) according to the experiential/informative character of the conversational exchanges on *the SNS* as a function of their communicative constraints;
3. Cross-national differences in the SNS users' *SR* depending on their anchoring in the two cultural contexts (France and Italy) due to the media echo effect of the recent controversy on the scientific validity of psychoanalysis and to the different legal and institutional frameworks;
4. Different communicational styles defined by the context of *Social Media* and specific aggregative and communicative attributes which differ considerably in regard to their members' patterns of affiliation and segmentation, constraints on the length of messages and their semantic context and emotional expressiveness, like the use of the SN as a *conversational space* for sharing and negotiating personal emotional/psychological problems and providing social support (the members of the SN as therapists).

Method

Data Collection and Sample

This exploration required a systematic and robust methodology for the retrieval and analysis of the semantic structures underlying the online user-generated content.

Consequently, we developed a search engine-assisted strategy for the collection of spontaneous public conversations among SN users, through Google Advanced Search (de Rosa, 2012; 2013).

This approach enabled us to access dialogues, conversational exchanges and discussions on the objects of analysis spontaneously produced in SNS rather than being affected by the researcher's mediation.

Conversations were collected over a one-year period (1/3/2010-1/3/2011). A set of keywords ('psychoanalysis', 'psychiatry', 'psychoanalyst', 'psychiatrist', 'mental-health', 'mental-illness') semantically related to the object of analysis, was employed in the search. All the posts appeared in Google Search, on the basis of the following criteria, are included in the statistical analysis: keywords, temporal window, SN and language (Italian and French).

In order to collect data we applied different steps (de Rosa, 2012):

Step 1: Open the web page www.google.it (or www.google.fr) and access to Google advanced search functions using the link located on the right of the search bar.
Step 2: Define the web search parameters in the specific language of interest.

Specify keywords in Google's "all these words" search bar. Specify the search language in the "Language" bar.

Limit the search to the domains of interest; i.e. for Facebook posts, specify: www.facebook.com in the "Domain" bar

Finally, leave the values of the other parameters as default, turn off - if activated - the SafeSearch filter, and click on the "Search" button to display the results.

Step 3: Limit the search to the pre-specified time frame, by using the function in the left column on the page displaying the results. Note that in our case we opted for a search for each month within the time frame of interest (i.e. "1/1/2010 - 1/1/2011").
Step 4: Opening of all the links obtained (one by one).
Step 5: Save pages in .html format, renaming them by title, page name, group name, discussion topic.
Step 6: Repeat the procedure using keywords composed of two or more words, phrases. The only difference with the previously indicated procedure, resides in the Google search bar in which to place these words, in this case corresponding to the following: "this exact word or phrase", and proceed with the instructions already explained above. However so, it is important to specify that in this case we had to proceed by utilising one phrase at a time, given the inherent characteristics to the logarithm of the search engine.

Twitter required to implement the following specific procedure through the Advanced Search feature:

in the first place, the search parameters remain unchanged, proceeding analogously to Step 1 as previously presented, taking care, however, not to specify in this case the web domain of interest; once obtained the results, to search in the Twitter domain, we used Google's "real-time" function (such func-

tion went off-line on July 2, 2011 after the deal with Twitter expired - reference: http://searchengineland.com/as-deal-with-twitter-expires-google-realtime-search-goes-offline-84175), located in the left column of Google's results page; Google in fact, automatically returned all Tweets related to the previously specified key-words.

In order to specify the time range, we used the time diagram in the right column of the real time results page, displaying results by month.

By clicking on each individual month, the search engine returned online tweets posted in that specific month. At this point, it was possible to save the Google search page in .html format, such a page including all tweets of interest.

Currently, via Google Trends you can collect interesting descriptive statistics on a theme starting from the following information: keywords, country and time period.

Social media sites have gradually spread over time; we recall in this regard some among those that are free: Socialmention.com; Tagboard.com; Hashtagify.me; Keyhole.co.

Socialmention favours some particular search sources ("wordpress", "ask" etc.) and by inserting the # symbol in front of the keyword it also allows to identify tweets; It also allows to select the time frame and language, with the added benefit of being able to investigate "sentiment" (the ratio of positive mentions against those that are generally negative) for each comment. Tagboard allows research on classical SN like Facebook and Twitter, viewing sentiment globally on the keywords selected, but not comment by comment.

In research, however, it is important to remind that most of the popular social SNS let crawlers extract data only through Their Own API (Application Programming Interface) so as to control the amount of information about users and their activities.

Data Analysis

We employed an inductive and non-probabilistic approach to automated text content analysis (Lahlou, 2011). Specifically, co-occurrence analysis and descending hierarchical classification -four classes from the French corpus and three classes from the Italian one- were applied to the text corpora by means of the Alceste algorithm (Reinert, 1986) implemented in the *Iramuteq* software. *In particular, we took in account* the most relevant cited "words" in the descending hierarchical classification, selected on the bases of the chi2 value.

Results

Regarding the French context, Class 1 was the biggest (34.1%), followed by Class 2 (24.5%), Class 4 (21.2%) and Class 3 (20.1%). With regard to the Italian context, Class 1 was the biggest (51,2%), followed by Class 2 (37,2%) and Class 3 (11,6%).

The French Class 1 contained conversations mainly collected from *Facebook Pages* ($chi^2$1802,4) and related to psychoanalysis ($chi^2$155,9), mental-health ($chi^2$46,2) and psychoanalyst ($chi^2$28). In this class, the general topic of mental-health was prevalent, as testified by the occurrence of terms such as *disorder (*chi^2*274,2)*, *depression (*chi^2*262,4)*, *symptoms* ($chi^2$203,2) and *anxiety (*chi^2*126,6)*. As expected, the language and the style emerging from the analysis of the sentences highlighted the presence of users characterized by high levels of expertise in the field, particularly groups and organizations, rather than

private individuals, displaying specialized lexicons and information, in agreement with hypothesis a) -focused on position of different social groups in the SN-.

Moreover, we found a specific effort to delimit the boundaries between psychoanalysis and psychiatry in the field of psychopathology, particularly depression. Similarly, the Italian Class 2 included conversations from *Facebook Pages* (*chi*^{2}2276,3) and to a lesser extent from *Groups* (chi^{2}27,6). Psychoanalysis (chi^{2}260,7) and psychiatry (chi^{2}289,9) were the main objects of discussion. *Psychiatry (chi^{2}321,3)* also represented the most relevant cited word in the class, followed by the terms *social (chi^{2}221,7)*, *psychiatric (chi^{2}209)*, *psychology (chi^{2}199,9)* and *patient (chi^{2}197,5)*. Differently from the French context and in agreement with hypothesis c) (focused on cross-national differences) the representation of psychiatry and the domain of mental-health lay on a communitarian dimension, whereas intervention by professionals (professional educator) was centred on a rehabilitation process targeted on interpersonal and family relationships.

Again, specification of the boundaries of the psychiatric domain was subject to discussion. Formal and instructional language was used, although it focused on describing the methods and tools characterizing the relevant profession rather than providing diagnostic information on specific mental diseases.

As regards the representations identified -in line with hypothesis b- there emerged a difference between the SR of psychoanalysis and psychiatry in their approaches to mental-illness. In regard to the former, mental-illness was described in terms of a "painful psychic process" (French Class 1). By contrast, the latter conceived mental-illness as a "disease" requiring suitable treatment relying on diagnostic techniques and pharmaceutical methods (Italian Class 2).

Both French Class 2 (chi^{2}168) and 3 (chi^{2}4599), as well as the Italian Class 1 (chi^{2}3181,5), included conversations retrieved from *Yahoo! Answers*. The French Class 2 was focused on mental-illness (chi^{2}183,5) and mental-health (chi^{2}14,5).

Class 3 instead referred to the psychiatrist (chi^{2}355) and psychiatry (chi^{2}31) and also in the Italian Class 1 focused on the psychiatrist (chi^{2}995,7). Interestingly, the latter was also composed of sentences from *Facebook Profiles*, although to a lesser extent (chi^{2}6). Contrary to what was previously observed, the semantic field of these classes seemed to reproduce a naive view of mental-health, once again in agreement with hypothesis a). The lexicon utilised included words pertaining to everyday language and especially linked to the emotions, actors and actions of ordinary social life and aspects regarding socialization: e.g. *love (chi^{2}269,8)*, *man (chi^{2}193,5)*, *eat (chi^{2}121,7)* and *wife (chi^{2}118)* in the French context and *life (chi^{2}167,4), speak (chi^{2}164,8), child (chi^{2}158,2)* and *friend* (chi^{2}104,1) in the Italian Class 1. Accordingly, the topic of mental-health was approached from a non-professional, heuristic perspective, in which users engaged in dynamics of experiential support rather than pointing out specific guidelines.

In the same vein, in the Italian Class 1, we found an emphasis on the role of peers and the family in situations of psychological distress, as conveyed by words such as *support (chi^2 132,7)*, *friend (chi^{2}104,1)*, *person* (chi^{2}86,3) and *boyfriend (chi^{2}86).* In this case, users seemed to act as 'infomediaries' of expert knowledge, providing informal help and suggestions on choice of a therapist.

It was also possible to distinguish a representation of the psychiatrist in terms of 'he who prescribes' therapies, but 'not enough' to accomplish an adequate healing process, as opposed to a more functional psychotherapeutic intervention.

This medicalized representation of psychiatry was also present in the French Class 3. The word '*psy*' (chi^{2}773,9) was the most important, followed by *doctor (chi^{2}647,5)*, *drug* (chi^{2}318,5) and *psychiatrist (chi^{2}300,3)*. To be noted is that this French expression is an effective and succinct way to express a

single profile including many and differentiated professional jobs within (psychologist, psychoanalyst, psychiatrist…).

Interestingly, in this class the elements 'doctor-ill-hospital' could be identified with the axes of an epistemic triangle (Moscovici, 1961).

As expected (hypothesis c.) a basic difference in the conception of mental-health emerged in the two cultural contexts investigated. Whilst in France this domain was associated with the practice of hospitalization and psychiatrists were institutionally given responsibility to control such state of individual 'deviance' in Italy professionals were expected to work within a dimension of socialization through schemes to rehabilitate the mentally ill within the community. These cultural differences – based on our hypothesis concerning the anchoring into the French and Italian legal and societal frameworks of the SR of mental-health and the relative social practices – highlight the interest of cross-cultural differences for studies on SN. They do so both from the perspective of content-knowledge building and meaning-sharing among the SNS users (including their representational systems) and from the perspective of shaping the use of technology. This assumption has been adopted by authors who have empirically demonstrated "that even more so than experience of use, culture is a key behavioural determinant" and on revisiting the behaviour chain model, have "found that even though users had to their disposal the same set of features, the uses for creating content and value and involving others and the time investment for staying active and loyal in the site differed across countries." (Vasalou, Joinson & Courvoisier, 2010:727).

The French Class 4 comprised conversations from *Facebook Pages* (*chi*^{2}787.9) and *Groups* (*chi*^{2}64.7) and from *Twitter* (*chi*^{2}52.3). Psychoanalysis (chi^{2}31,6) and the psychoanalyst (chi^{2}85,4) were the main objects of discussion within this class. The semantic fields and the underlying representation of psychoanalysis were linked to the psychological and psychotherapeutic domains expressed through words like *psychology (chi*^{2}*371,3)*, *health (chi*^{2}*370,7)*, *psychologist (chi*^{2}*318,7)* and *psychotherapist (chi*^{2}*232,1)*. Notably, in this case users mainly exchanged information on the training and career paths required to achieve the professional competence and status of psychoanalyst, thus introducing a discussion which negotiated the scientific boundaries of the discipline itself.

Similarly, the Italian Class 3 was based on posts retrieved from *Twitter* (chi^{2}6963,9), whereas mental-health (chi^{2}2915,2) and mental-illness (chi^{2}5318) constituted the main objects of representations. In this case, the discourse focused on promotion of services and activities provided by local aid agencies through the words *mental (chi*^{2}*7493,2)*, *health (chi*^{2}*6362,1)*, *centre* (chi^{2}200,6) and *department (chi*^{2}*155)*. Furthermore, the recurrence of Italian city names marked a common reference to specific local and community aid centres. Twitter was evidently employed as a marketing tool to exchange information and updates on services and initiatives, rather than being a 'room' for conversation.

Study of the communication systems underlying these online conversations yielded even more interesting findings. Because changes in communication systems are significant for studying SR, we assumed that the SNS investigated would implement specific aggregative and communicative attributes, differing considerably in regard to their members' patterns of affiliation and segmentation, constraints on the length of messages and their semantic context and emotional expressiveness (hypotheses a. and d.).

In particular, we found in Facebook Pages experts and institutions belonging to the field of mental-health that stimulated and contributed to discussions on the topic of mental disorders in order primarily to promote their expertise and 'advertise' their work and activities so as to provide primary support

for persons who might resort to the Internet to find such information and support. The same objectives seemed to characterize communication on Twitter, although in this case it is not possible to speak of conversations, but rather of information exchanges and updates on initiatives and activities characterizing the agenda of professionals and agencies in the field of mental-health. Differently and interestingly, in *Yahoo! Answers* as well as in *Facebook Profiles*, psychological problems and disorders were contextualized in a sort of *mutual aid context* in which users, according to different levels of familiarity with expert knowledge, tried to share and negotiate information to support each other in identifying adequate remedies or professional aid for precarious psychological conditions (in agreement with our hypothesis d.).

CONCLUSION

Finally, we sought to verify Moscovici's original hypothesis that the dynamic relation between SR and public issues in the new 'social arena' of SNS is likely to determine the symbolic positioning of groups with similar or conflicting interests and visions of the world (de Rosa, 2013). In our research we found a specific struggle for the definition of roles, forms of knowledge and practices related to the domain of mental-health negotiated among actors characterized by different levels of access and proximity to the objects of the representations investigated. On the one hand, we found lay users asking for advice and information from the community, specifically about specialist and professional services in the field of mental-health. They were frequently re-directed to instances of support and aid by the online community, so that scientific mediation was replaced with mutual understanding. In this framework, professionals are even averted through denouncing their pointlessness competence, in view of a relative distance from 'real' life and everyday 'common' experiences.

On the other hand, posts produced by professionals in the mental-health field emphasised their engagement in re-definition of their identities and the borders between 'expert' knowledge and common sense. They symbolically 'opened the doors of their rooms' through participation in the online discussion, harmonizing presences, styles and lexicons on the basis of the new communication patterns required by these web environments.

Briefly, in this new communicative scenario the results of our study show how different target groups act new practices, showing their positioning:

- Users act as 'infomediaries' of expert knowledge, providing informal help and suggestions online;
- Experts open the doors of their "physical-rooms" to "cyber-rooms".

Echoing the famous words of Woody Allen: "Psychoanalysis is a myth kept alive by the sofas", meaningful results from our research show how the "sofa" has moved in the recent decade "from the psychoanalyst's couch to SN". These are the new "living rooms" – in a cyber world (de Rosa, 2004) – where the familiarity effect induced among the SN members, who perceive themselves as "clubs of friends", contribute also to redefine the borders between the expert's knowledge, the professional's role aimed at the intervention and the lay people's social discourse around psychoanalysis and psychiatry.

Figure 1. The psychologist and the SN

Table 1. The main feature of the research design

THEORETICAL FRAMEWORK	THE RESEARCH IN SHORT		
	OBJECTIVES	HYPOTHESES FOCUSED ON	MAIN RESULTS
We focus the interest of promoting researches on social representations, which take account of new arenas for social transmission and elaboration of knowledge through social exchanges among the members of the *thinking society*. (Moscovici, 1961/1976). Co-production among social networks' users, allow to go over the present sociological supremacy (influenced by mathematical and computer-science-based contributes) to the study of the structure and content of social networking (vs. the paradigm of Social Network Analysis, SNA) (Carrington, Scott & Wasserman, 2005).	To explore: • the social representations of psychoanalysis, psychiatry and mental health emerging as interrelated systems of representations from online conversations on SNS; • the positioning of social actors, groups and communities on the basis of the social representations shared; • the communication systems emerging from the user-generated content analysed according to different constraints characterizing each of the SNS considered.	a) position of different social groups in the SN.	a) The French Class 1 contained conversations mainly collected from Facebook Pages (chi2 1802,4) and related to psychoanalysis (chi2 155,9), mental health (chi2 46,2) and psychoanalyst (chi2 28). In this class, the general topic of mental health was prevalent, as testified by the occurrence of terms such as disorder (chi2 274,2), depression (chi2 262,4), symptoms (chi2 203,2) and anxiety (chi2 126,6). As expected, the language and the style emerging from the analysis of ECUs highlighted the presence of users characterized by high levels of expertise in the field, particularly groups and organizations, rather than private individuals, displaying specialized lexicons and information. The topic of mental health was also approached from a non-professional, heuristic perspective, reproducing a naive view of mental health. The lexicon utilised included words pertaining to everyday language and especially linked to the emotions, actors and actions of ordinary social life and aspects regarding socialization: e.g. love (chi2 269,8), man (chi2 193,5), eat (chi2 121,7) and wife (chi 118,0) in the French context and life (chi2 167,4), speak (chi2 164,8), child (chi2 158,2) and friend (chi2 104,1) in the Italian Class 1.
		b) differences between the social representations of psychoanalysis and psychiatry in their approaches to mental illness.	b) As regards the representations identified, there emerged a difference between the social representations of psychoanalysis and psychiatry in their approaches to mental illness. In regard to the former, mental illness was described in terms of a "painful psychic process" (French Class 1). By contrast, the latter conceived mental illness as a "disease" requiring suitable treatment relying on diagnostic techniques and pharmaceutical methods (Italian Class 2).
		c) cross-national differences.	c) the Italian Class 2 included conversations from Facebook Pages (chi2 2276,3) and to a lesser extent from Groups (chi2 27,6). Psychoanalysis (chi2 260,7) and psychiatry (chi2 289,9) were the main objects of discussion. Psychiatry (chi2 321,3) also represented the most relevant cited word in the class, followed by the terms social (chi2 221,7), psychiatric (chi2 209), psychology (chi2 199,9) and patient (chi2 197,5). Differently from the French context and in agreement with hypothesis c) the representation of psychiatry and the domain of mental health lay on a communitarian dimension, whereas intervention by professionals was centred on a rehabilitation process targeted on interpersonal and family relationships: These cultural differences – based on our hypothesis concerning the anchoring into the French and Italian legal and societal frameworks of the social representations of mental health and the relative social practices – highlight the interest of cross-cultural differences for studies on SN.
		d) different communicational styles defined by the context of Social Media.	d) In particular, we found in Facebook Pages experts and institutions belonging to the field of mental health that stimulated and contributed to discussions on the topic of mental disorders in order primarily to promote their expertise and 'advertise' their work and activities so as to provide primary support for persons who might resort to the Internet to find such information and support. The same objectives seemed to characterize communication on Twitter, although in this case it is not possible to speak of conversations, but rather of information exchanges and updates on initiatives and activities characterizing the agenda of professionals and agencies in the field of mental health. Differently and interestingly, in Yahoo! Answers as well as in Facebook Profiles, psychological problems and disorders were contextualized in a sort of mutual aid context in which users, according to different levels of familiarity with expert knowledge, tried to share and negotiate information to support each other in identifying adequate remedies or professional aid for precarious psychological conditions.

FUTURE RESEARCH DIRECTIONS

Even if taken as a specific inquiry on SNS, we consider our research to be a preliminary step in the study of the semantic production of social-interactional phenomena generated by the ongoing global redefinition of patterns of communication and it is our conviction that further research in the field is warranted. We have shown how studies of social media can inform and be informed by, the concept of SR and its inseparable and constitutive role of communication.

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KEY TERMS AND DEFINITIONS

Facebook: Free social networking service. Activated in 2004, it registered about 100 million users in less than 9 months.

Google Advanced Search: The most popular and currently the most used web search engine.

Social Networks: In the definition of social networks, inter-relationality among diverse social actors, such as individual private users and organizations, is a core element.

Social Representations: Common sense theories on key aspects of the world that allow individuals and groups to represent it and master it.

Twitter: Free social network and micro-blogging service that gives its users a personal page that can be updated by means of text messages with a maximum length of 140 characters.

User-Generated Content: Any form of content such as blogs, forums, posts, chats, tweets… created by users of an online system or service, often made available via social media websites.

Yahoo! Answers: Community-driven question-and-answer (Q&A) site launched by *Yahoo!* in July 2005.

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Chapter 32
The Internet Behavior of Older Adults

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ABSTRACT

Older adults are increasingly joining younger ones in using the internet, including social media, although use decreases with age, especially after age 74. Most older adults who become first-time internet users are enthusiastic users, frequently going online. Barriers to their use of the internet remain, such as physical and cognitive limitations. Attitudinal barriers may exist, but it is unclear whether this result from lack of experience or aging. Marketing research has found that older persons are less likely to engage in online purchasing. Research still has not clarified whether the ongoing pace of change in technology, along with changes associated with aging, may mean that there will always be fewer older than younger adults using the newest technologies. However, as current internet users age into the senior population, they are likely to maintain positive attitudes towards technology and continue frequent use, which the research suggests may benefit mental health and social relationships.

INTRODUCTION

Internet activities of persons over age 65 include communication (i.e., email, instant messaging); social media (i.e., Facebook, LinkedIn, Twitter), search engines (e.g., Google), online newspapers (e.g., nytimes.com), magazines (e.g., salon.com), discussion forums, classifieds (e.g., craigslist.org), photo sharing (e.g., Flickr), online banking, and bill paying. Most studies on this topic (i.e., Choi & DiNitto, 2013; Madden, 2010) have concentrated on email, texting, web surfing, banking, shopping, and more recently, social media, and are notable for being conducted by researchers in fields as diverse as psychology, business, communications, social work, gerontology, computer science, engineering, and robotics.

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Although this entry emphasizes research with persons over age 65, some studies exclude age information, preferring instead the phrases retirees (Hahm & Bikson, 1989), senior citizens, or, as in one early publication (Edwards & Englehardt, 1989), members of AARP (age 50 and over). Publications that do specify participant age often group together persons differing in age by as much as 30 to 40 years (e.g. Trocchia & Janda, 2000; Zhang & Kaufman, 2015), inconsistently define *older adult* as beginning at ages 55 (i.e., Wong, Yeung, Ho, Tse, & Lam, 2014; Zhang & Kaufman, 2015), 59 (e.g., Berner et al., 2015;), or 60 (i.e., Choi & DiNitto, 2013), or do not specify age distribution past the defined minimum age (i.e., Reisenwitz, Iyer, Kuhlmeier, & Eastman, 2007; Zhang & Kaufman, 2015).

BACKGROUND

The earliest publications concerning older persons' Internet behaviors – before the word *Internet* was ever used - speculated that technological solutions, connected computers included, could improve the daily lives of older persons in their homes and communities. Theorists initially centered their attention on two-way communication, especially to mitigate perceived loneliness. For example, Ramm and Gianturco (1973) envisaged a "picture communication system with the aid of computers" (p. 325) that could personalize entertainment, education and home employment in order to fight isolation and feelings of uselessness.

As editor of a special issue of *American Behavioral Scientist* on technology and aging, Monk (1988a, 1988b) emphasized the significance of networked communication to the isolated elderly and argued that the elderly are often active users of technology rather than passive recipients. In 1989, Edwards and Engelhardt (1989) explicitly introduced the concept that older persons are not necessarily technophobic. The self-selected college-educated survey respondents over age 50 were generally positive about computers, notably in terms of a short-term change in attitudes as a result of their brief supervised technology experience and interest in Internet-related computer use for health insurance benefits, personal and family medical history, genealogy, and stock market information. In a comparison of retired and employed computer inexperienced public utility workers in California, Hahm and Bikson (1989) found that email increased interactions among retirees, though, according to the authors, "older adults must be given multiple sources of instruction" (p. 127).

OLDER ADULTS AS ACTIVE INTERNET USERS

Fortunately, a growing body of theoretically informed, empirically based literature, still mostly focused on electronic mail, began appearing in the 1990s. Beyond their specialized foci, research in this area underscored that the elderly are active users of technology, more capable of understanding and enjoying the Internet than was originally assumed.

The Pew Research Center Describes the "Gray Gap"

Beginning with its initial survey of the "gray gap" between young and older Americans (Lenhart, 2000), Pew Internet & American Life Project consistently has recounted that Americans age 65 and older are among the least likely groups to go online; once online, however, they are typically enthusiastic emailers, information searchers, and social networkers.

Why have older persons been less likely to go online? Initially, few persons over age 65 had Internet access (Lenhart, 2000), partly due to many being retired and some living on fixed incomes. However, economic factors never by itself explained the age differential. A second major factor was lack of contact with computers, and this was true even for older Americans with college or graduate degrees. As detailed by Fox (2004), most older persons lived lives far removed from the Internet, knew few people who used email or surfed the Web, and could not imagine reasons for spending money and time learning how to use a computer. In addition, Fox (2004) reported that persons over 65 were more likely than any other age group to be living with disability, which could hinder their ability to obtain computer training or read the small type on many Web sites.

Since the initial 2000 report, each subsequent Pew paper has described an increase in older persons' Internet use, especially between 2000 and 2004, when Fox (2004) reported a 47% jump. In 2001, Fox enumerated the top Internet interests among seniors who go online to include mainly email, but also hobby information, news, health information, browsing "just for fun," and weather updates. By 2010, although users age 65 and older were still primarily using email to maintain personal contacts, 13% - more than three times as many as in 2009 - were relying on social media to manage their daily communications – sharing links, photos, videos, news and status updates (Madden, 2010). By 2013, the percentage of social media users had jumped to 27%. Yet, older computer users are still significantly less likely than all American adults (63%) to use social networking sites (Smith, 2014). According to Duggan (2015), of the five major platforms of current social media, Facebook is the most popular among older adult Internet users (48%), though they are less likely to go on Facebook than all U.S. adult Internet users (72%). Connected older adults also use – though less frequently – the social media platforms Pinterest (16%), LinkedIn (12%), Twitter (6%), and Instagram (4%). Relatively few older wired users participate in other online platforms such as discussion forums (8%) and Tumblr; only 2% of Internet users ages 65 and older report doing so (Duggan, 2015).

Since 2000, wired seniors consistently have been more likely than their offline peers to be younger, married, white, highly educated, and enjoying relatively high incomes; recent data confirm this trend (Smith, 2014). Lenhart and Duggan (2014) noted some interesting behaviors among older Internet users in committed relationships; almost half (47%) reported sharing email accounts with their partner, as compared to 27% of all Internet users who were married or in a committed relationship. Older users' sharing of social networking profiles was less frequent (11%), and unlike email account sharing, there was little age variation in this behavior (Lenhart & Duggan, 2014).

Gender differences in Internet usage have been inconsistent over the years. Although in 2000 about 40% of older Internet users were women, in 2004 the gender ratio among U.S. wired seniors appeared to have reached parity, similar to the general Internet population. However, recent data indicates that almost two-thirds (65%) of men ages 65 years and older use the Internet or email as compared to 55% of women (Smith, 2014). Interestingly, whereas disability initially may decrease computer use, more recently older adults living with chronic disease have been increasingly likely to state that they work on a blog or contribute to an online discussion, a listserv, or another Internet forum that helps people with personal issues or health problems (Madden, 2010). According to Smith (2014), older adults with physical challenges often enjoy tablets and e-readers, but at a rate that is somewhat lower (22%) than those without health or disability issues (30%).

There is a burgeoning group of Americans who are slightly younger than retirees and who are more attached to the online world. This "silver tsunami" has gained momentum through the past decade. Internet users age 65 or older are often cited as the fastest-growing demographic group online, but that description can be misleading. Much, though not all, of the growth in this age group over the past decade has come from long-time Internet users aging into senior status rather than from waves of elderly non-users in their seventies and eighties suddenly going online. Current data indicate that after ages 65-69, Internet and broadband use decreases with age and falls off most dramatically starting at about age 75 (Smith, 2014). At the same time, data indicate that most older adults who become first-time Internet users in their senior years become enthusiastic users, going online daily or almost every day (Smith, 2014).

Does Use of the Internet Improve Older Adults' Social Involvement and Quality of Life?

The first longitudinal study to examine causal relationships among use of the Internet, social involvement, and psychological consequences suggested potential drawbacks to Internet use, although older persons do not appear to have been included. Kraut and his colleagues (1998) tracked participants longitudinally, and over 12 to 24 months, disturbing trends were identified. Increases in Internet use predicted less communication within the family and more loneliness and depression. The initial reactions in the press were not surprising ("Sad, Lonely World Discovered in Cyberspace"; Harmon, 1998); however, Kraut's research team later found that the negative effects did not persist over longer periods of time (Kraut et al., 2002). Nonetheless, research continues to suggest that there could be social and emotional drawbacks to Internet use. For example, Stepanikova, Nie, and He's (2010) large cross-sectional study of U.S. adults ages 18 to 70 showed negative impacts on interpersonal interaction, communication, loneliness, and life satisfaction. These hypothesized consequences are sometimes called *displacement*; the Internet replaces presumably more meaningful face-to-face interactions (Huang, 2010).

The implication that Internet use might lead to social isolation is problematic for older adults, at least in the US, given their high risk for depression, especially for those who experience loneliness and lack social support (e.g., Seritan, McCloud, & Hinton, 2009). Yet, it is possible that Internet communication actually might facilitate social networks among those who are geographically dispersed (Stepanikova et al., 2010). Early research in the US did suggest significant benefits of computer use for older adults. For example, White and colleagues (1999) taught retirement community members (average age 77 years) to operate computers for word processing, accessing the Internet, and email. There was an immediate post-training improvement in feelings of loneliness among the 15 computer users compared to the eight members of the control group, but this difference was not significant at the five-month follow-up.

In a review of the literature provocatively titled "Computer use has no demonstrated impact on the well-being of older adults," Dickinson and Gregor (2006) outlined several reasons supporting their thesis. One problematic issue identified was that many of the intervention studies did not control for variables that likely accompanied computer instruction, such as face-to-face interactions. The authors also noted a tendency for small or even nonsignificant effects to be considered *improvements* when summarized in subsequent research. Finally, Dickinson and Gregor (2006) recognized that individuals whose well-being is higher initially are more likely to successfully learn to use computers and are less likely to drop out.

Recent research using large samples, longitudinal data, and mediational models, as well as reviews and meta-analyses, suggests that there are likely no major negative consequences of Internet use for older adults, and there may be some benefits. The least positive recent report was in a meta-analysis by Huang (2010), who examined the relation between measures of psychological well-being and Internet use. Although Huang found a very small association between greater Internet use and reduced well-being, a major limitation Huang cites is that only 7.5% of the participants were adults over age 55. On the positive side, Chang and colleagues (2015) studied adult Facebook users in the U.S. Younger adults had more Facebook friends, but increasing age was associated with a higher proportion of Facebook friends that were actual friends beyond the Internet. Across all ages, having a higher proportion of actual Facebook friends was associated with lower reports of loneliness.

Cotton and colleagues have conducted several recent studies suggesting positive impacts of Internet engagement on older adults. Initially, the researchers studied residents of communities for aging persons in one U.S. state (Cotton et al., 2013). Although the sample was not diverse and predominantly female, it is notable for having an average participant age of 83. The major positive result was that even after controlling for possible confounding factors, greater Internet use was correlated with lower depression. A longitudinal study with a larger sample size by Cotton and co-authors (2014) similarly showed a reduction in depression in older adults associated with higher Internet use, with a stronger effect for individuals living alone. Thus, taken together, the research studying Internet engagement and psychological well-being suggests that Internet use is unlikely to cause great harm, and shows promise for conditions such as depression.

OBSTACLES TO OLDER ADULTS' INTERNET USE

The three most common barriers to older adult computer use cited in the literature are physical disability, cognitive limitations, and negative attitudes towards computers.

Physical Limitations

Common recommendations to ameliorate physical issues that may impact older adults as well as younger persons with disabilities include using large fonts, providing visual contrast, and minimizing actions such as scrolling that might be impacted by physical difficulties (Charness & Boot, 2009; Kim, 2008). Novice users perform better with input devices that allow direct interaction with the screen; persons with severe mobility problems typically do best with voice input (Fisk et al., 2004). Computer programs and systems now often include such accessibility features that users can activate when needed (Kim, 2008), and websites have improved in ergonomic design (Nielsen, 2013). Recent tests by Nielsen (2013) showed that computer users over 65 performed better than previous cohorts, but still had more challenges than those under 55. On all measures (success, speed, errors, satisfaction), older users performed more poorly. Visual issues were one problem, with tiny text or poor contrast causing difficulties; another was what Nielsen calls "unforgiving" design, such as forms that cannot handle minor typos or hyphens in phone numbers. Larger mobile devices may help overcome some of these issues. Smith (2014) reports that 27% of older users own a tablet, an e-reader, or both, more than the 18% with smartphones.

Cognitive Limitations

Research has suggested that older computer users are likely to be slower to learn how to operate computers and their programs and that they will commit more errors in doing so (Charness & Boot, 2009; Kim 2008; Nielsen, 2013). Some of these problems may be due to declines in working memory, problems in regulating attentional processes, lesser abilities to form new procedural knowledge, difficulties in multitasking, and movement difficulties that impact the ability to respond to commands or use computer program menus and other interface elements (Fiske et al., 2004). Rogers and Fisk (2010) concluded that the challenge is translating knowledge of people's potential limitations into universal design.

Much attention has been given in recent years to the question of whether computer gaming can ameliorate cognitive decline. At present there are no clear answers. The online "brain training" site, Luminosity, recently had to refund its customers because the company made unsubstantiated claims that the games could improve cognitive functioning and reduce dementia risk (Span, 2016). There have been numerous failures in recent empirical work to find positive effects of online games on cognitive functioning. A meta-analysis by Powers and colleagues (2013) did indicate some experimental evidence of positive impacts on older adults, but the domain affected most was motor skills.

Attitudes

Research examining the attitudes of older computer users has been difficult to interpret. Although some studies have shown improved attitudes towards computers after training (Kim, 2008), it cannot therefore be assumed that older persons' negative attitudes towards computers cause computer or Internet avoidance. Nonetheless, older users remain "slower to adapt to new technologies and more likely to report anxiety…or frustrations" (Rogers & Fisk, 2010, p. 647). Researchers also report older adults' difficulties in learning as well as the lack of availability of in-person help and access to computers and technology (Chen et al., 2013). However, because these studies lack employed older persons, who are more likely to have computer experience, the challenge for researchers lies in disentangling computer knowledge (and, relatedly, computer experience) from factors such as income, education, and health status.

Little attention has been given to the issue of older users' knowledge of computer security. Grimes, Hough, Mazur, and Signorella (2010) examined the relationship of age to knowledge of various Internet hazards among 167 US adults ages 19 to 91 years. Older persons (average age 72) showed less knowledge of Internet hazards, such as viruses and spam, than did younger individuals (average age 24). Among the older adults, however, education and prior computer experience were more important in predicting Internet security awareness than were age and gender.

Thus, much of the research suggests that older persons may be more vulnerable to the difficulties that typically plague all computer users, such as horizontal scrolling, inconsistent controls, complex security rules, and other basic design flaws. Yet bad design and complexity may be particularly problematic for the oldest, especially when combined with their higher likelihood of being computer novices; these challenges may impact confidence and persistence.

CONSUMER IMPLICATIONS OF OLDER ADULTS' INTERNET BEHAVIORS

The consumer implications of older adults' Internet usage have been considerable, at least in the US. According to Roberts and Manolis (2000), age is the most important demographic characteristic for consumer marketers and researchers. Kamal and Patil (2003) note that many older adults in the US are rich in both time and money (see also Hough & Kobylanski, 2009). Yet the buying patterns and attitudes of this segment differ from those of younger consumers. Persons age 65 and older have been less likely than those ages 45 to 64 to use the Internet for online purchasing; in particular, those older persons who lack confidence in their Internet skills use it significantly less frequently (AARP, 2000).

From the results of interviews with 12 American men and women ages 57 to 87 years old, Trocchia and Janda (2000), identified differences between older Internet users and non-users. Expanding on that study, Hough and Kobylanski (2009) theorized that marketing interventions focused on placing technology in consumers' hands can be particularly useful in influencing older persons' reference group affiliation, nature of social relations, and perception of reality. They also noted that marketing focused on price or on special promotions have little to moderate impact on increasing older persons' engagement with computers or the Internet. According to results from surveys of 171 Americans between ages 65 and 85, Iyer and Eastman (2006) found that older persons' attitudes about the Internet were also affected by whether they felt that the Internet was fun, convenient, and efficient. Lee, Han, and Chung (2014) found perceived usefulness, enjoyment, and ease of use to be crucial factors in Internet adoption by mature users.

Reisenwitz and colleagues (2007) posited that other factors that impact the effectiveness of marketing to older consumers include emphasizing the ability to create nostalgic experiences online, promoting aspects of innovation, and addressing perceptions of risk. Bruine de Bruin, Parker, and Strough (2016) note multiple studies that indicate that older adults tend to search for fewer options and prefer limited selection sets as compared with their younger counterparts. Older adults are significantly less inclined to engage in intensive alternate searching with the goal of selecting the optional choice. These results suggest that older consumers are less likely to engage in prolonged on-line research sessions when making purchase decisions. Taken together, these studies indicate that the commercial implications of older adult engagement with the Internet continue to be challenging and complex.

FUTURE RESEARCH DIRECTIONS

The issue of whether the Internet will improve older adults' quality of life and social relationships remains unresolved, due partly to the lack of generalizability of many empirical findings. With the exception of studies from Pew Research Center, much of the research has ignored older persons living in private households, independently surfing the Internet. Researchers also often omit information concerning participants' gender, income, education, health, and employment status.

Despite the commercial advertisements, there are few experimental studies of computer gaming's possible link to reduction of cognitive decline in older adults. There is also little research on telehealth, which promises improved access to medical and psychological services, especially for persons with disabilities and older persons living isolated lives (Khubchandani & Thew, 2016). There is a paucity of cross-cultural research, especially in the global south, where promoting Internet access to resources and fostering social inclusion may be more important than in the west, where most of the research has been completed.

CONCLUSION

As Ogozalek (1991) first predicted in an early review of the impact of computer technology on aging, cohort effects complicate prediction from one age group of older adults to another. Charness and Boot (2009) have questioned whether the "gray gap" in both computer and Internet use described over a decade ago (e.g., Lenhart, 2000) will ever be completely eliminated. Current research still has not answered whether the ongoing pace of change in technology, combined with changes associated with aging, may mean that there will always be fewer older than younger adults using the newest technologies. However, as current Internet users in their 50s and early 60s age into the senior population, they are likely to maintain positive attitudes towards technology and continue frequent use, which the research suggests may benefit mental health and social relationships.

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KEY TERMS AND DEFINITIONS

Accessibility: The goal of making any place or process usable by individuals with disabilities or challenges; in this context, making the Internet and computer technology usable for older adults with physical or cognitive limitations.

Brain Games: Video games, usually online, hypothesized to keep brain functioning at levels of younger individuals.

Gray Gap: Refers to data that indicates that older adults are less likely than those under 55 to be online.

Marketing: Techniques used to encourage consumers to make purchases.

Psychological Well-Being: Usually operationalized in terms of mood or interpersonal functioning; lower wellness would be reflected in indicators such as depression, loneliness, or social isolation.

Silver Tsunami: Phrase referring to the large number of rising seniors in many world economies.

Telehealth: The use of electronic information and telecommunication technologies to support long distance clinical health care and health education.

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Chapter 33
Issues and Challenges in Enterprise Social Media

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ABSTRACT

Contemporary organizations face the challenge of collaboration among the widely dispersed workforce. Information technology is an enabler and a facilitator of organizational processes. One such application of information technology is enterprise social media (ESM) platform which serves as an effective medium for organizational communication and exchange of ideas among peers in a workplace. The chapter describes the structural and functional aspects of ESM with a focus on knowledge sharing activities supported by its usage. Issues and challenges in respect of its design and adoption have been discussed.

INTRODUCTION

Social media is a ubiquitous phenomenon enabling social connections worldwide. This communication platform has given rise to a new social order wherein users can create and disseminate information, opinions, self-created content and knowledge to widespread audience. Business organizations are also catching up with the phenomenon in terms of utilizing the functionality of social media tools for intra firm communication among employees for enterprise wide social networking and collaboration (Fulk & Yuan, 2013). Many organizations are using Enterprise Social Media (ESM) tools for information sharing, crowdsourcing ideas and solving problems, and relationship building (Riemer & Scifleet, 2012). The present article attempts to understand the enterprise social media tools from the perspectives of its functional and interactional aspects along with highlighting the key issues associated with its usage.

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BACKGROUND

Social media provides a platform to create and share user generated content along with the functionality of connecting with people. Facebook, Twitter and LinkedIn, wikis, blogs etc. are some examples of popular social media tools. Users can look for people with similar interests, connect with them, create groups and share varied types of content. Web tools similar to popular social media are being utilized in the enterprise context to foster collaboration and knowledge sharing within the firm. These tools are known by varied names such as Enterprise Social Media (ESM) or Enterprise Social Software Platforms (ESSP).

Defining Enterprise Social Media

Leonardi et al. (2013) define Enterprise Social media (ESM) as "Web-based tools that allow workers to communicate messages with specific coworkers or broadcast messages to everyone in the organization; explicitly indicate or implicitly reveal particular coworkers as communication partners; post, edit, and sort text and files linked to themselves or others; view the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organization at any time of their choosing" (p.2). According to Boyd and Ellison (2007*),* these are "web-based services that allow individuals to construct a public or semi-public profile within a bounded system; articulate a list of other users with whom they share a connection; view and traverse their list of connections and those made by others within the system"(p. 211).

ESM includes tools like as blogs, social network sites (SNSs) and wikis. A lot of different packages are available for use by enterprises. SharePoint by Microsoft, is an online application platform where members can collaborate for team projects, upload and modify files, initiate discussions and work together in a virtual space making the collaborative work easier to execute and monitor. Jive is another name in the same list that provides functionality of enterprise wide connections facilitating online sharing and collaboration among employees across the world. Other tools in use are Yammer and Chatter.

Benefit of ESM Tools

ESM provides an ability to maintain social connections along with accessibility to digital content (Kane, 2015).It gives a way of connecting with employees across the organization facilitating interactions and information sharing. Online connections, social interaction and communication patterns can reveal a lot about the various knowledge communities in the organization. Along with providing a functionality similar to traditional media of communication exchange such as email, it provides a way to connect and display the shared information to a preferred set of people who can further benefit from the exchange. The mutual communication partners, shared information and membership of different online groups can help employees understand the prevalent social dynamics along with locating the relevant support for knowledge (Ellison et al., 2015).

Some of the major benefits are listed below.

Acts as an Interactive Platform

Members of an ESM platform can interact in a variety of ways. Subramaniam and Nandhakumar (2013) identified the following ways in which members interact over an ESM platform

1. **Impromptu or Informal:** Ad-hoc problem solving is enabled by collective work of individuals in an Informal way where formal structures do not inhibit communication and interaction. Members come together to work on some common problem that needs immediate attention.
2. **Planned:** This happens in the duration of a planned project where the interaction is sustained for specific information needs from different members of the community.
3. **Ongoing:** Focused and repetitive interactions help in developing roles as members share knowledge over ESM platform.

Helps to Locate Knowledge Source Within Organization

Awareness about the communications of others can help the knowledge seekers understand the potential knowledge sources. An understanding of who knows what and who knows whom helps the employees become aware of the communications among the coworkers and it becomes imperative in eliciting knowledge from them whenever required. This kind of awareness has been referred to as 'ambient awareness (Leonardi & Meyer, 2015) which is facilitated by the use of enterprise wide social media tools. Message transparency and translucent network connections offered by social media (Leonardi, 2015) give employees an edge over the opaque communications handled by conventional technologies.

- Message transparency is the ability of users to see the different conversation threads and the contents generated therein.
- Network translucence or the knowledge of people's communication partners helps in identifying real communication patterns in any organization which may be different from the traditional or expected ones.

Employees can gain an understanding about the nature and kind of projects done by their colleagues along with their individual expertise. The communication threads and patterns can be observed to make sense of individual's tacit knowledge which can be accessed whenever required.

Facilitates Knowledge Sharing Among Employees

Social tools enable knowledge sharing and collaboration which is important for the new and creative ideas to emerge and a sufficient flexibility of sharing information across the organization provides a foundation for such an activity (Patroni et al., 2015; Subramaniam & Nandhakumar, 2013). Knowledge sharing is an equivocal concept involving a communicative process affected by social dynamics and interpersonal processes. It can be a difficult process in case of geographically dispersed organizations as employees may not be aware of the right source of getting advice and expertise. In such a case, ESM allows employees to connect with their counterparts working in dispersed locations across organization and hence help them to access knowledge from the right source and person. (Ellison et al., 2015).

Facilitates Collaborative Work

ESM tools enable collaborative content generation. It fosters collective intelligence which is a source of new ideas and creative solutions. Capability of sharing knowledge and expertise allows creativity to flourish as it enables the combination of varied perspectives and enables the completion of collective work within shared timeframes (Subramaniam & Nandhakumar, 2013). Virtually co-present actors are bound by focused interaction with other actors in real time to create an interaction order which facilitates collective work (Subramaniam & Nandhakumar, 2013). ESM helps in crowdsourcing solutions for problems by facilitating the provision of diverse information from various sources in the organization (Mäntymäki & Riemer, 2014).

ISSUES IN ESM USAGE AND KNOWLEDGE SHARING

ESM tools act as enabling technology providing a means for the desired ends like collaboration, networking and knowledge sharing across enterprises. However, its actual usage in different contexts may be varied. There are a number of factors that have an impact on knowledge sharing via ESM tools and subsequent employee performance, some of which are listed below.

Inter vs. Intra Team Usage

Teams have their own peculiar demands w.r.t. task requirements. The kind of information required by the members of a team varies with the context of interaction. Hence, ESM usage in inter-team and intra-team context has different effects on knowledge sharing. The former is more suited for innovative performance associated with finding new knowledge and the latter is more suitable for task performance using knowledge for short term use without any consideration for discovering novel information (Kuegler et al., 2015). Thus, task context is an important aspect to be taken into perspective while assessing the role of ESM in employee performance.

Cultural Norms

Cultural norms of the organization play a significant role in defining the mindset of the employees to collaborate. Competition for better performance and sharing can also motivate employees to read and explore more about a given area. Both collaboration and competition facilitate knowledge sharing leading to faster learning among employees (Patroni et al., 2015).

Tie Strength

Social ties are connections among people which are used to share varied information with tie strength being strong, weak or absent in any given social circle. Granovetter (1973) defined tie strength as "a combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (p. 1361). In context of knowledge sharing, social ties and their strength affect the behavior of knowledge seeker and provider. In case where initial ties are strong and knowledge is less complex, there exists a greater possibility that knowledge will be sought

right away (Leonardi & Meyer, 2015). However, the kind of knowledge sought also varies with different social ties. Strong ties have individuals with whom there is information overlap. Hence, weak ties may generate information that is novel (Granovetter, 2005).

Cognitive Overload

Employees all across the organization may exchange different kinds of information interacting over ESM tools. This leads to increased load or volume of communication. Hence, it may be difficult to keep a track of all relevant communication and conversation threads. Also, there is a disadvantage if there are too many conversations going on as people may fight for attention. In such a case, the aim of reducing an employee's knowledge search efforts by developing a contextual understanding of the knowledge sources may not be fully achieved (Leonardi, 2015).

CHALLENGES IN ESM DESIGN AND ADOPTION

Apart from the issues that arise in the usage of ESM tools in particular reference to knowledge sharing and collaborative work, there are certain challenges in its design and adoption which need to be addressed.

ESM Platform Design

Designing a platform requires the consideration of organizational conditions, culture and employee needs. Kane (2015) classified various aspects of platform design for enterprise social media. Different functionalities and design aspects present in the popular social media tools can be utilized in the context of designing a platform for enterprises taking into view their requirements and peculiarities. Some of the interaction and content related aspects identified by Kane (2015) are:

1. Persistence of relationship depicting the network boundaries w.r.t inclusion of various stakeholders in the organization wherein a decision has to be made regarding the inclusion of internal and/or external stakeholders like clients and vendors as well. Including external stakeholders may help in solving shared problems (Kane, 2015).
2. Types of connections which can be either interactions (messaging and chats), proximities (Digital proximities via forums and common online discussion) or flows (movement of information among non-connected users such as in case of Twitter hashtags).
3. Connection capabilities which may offer an option to understand the strength of social ties generated by binary connections and their interaction intensity.
4. Supported content may vary from simple text to audio, video and hyperlinks etc. along with the option of expressing one's opinion on information and posts shared with others.
5. Digital trace enabling a log wherein activities of members on the social media tools can be recorded and summarized for use by other members.
6. Profile authenticity aspect covers the extent of accurate representation of real identity of users who generate and share content thereby increasing its trustworthiness.

ESM tools can be designed in view of existing popular social media tools tailoring their basic functionalities as per organizational needs. Individual usage defines the way technology is understood and utilized in the long run. Users make sense of technology according to their own peculiar needs and may have differentiated usage. Thus, understanding user perspective at various phases in the ESM adoption and implementation can aid better design of the system with consideration of issues like intra-team and inter-team usage. Features like creating filters for eliminating the excessive information, social tie metrics based on the conversational and exchange frequency etc. may be considered while designing different ESM tools.

ESM Platform Adoption and Usage

Any enterprise system is adopted keeping into view certain key organizational requirements along with assessing the system's compatibility with the idiosyncrasies of organization. In case of ESM tools, factors such as purpose of ESM, participants involved, legal and security risks along with governance and policy mechanisms (Turban et al., 2011) must be considered in adoption decision. Adoption of any enterprise system makes the system accessible and available but there are certain factors that influence its continued usage. On the individual level, self-construal and interdependent tendencies of employees should be taken into view (Liu & Rau, 2014) in respect of ESM tools for intra organizational usage. Employees engage in social sense making of ESM creating their own peculiar communicative practices over such media (Riemer et al., 2012). Utility of ESM can be enhanced by positive organizational factors in terms of conducive knowledge sharing culture and leadership support. Thus, various factors at technological, organizational and individual level are interrelated and their constructive interplay is necessary for ensuring successful assimilation and continued usage of ESM tools.

FUTURE RESEARCH DIRECTIONS

Enterprise social media is a relatively new area for scholarly research in information systems domain. It has previously been explored in context of its knowledge sharing, interactional and communicative consequences mediated by different organizational, technological and individual user related variables. However, a more holistic understanding can be achieved by a adopting a multi-perspective view of the phenomenon. For instance, the effect of organizational support in terms of leadership and supportive team culture may be explored in terms of its effect on knowledge sharing and organizational communication. In addition, user perspective may understood in greater detail with the help of more qualitative studies that may aid in uncovering design related constraints which can be subsequently worked upon to create efficient tools suitable for organizational requirements. Constant connectivity on ESM tools may lead to a wide variety of information generating attentional conflict (Brzozowski, 2009). Apart from understanding the beneficial consequences of the ESM, future research can explore the effect of this attentional conflict generated due to excessive usage of ESM tools on knowledge sharing behavior of employees and subsequent work performance related consequences.

CONCLUSION

ESM tools have potential to foster collaboration and make information exchange easier. However, the successful assimilation of this technology requires support both at the organizational and individual levels. Technology in itself is a means. The ends to which it is eventually utilized rests on the user. Hence, organization needs to understand various dimensions of adopting and implementing ESM tools in phased manner allowing users to understand and make sense of it. Considering the interplay of various factors at organizational, technological and individual level can help in devising suitable plans for adoption and implementation. Effective usage of ESM can benefit organizations in terms of shared learning and cross-functional expertise in solving problems which can lead to enhanced innovative performance of the organization as a whole.

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KEY TERMS AND DEFINITIONS

Collective Intelligence: Shared intelligence resulting from group efforts where group members collaborate and compete to reach consensus in respect of mutually relevant problem.

Geographically Dispersed Team: A team whose members are located at geographically distant places and employ collaborative web based tools to accomplish group tasks.

Knowledge Communities: Group of people sharing common interest who come together for generating and exchanging information and ideas on specific issues in an organizational context.

Knowledge Management: The practice of creating, recording, sharing and using knowledge generated within organizations for fulfilling organizational goals.

Sense Making: Process by which people understand and attribute meaning to experiences.

Social Ties: Individual connections maintained by people in their social circle within which they interact and exchange varied kinds of information.

Tacit Knowledge: Knowledge that results from internalized information and experiences and is difficult to explicate in a formal way.

User Generated Content: Content such as text, video, audio, images appearing on blogs, wikis, discussion forums and other social media websites created by users of these online services.

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Chapter 34
Mapping the Dissemination of the Theory of Social Representations via Academic Social Networks

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ABSTRACT

This chapter examines the role of academic social networks in the dissemination of the social representations literature. In particular, it takes into account 9414 entries filed in the specialized SoReCom "A.S. de Rosa" @-library. Each entry was assessed concerning the presence of the publication in the three academic social networks (Academia.edu, ResearchGate, and Mendeley), which amounted to 2956 total entries. The publications on social representations found in academic social networks have undergone some of the comparative analyses based on "big data" and "meta-data" filed in the SoReCom "A.S. de Rosa" @-library repositories, concerning authors' countries and institutional affiliations, years of publication by year, type of publication, etc. This allowed presenting the geo-mapping of the wider scientific production in social representations and comparative results with different types of publications. Overall, the academic social networks constitute excellent allies in spreading knowledge in spite of their still relatively modest use.

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INTRODUCTION

Academic social networks are forms of Internet service, which facilitate the management of relations among scientists, sharing resources for publications, and in some case data, research results and multimedia sources. This chapter concentrates on what are the benefits of academic social networks, how to analyze their impact in spreading knowledge and why they are important. In particular, it aims at mapping the presence of publications using the case study of the theory of social representations in three academic social networks: Academia.edu, ResearchGate and Mendeley.

Academia.edu was founded in September 2008 by Richard Price, who did a PhD at Oxford in philosophy. After finishing his PhD, he founded Academia.edu, which is a platform for academics around the world to connect and share research, which in October 2016 had more than 43 million members. He spotted the need for the platform when doing his PhD. Once freely registered, a user can set his or her profile and fill in their publication list, upload papers and enlist field(s) of interest, finding at the same time researchers with a matching profile. Then, it is possible to follow what academics in the field are working on, i.e. the latest papers they are publishing, the talks they are giving or the blog posts and status updates they are writing. An important tool that Academia.edu offers is the statistic of one's downloads and page views; it also allows the researcher to know what keywords people use to search for them on Google (Giglia, 2011).

Research Gate, founded in 2008 by physicians Dr. Ijad Madisch (Boston) and Dr. Sören Hofmayer (Berlin), and computer scientist Horst Fickenscher (Berlin), is aimed at creating a working and discovering network among scientists, "Discover", "Communicate" and "Collaborate" are its main purposes (Giglia, 2011). In October 2016 it had more than 11 million members.

London-based *Mendeley*, founded in 2009 by three German PhD students (Victor Henning, Jan Reichelt and Paul Föckler), in October 2016 was used by around 2.5 million researchers worldwide to discover, share and annotate research papers (as a reference manager), and to network and collaborate with other academics (Giglia, 2011). Mendeley has two components: a desktop program and a web-based storage space, which can be used independently or synchronized (MacMillan, 2012).

The main differences among these three academic social networks can be summarized as below:

- *Academia.edu* and *ResearchGate.net* focus more on the producers of research and their networking (main function: "to be contacted");
- While reference-sharing *Mendeley.com* sites focus on readers, helping users to share and find relevant references for their work (main function: "discover recommended papers"),

One difference still existing in October 2016 is that *Academia.edu* users can post their own papers, but *Mendeley* users can also share others' papers in their *My Library* section (Thelwall & Kousha, 2014).

Overall, it has been found that different disciplines favor different academic social networks and some authors argue that at some point there will be a "winner in the race" (van Norden, 2014). At the moment awareness among scientists of the Academic Social Networks varies, but the most well-known site tends to be Google Scholar, both among natural and social scientists, as stated by van Norden (2014).

If the Personal Social Networks have become exponentially popular among lay people by sharing personal information, snapshots on private life, CV, or even for institutions and companies aimed at their web-marketing; turning to a scholars and researchers target, the academic social networks, born in 2008, have quickly become a fundamental tool to manage, read, share, annotate and cite research

papers, among tens of millions of connected users. In the era of bibliometric culture, the academic social networks – moving from the first collaborative aim of global knowledge sharing and co-producing - have also become a tool for the author's popularity. Therefore they have contributed to originate a new disciplinary field called *Altermetrics* (De Bellis, 2009, 2014), aimed at identifying new indicators for measuring their scientific impact.

This chapter first presents the literature review on the topic of Academic Social Networks, which constitutes a fairly new field of study, given their emergence less than ten years ago. Subsequently, it focuses on the case study of the publications inspired by the theory of social representations and their presence in Academic Social Networks, exploring their characteristics (such as publication year and language) and mapping the geo-cultural contexts of the location of institutions of first authors. Follows the discussion of open networked science and bibliometric culture and possible future research directions, including further statistical analyses of existing material and switching from publications to authors as units of analysis. Finally, the conclusions concern the diffusion of the theory of social representations outside of Europe and the role of academic social networks in this process.

BACKGROUND

Academic Social Networks have become a significant part of informal scholarly communication (Thelwall & Kousha, 2014). According to Hoffman, Lutz and Meckel (2015), they provide channels for quick dissemination of research results and interaction with both peers and lay audiences, while the open access philosophy increases their appeal (Nielsen, 2012). Academic social networks address the researchers' need to ensure that their publications are accessible and visible to a wide audience (Thelwall & Kousha, 2014). They also form a part of academic identity, akin to a business card, or serve as a personal repository (Jordan, 2016).

The established services are constantly changing, hoping to improve user experience, including the design of the user interface, which has to be attractive but also simple, providing a low bareer for newcomers (Goodwin, Jeng & He, 2014). Moreover, academic social networks allow a responsiveness and informality, unlike the formal publishing process (Ovadia, 2014).

Current trends of the research on Academic Social Networks have often concentrated on users, for example Rosenzweig, Grinstein and Ofek (2016) suggest women and authors from less economically advanced countries are more likely to utilize them. According to Williams and Woodacre (2016), the overarching outcomes of the review of research on academic social networks suggest that it falls into two primary areas: promises and perils. There has also been some research (He & Jeng, 2016), dedicated to the development of scholarly collaboration facilitated by academic social networks. On the other hand, some authors have explored the relationship between social and usage metrics, and traditional bibliometric indicators at author level (Ortega, 2015). This type of research is possible thanks to the fact that academic social networks encompass both levels, suggesting that such metrics could be used as proxies or predictors of research impact (Priem & Hemminger, 2010). Since bibliometrics (traditional techniques for measuring scholarly impact) have become well known for generating conflict and concern (Roemer & Borchardt, 2012), alternatives proposed by academic social networks appeal more attractive. Readership data also constitutes a useful supplementary measure to remedy some limitations of citation analysis across the social sciences and humanities (Mohammadi & Thelwall, 2014).

In the emerging field of research on academic social networks there have been no studies so far dedicated to a specific case of an interdisciplinary theory, comparing publications disseminated via these innovative tools. The method proposed below could be employed in other fields, taking under scrutiny a distinct school of thought.

Serge Moscovici developed the theory of social representations when assessing the process assimilation and transformation of expert knowledge on psychoanalysis among the lay people (1961/1976). According to de Rosa (1994), it can be operationalized on three different levels: a) social representations as *phenomenon* – "ways of knowing" characteristic of social reality that emerge in daily life during interpersonal communication and are directed toward comprehension and control of the physical-social environment; b) *theory* of social representations – the collection of conceptual definitions, methodological operations and formulation of constructs that have social representations as their object; c) *meta-theory* of social representations – the collection of critical comments, ripostes and comparisons with other theoretical models which emerges from the critical debate on the theory of social representations. For a stock of the wide scientific field developed in more than 50 years since 1961, see de Rosa, (2011, 2013a) de Rosa & d'Ambrosio (2008).

ACADEMIC SOCIAL NETWORKS AND SOCIAL REPRESENTATIONS

This research is part of a wider research program led by de Rosa (2013b) dedicated to the investigation of the spread of the Theory of Social Representations (Moscovici, 1961/1976, 2000; de Rosa, 2013a), in online contexts, specifically in Academic Social Networks, taking into consideration the most important ones: Academia.edu, Research Gate and Mendeley.

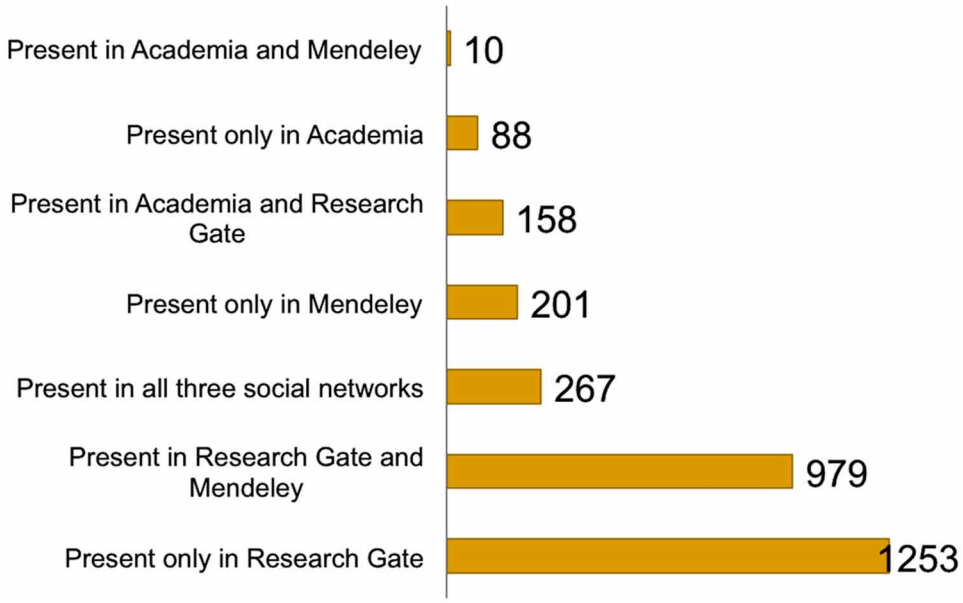
This paper use data and meta-data collected by a research tool - the Grid for theorical Meta-Analysis of Social Representation Literature - created by de Rosa in 1994 and and progressively updated depeding on the development of the scientific field and the needs linked to the new forms and practices of sociology of kowledge in the *era of networked science* (Nielsen, 2012). The grid is a fundamental tool of the *SoReCom "A.S. de Rosa" @-Library* (de Rosa, 2016b). For the purpose of the research line presented in this chapter, a specific section has been added to the grid, recording each publication's presence/absence in each of the three Academic Social Networks.

The research presented in this chapter was conducted in November 2015. Of 9414 publications analyzed, filed in the bibliographic repertories of the online SoReCom "A.S. de Rosa" @-Library, 6458 (69% of the total) were not found in any of the three Academic Social Networks examined, while it has been found the presence of the remaining 2956 articles in at least one or more of them.

Concerning the distribution of the sources in the three Academic Social Networks, the most numerous contributions were found in Research Gate, followed by Mendeley and Academia. Different combinations are presented in Figure 1.

The analysis of the years of publication of literature in Social Representations is organized in decades: from 1952, the date of the article by Moscovici (1952) which can be considered a sign of the embryogenesis of the theory of social representations (de Rosa, 2011), to the date of this empirical investigation, in November 2015. It consists of 6 decades, through which there is a progressive and increasingly widespread use of the theory of social representations:

Figure 1. The frequencies distribution of 2956 items related to social representations in different academic social networks



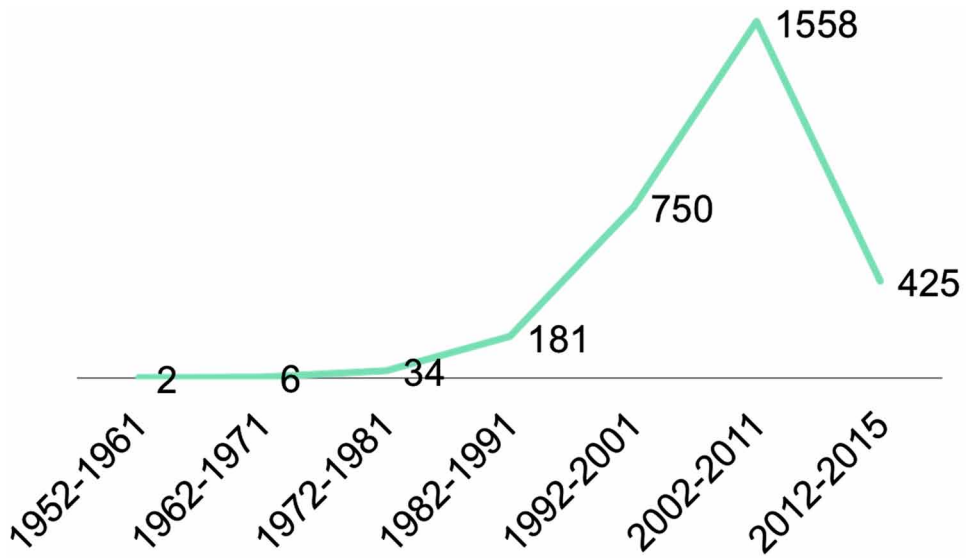
- 1952-1961
- 1962-1971
- 1982-1981
- 1992-2001
- 2002-2011
- 2011-2015

In the graphical representation in Figure 2, there seems to be a sharp decline of production in the timeframe 2012-2015, due quite surely to the fact that the amount of time taken into account is limited to four years, and not ten as it is instead for other time periods.

Another criterion that has been adopted to analyze the sample was the language, framing the theory of Social Representations as a multi-cultural, multi-generational and multi-linguistic scientific field. As it was plausible to imagine, English (f=1614, 54.60%) is always the predominant language, maintaining this role in all samples analyzed - the set of 2956 items and specific items in each Academic Social Network. It seems to be the hegemonic language of the web. Moreover, English has become over the years the main vehicle of scientific communication, means of shared communication, beyond the country of publication of the native language of the scientists. Follows the order in French (f=497, 16.81%), the native language of the theory, born and developed in France, and Spanish (f=406, 13.73%) and Portuguese (f=354, 11.98%), incontrovertible sign that sees Latin America as the most fertilized scenario.

The classification according to the Resource Type encompasses multiple sources from which the extracted contributions that draw on the paradigm of social representations, are distinuished according to the type of publication. Various types of publications have been found in the Academic Social Net-

Figure 2. The frequencies distribution of 2956 items related to social representations in academic social networks by decade



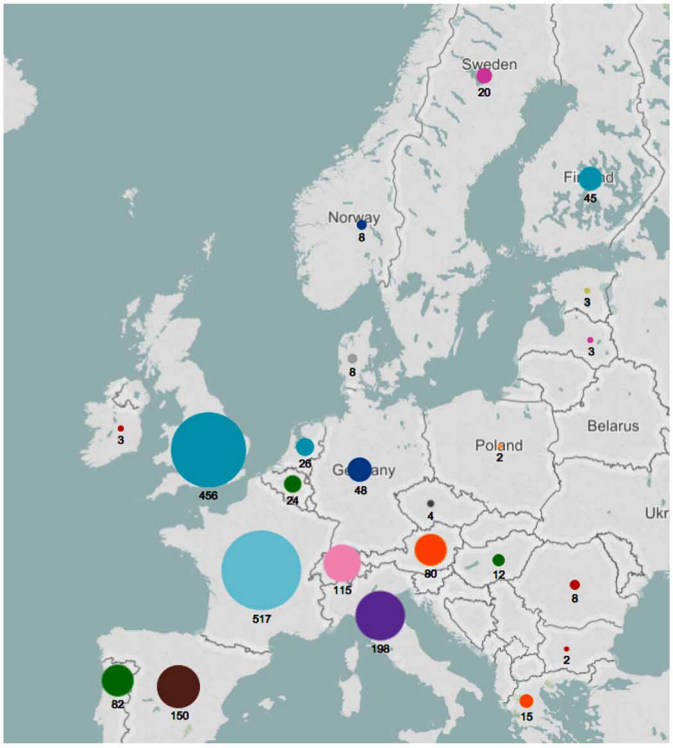
works, with the overwhelming majority of articles in scientific journals (f=2307, 78.04%), followed by book chapters (f=282, 9.54%), conference presentations (f=224, 7.58%) and books (f=68, 2.30%).

Mapping the expansion of the theory and its different spread within Academic Social Networks has always been one of the main goals of the "A.S. de Rosa" @-Library, as well as evaluating its development throught various paradigmatic approaches and its dissemination in different thematic domains of applications, identifying precise geographical boundaries. Europe (f=1856, 62.79%) tends to be always the most dynamic area in the production and dissemination of scientific literature on Social Representations, followed by Latin America (f=706, 23.88%) and North America (f=232, 7.85%), when considering the institutions of the authors of publications on social representations that can be found in the Academic Social Networks. Latin America's importance is in line with the overall trends of literature production in this field, where in particular Brazilian authors are starting to replace authors from European institutions as leaders (Wachelke, Matos, Ferreira, & Costa, 2015).

In a more specific manner, this contribution examines the country of origin from which the major contributions are present in Academic Social Networks. Through the use of *Tableau software* (http://www.tableau.com), it was possible to create a graphical representation that would take into account the diffusion of the Theory of Social Representations in Academic Social Networks from a geographical point of view, for nations and continents. Figure 3 shows how France (f=517, 17.49%) occupies the undisputed first place of the greatest visibility in the Academic Social Networks of the literature inspired by the theory of social representations, followed by the United Kingdom (f=456, 15.43%), Brazil (f=390, 13.19%) and Italy (f=198, 6.70%).

The following continent, Latin America, presented in Figure 4 sees as the most prominent countries Brazil, Mexico and Argentina (among others with less frequencies) in this fertilised scenario.

Figure 3. The frequencies distribution of 1856 items in Europe



In the remaining continents, the numbers of publications present in Academic Social Networks are progressively lower, which confirms earlier results of geo-mapping (de Rosa, in press, forthcoming). Figure 5 groups these "*new emerging scenarios*".

SOLUTIONS AND RECOMMENDATIONS

Due to space limitations, it is not possible to go into detail for each of the three Academic Social Networks, where the numerical values differ for each country, but in proportion the trends tend to be the same, positioning Europe as the main continent where the authors who post their papers that use the theory of social representations, followed by Latin America and other scenarios. Certainly, international conferences play a crucial role in the dissemination of the theory (de Rosa, & d'Ambrosio, 2008), although conference presentations are not that frequently posted in the Academic Social Networks.

It is worth noting that the Academic Social Networks also play a crucial role in the debate on the evolution of the bibliometric culture in the recent decades from the scope of *information retrieval* and *science citation* (Garfield, 1955) to Webometrics (De Bellis, 2009) and beyond to *Altmetrics,* based on the transactions of users in the new scenario of the Web 2.0 and the on-growing scenario of *social networking* of especial interest to scholars now undertaking large-scale migration to online publishing and moving toward a universe of web-native communication (de Rosa, 2015a). This will not be irrelevant also for the evaluation of the science impact; in fact, some reasonable doubts about the use of social

Figure 4. The frequencies distribution of 706 items in Latin America

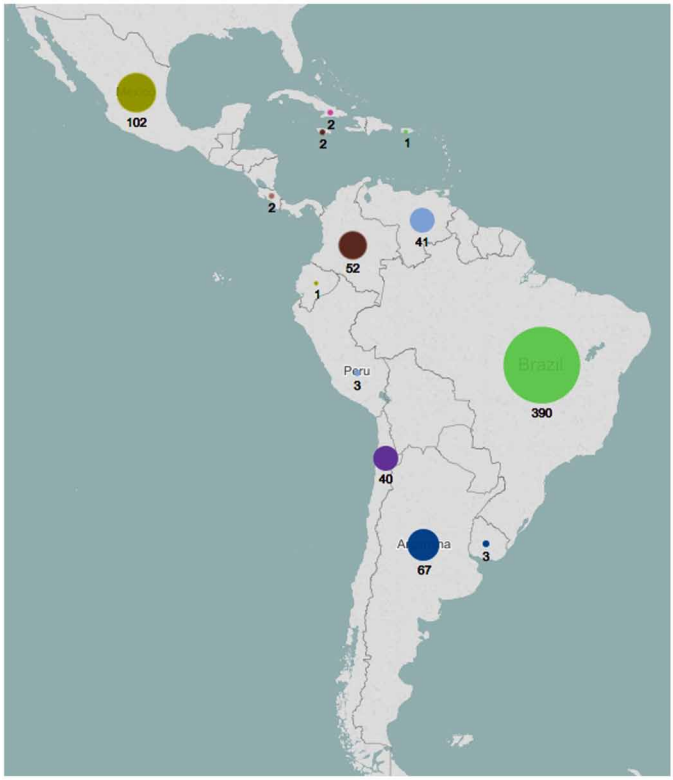
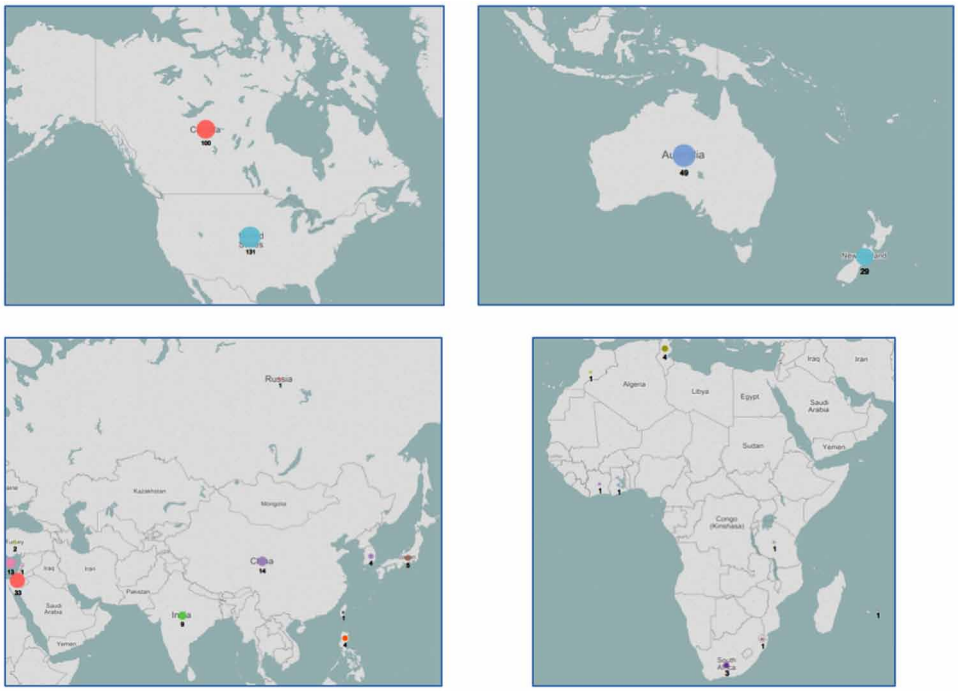


Figure 5. The frequencies distribution of the remaining items in North America, Oceania, Asia and Africa



media in the research evaluation and the need to distinguish between authors' *social popularity* (based on opinion) and *scientific impact* (based on peer reviewed quality filter of scientific facts and results) have been expressed by Moed (2014).

The evolutionary scenario of the new bibliometric culture from *Science Citations* to *Scientometrics* to *Altmetrics* is widely documented in a multi-disciplinary research field which has moved from information science, informatics, statistics, mathematics, technology, communication and new media studies, but which, due to asymmetric applications in the domain of social sciences and humanities compared natural and applied sciences, has crossed epistemological issues in the history of sciences and their disciplinary policies (de Rosa, 2015a, 2016b).

FUTURE RESEARCH DIRECTIONS

While this chapter concentrated on mapping the geo-cultural trends, the limitation of presented results is the focus on descriptive statistics (e.g. frequencies). Further analyses should be carried out, including correlation of papers featured in Academic Social Networks with their bibliometrics and analysis of variance, taking into account multiple variables, such as whether the papers are empirical or theoretical, what constructs and theories they employ, etc.

A possible future research direction consists of the assessment of the "*personal profiles*" on the academic social networks of authors who publish using the theory of social representations. While the presented research is based on the presence/absence of specific publications, it is possible that not all of their authors actually have a personal profile. On the other hand, it may be interesting to trace who extensive are the personal profiles and how much information the authors are willing to include on them.

Another possible development concerns the willingness of authors to send privately or post full-text publications when prompted by other users, based on the functionalities of different Academic Social Networks that allow such exchange.

Consistently with the main goals of the overall research program aimed at the meta-theoretical analysis (de Rosa, 2013b, 2015a, 2016a), the reconstruction also in the academic social networks of the kind and evolution of inter-individual and inter-institutional co-operations is another goal of the wider meta-theoretical analysis research program. Therefore further efforts will be dedicated to the reconstruct also "within" and "by" the different academic social networks the dynamics of the knowledge epidemiology via the inter-institutional collaborations between authors belonging to institutions in different countries and continents: *who* works with *whom*, (on what) and *where*? Some tools like the analytics of the "followers" (*who is following of followed by whom*) may help to reconstruct the map of the relations among the scientists.

Moreover, a qualitative research line will be integrated with the empirical research line based on the systematic meta-theoretical analysis of the overall scientific production. It will enrich the multi-year collection of interviews already conducted by de Rosa for the main purpose of reconstructing a "*biography of the theory*" based on personal narratives of the protagonists of the theory of social representations (starting from his founder Serge Moscovici) and scholars of different generations about the relevance that this theory had in their intellectual life and the evaluation of the prospective scenario about the theory development. This qualitative extension of the study based on individual interviews will be pursued also with scientists belonging to this scientific field present in the academic social networks,

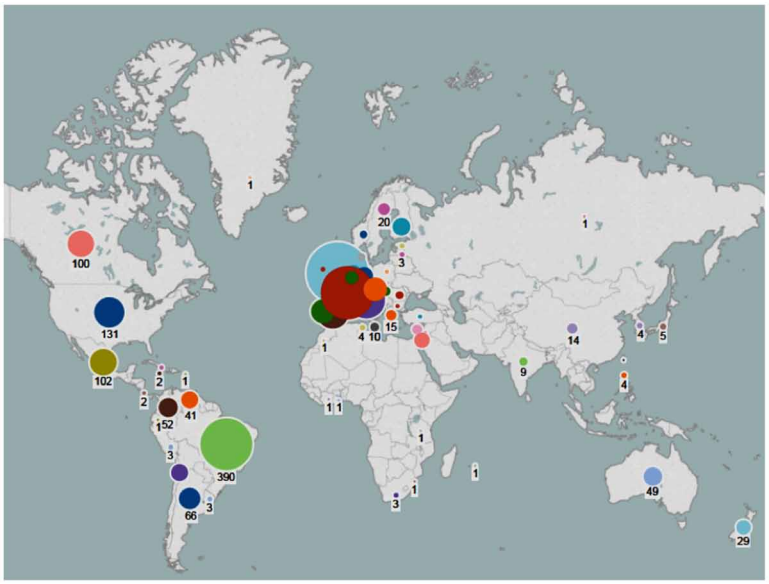
orienting specific questions also aimed at revealing their attitudes towards these new environments and their motivations for using them.

Additionally, this research could be extended to other types of academic social networks aside from the three considered up to date in the So.Re.Com. "A.S. de Rosa" @-Library, which is a flexible instrument, where additional variables can be included in the future.

CONCLUSION

In conclusion, it may be stated that this research has shed some more light on the diffusion of the Theory of Social Representations, the origin of a number of works and debates in social psychology, which tends to occupy a central position in the social sciences and that, as now established, meets an interest growing in different countries, in Europe and across the Atlantic. The Academic Social Networks can constitute excellent allies in spreading knowledge and - though they still relatively modestly refer to the field of Social Representations - in time it is likely to expect a progressive, comprehensive and very useful dissemination of scentific production using these channels, as demonstrated by literature review. The hard work done by the team of the European/International Joint Ph.D. on Social Representations and Communication Research Centre and Multimedia Lab, founded and directed by Annamaria Silvana de Rosa (2015b) has allowed generations of students and early stage researchers to work on a large sample of items relating to social representations.

Figure 6. The frequencies distribution of 2956 items related to social representations in academic social networks



The impressive number of contributions from French, English, Brazilian and Italian institutions (among many others worldwide) demonstrates that both European and non-European researchers engaged in the dissemination of the theory are succeeding in efforts to spread it using the Academic Social Networks, identifying a microcosm that mirrors a much larger universe. However, "emerging scenarios" also deserve the attention, because it is very interesting if and how the data described in this paper (combined in Figure 6) will undergoes continuous evolution compared with the set of data gathered in different times through follow-up investigations.

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KEY TERMS AND DEFINITIONS

Academia.edu: Founded in September 2008, it is an academic social network for researchers around the world to connect and share research, which currently has more than 30 million members.

Academic Social Networks: Online platforms aimed at free exchange of publications, resources and information in the realm of academia, open to students, researchers and professors. Once freely registered, a user can set his or her profile and fill in their publication list, upload papers and enlist field(s) of interest, finding at the same time researchers with a matching profile.

Altmetrics: Metrics based on social media (like blogs, Twitter, and Mendeley) which inform broader and faster measures of impact of a scientific publication, complementing traditional citation metrics.

European/International Joint PhD on Social Representations and Communication: An international joint doctorate led by the Sapienza University of Rome, dedicated to the research training in the field of social representations (http://www.europhd.eu).

Geo-Mapping: Technique to visualize data from different geo-cultural contexts or specific geographic locations that takes into account the cultural characteristics of inhabitants, which demonstrates the diffusion of the theory.

Mendeley: Founded in 2009 and used by around 2 million researchers worldwide to discover, share and annotate research papers (as a reference manager), and to network and collaborate with other academics.

ResearchGate: Founded in 2008, aimed at creating a working and discovering network among scientists, "Discover", "Communicate" and "Collaborate" are its main purposes, in January 2016 it had more than 8 million members.

So.Re.Com. "A.S. de Rosa" @-Library: A multi-purpose web-platform for integrating scientific documentation, networking and training in the field of Social Representations and Communication (So.Re.Com.) (de Rosa, 2016b).

Social Representations: A construct developed by Serge Moscovici (1961/1976), which – according to de Rosa (1994) - can be operationalized as "ways of knowing" characteristic of social reality that emerge in daily life during interpersonal communication and are directed toward comprehension and control of the physical-social environment.

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Chapter 35
The NetLab Network

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ABSTRACT

The authors discuss the NetLab Network – an interdisciplinary network studying the intersection of social networks, communication networks, and computer networks. It has developed since 2000 from an informal network of collaborators into a far flung virtual laboratory with members from across Canada and the United States as well as from Chile, Hungary, Israel, Japan, Norway, Portugal, and the United Kingdom. Connecting them is a shared sensibility of interpreting behavior from a social network perspective rather than seeing the world as composed of bounded groups, tree-like hierarchies, or aggregates of disconnected individuals. NetLab's researchers focus on the interplay between social and technological links, social capital in job searches and business settings, new media and community, internet and personal relations, social media, households, networked organizations, and knowledge transfer. NetLab has had two main achievements: first, its researchers make substantive contributions to the issues they study, and second, they demonstrate that this model of scholarly collaboration works.

INTRODUCTION

The NetLab Network ("NetLab") is an interdisciplinary scholarly network studying the intersection of social networks, communication networks, information networks, and computer networks. NetLab gets its identity and zeitgeist from its distinctive subject matter, multi-disciplinary nature, and the way in which it functions as a social network.

As a network in its own right, NetLab comprises shifting teams, spatially dispersed relationships, and permeable boundaries. Its members have come from many disciplines: Communication Science, Computer Science, Geography, Information Science, Management Science, and Sociology. NetLab has been inclusive in academic status, including faculty, graduate, undergraduate, and high school students. Although centered at Toronto, Canada, NetLabbers are elsewhere in Canada, as well as Australia, Chile, China, England, Israel, Italy, Japan, Norway, Singapore, and the United States. Connecting them is a

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shared sensibility of interpreting behavior from a social network perspective rather than seeing the world as composed of bounded groups, tree-like hierarchies, or aggregates of disconnected individuals.

Not only ideas connect the network. NetLab is an informal network of collaborators - faculty and students - that function as a community of practice: a self-selected, self-organizing, informal group of collaborators who solve problems together and learn from each other. In addition to congruent intellectual perspectives, frequent communication and a culture of inclusiveness and mutual supportiveness also connect NetLabbers. With its paramount interest in social networks, as well as its collaborative focus, interdisciplinary nature, remote team members, and partnerships with government and industry, NetLab exemplifies key trends in research (Wellman, et al, 2016). It is important not only for what it does but for also how it achieves it.

This chapter summarizes and updates an earlier description published in the *Encyclopedia of Cyber Behavior*. As the space allotted for this chapter is less than half of the original chapter, we emphasize recent research and refer readers to the earlier version for fuller discussions, citations and references (Dimitrova & Wellman, 2012).

GUIDING PRINCIPLES

NetLab research has been informed by a set of guiding principles:

1. *The world is composed of networks, not groups.* People function more as individuals connected via partial memberships in multiple networks and less as people embedded in tightly-bounded, densely-knit, settled groups.
2. Many people meet their social, emotional, and economic needs by tapping into multiple, loosely knit networks of diverse associates rather than relying on tight connections to a relatively small number of core associates.
3. The social structures people are in largely determine the operation of two-person relationships: it is sociology, not psychology. Ties are usually asymmetrically reciprocal, differing in content and intensity.
4. Ties link network members indirectly as well as directly.
5. Asymmetric ties and complex networks differentially distribute scarce resources.
6. Information and communication technologies (ICTs) are usually extensions and enhancers of ongoing relationships. Few people have most of their ties in segregated virtual worlds.
7. Households have become more networked, with ICTs keeping mobile spouses and their children in contact.
8. At work, less-formal, fluctuating and specialized peer relationships are common, and the benefits of boss/subordinate hierarchical relationships are less obvious. The organization of work has become more spatially distributed, with ICTs connecting people, and appreciable numbers working at home full or part-time.
9. As the dividing line between work and home has weakened, so has the more general boundary between the private and public spheres of life. In the less hierarchical and less bounded networked environment where expertise is more in dispute than in the past and where relationships are more tenuous, there is more uncertainty about whom and what information sources to trust.

10. Social movements arise out of both existing social networks and more organized groups; they rarely are disconnected bunches of alienated individuals.

BACKGROUND

Although social networking services such as Facebook, LinkedIn, and Twitter have highlighted the connection between social networks and technology, NetLabbers have looked at social networks – spatially distributed and sparsely knit – for decades. The International Network for Social Network Analysis was founded at the University of Toronto in 1977, and many local scholars have used a common network analytic approach in a variety of substantive areas and topics. Some focused on large-scale structures and their implications while others focused on interpersonal relations.

In the early 2000s, a cohesive set of scholars started examining how the internet fits into community and family life, friendships, civic involvement, and health practices. The network jelled, linked not only by overlapping research interests but also by a propensity to collaborate and help each other. They had an understanding of their overlapping intellectual pursuits and the connections among them, but they lacked a name and a distinct identity. Creating NetLab formalized existing practices of collaboration and gave an identity to an already well-functioning network of faculty and students.

The creation of NetLab – as a brand independent of any scholarly discipline – also facilitated the involvement of scholars from a variety of disciplines. Then and now, the boundaries of the network have been flexible: Faculty members are engaged to a different degree depending on the mix of projects they have at a particular moment in time. Students come in and out, graduate from university, or finish internships. Members move away or change interests. Yet the network remains: Former students come back for a visit or engage as collaborators; network members collaborate and ask for help with relevant references, a survey protocol, or an ethics submission.

Branding the network as "NetLab" provided a useful identity. It gave visibility to the University of Toronto among the global network of social network scholars; it provided an easy way for other scholars to connect with network analysts. It provided a quasi-formal identity to scholars, the general public, the media, and government bodies, NGOs, and corporations interested in the social network approach. Former students at NetLab have graduated to launch their own research programs that build on and expand on NetLab's research concerns. Some continue their interests in social capital or the way media is involved in social networks.

All this happened with a loosely bounded and fuzzily defined informal network. So NetLab became the name and the brand. It reflects the combination of serious scholarship and joyous collaboration. It reflects NetLab's openness to studying all sorts of networks: social, communication, information, and computer. No longer based at the University of Toronto, it is today "The NetLab Network," but informally still "NetLab".

COMPUTER NETWORKS MEET SOCIAL NETWORKS

The essence of NetLab is *social* networks, not *computer* networks. But, starting in 1990, a series of collaborative projects focused on the ways people used ICTs for work and community. Toronto computer scientists in the Cavecat and Telepresence projects were attracted to NetLab's focus on work and lei-

sure communities that transcended the traditional local proximities of work groups and neighborhoods. Several projects on the remote collaboration at work highlighted the importance of social context. For instance, a study of home-based teleworkers found that work tasks and supervision shaped their patterns of mediated and face-to-face communication. Similarly, the ways in which employees of a distributed organization used a pioneering desktop video conferencing system reflected their need of autonomy.

Significant efforts concentrated on how the emerging internet affected scholarly networks and community. Digital divide studies addressed an early concern: which kinds of people were actively using the internet? Scholarly network studies discovered that friendship was as important for the connectivity of white-collar employees as their collaborative work, and that weak ties among scholars were especially important for increasing the pool of available advice givers. The "Netville" community study showed that rather than destroying neighboring, the internet increased both local and long distance connectivity. These studies also had the effect of shifting research away from experimental groups and phenomena such as telework or video conferencing to looking at how ordinary people incorporated ICTs into their lives.

NetLab's projects in the early 2000s solidified its theoretical orientation, substantive focus, methodologies, and interdisciplinary orientation. Among the key ideas was the understanding that computer networks link people as well as machines. In other words, computer networks are social networks. At a time when the analysis of online relations tended to focus on ties between two people, NetLabbers emphasized the embeddedness of such ties in networks connecting people in-person as well as online. This interpretation had major implications for the study of ICTs: it meant that NetLabbers could fruitfully use the same intellectual apparatus for studying the internet that they had used to study work, community and households. This background enabled NetLab researchers to wade into major debates about the significance and implications of internet and mobile technologies on interpersonal relations, communities and organizations. Instead of armchair theorizing, they were armed with a broad theoretical approach, systematic methods, and a knowledge base of research lore. A continuing research thread in findings is: "the more, the more, the more." That is, the more social ties people have, the more they use digital media, and the more social support they exchange.

The central presence of social scientists in NetLab provided an emphasis on social context and linked its research to broad societal trends and the history of science and technology. This allowed the group to avoid the common pitfalls of early research on ICTs. Instead of implicit technological determinism – where computerization directly determined behavior -- NetLab researchers saw technology as providing social affordances, i.e. opportunities and constraints for social relations. The broader social context of NetLab's studies allows scholars to question ahistorical assumptions about ICTs. Rather than assuming that ICTs have no precedent in the past, NetLabbers have shown how debates about whether ICTs enhance or diminish community are continuations of centuries-old debates about the impact of the industrial-bureaucratic revolution on community. Instead of pedantically arguing about the theoretical effects of ICTs, NetLabbers have collected systematic evidence from surveys, in-depth interviews, and ethnographies. Instead of adopting parochial views that ICTs could be understood in isolation from face-to-face and phone communication interaction, and that only online phenomena were relevant for understanding the internet, NetLab researchers looked for the interplay between communication online and offline.

Such an approach has coupled with an appreciation of the social affordances of a series of successively developed technologies. NetLab research started with email and early collaborative technologies. Later studies turned to digital media, both interpersonal and social (e.g., Takhteyev, et al., 2012; Gruzd,

et al., 2012). Two key phenomena discovered in the research were *local virtualities* – where physically proximate people communicate online and *virtual localities* – where physically dispersed networks form communities online.

Researchers at NetLab have situated analyses in the context of historical trends and broader social phenomena. This leads them away from simplified utopian/dystopian interpretations of the affordances of ICTs. NetLabbers have shown that digital media have become incorporated in everyday life. They not only give people speed in data-heavy exchanges but also enable them to stay always connected and to make their communication personalized and portable. For example, NetLab researchers demonstrated that the use of ICTs could support both strong and weak ties, and that ICTs rarely replaced face-to-face interactions but were used instead to communicate in-between face-to-face contacts (Wang & Wellman, 2010; Rainie & Wellman, 2012). Nor have ICTs decreased the importance of proximity or precluded travel: Rather, they have been incorporated in the variety of tools people use to maintain their networks (Dimitrova, et al., 2015). Online connectivity may even increase face-to-face interactions and community engagement. People stay both locally embedded and globally connected, and have more close relationships, support, trust in others, and civic engagement.

Anabel Quan-Haase's book, *Technology and Society: Social Networks, Work, and Inequality* (2015), presents these and other findings in depth, examining the places where technology and society intersect; connecting technology to issues of social networks, communication, work, power, and inequality. Focusing on Canadian society, she provides an overview of how ICTs are changing peoples' perceptions of themselves and their relationships.

COMMUNITY AND HOUSEHOLD STUDIES

"Connected Lives" and "Networked Individuals"

To understand the networked nature of community, NetLabbers have studied a residential area of Toronto – East York – via surveys and in-depth interviews in four waves: 1969, 1979, 2004-2005, with the latest study starting in 2012. The most recent wave focuses on how the internet fits in with friendship, community, social capital, domestic relationships and civic involvement. This research has found that people happily integrate the internet into their personal networks: at home, at work, and with their families. There is strong evidence that the internet is promoting community, and that it is not a separate, alienating world. Communities are no longer bounded groups but are partially connected networks whose ties reach out into different spheres, linking people near and far. A culture of frequent connections has permeated families, keeping in touch during the day via email, texting and mobile phones. Many East Yorkers use digital media to work at home, either part-time or full-time (Kennedy, et al. 2011; Rainie & Wellman, 2012; Mathias, 2013).

This research is congruent with a national U.S. survey showing that the number of close friendships had increased in the United States between 2002 and 2007. Belying fears that internet use had caused the atrophying of relationships, the analysis revealed that not only do heavy internet users have more friends than light or non-users, but also that heavy users have experienced the greatest growth in the number of friends during that time period (Wang & Wellman, 2010).

Elsewhere in the world, NetLab's Japanese research in the Yamanashi prefecture depicted how young adults used web-enabled phones instead of personal computers almost a decade earlier than their North American counterparts. The findings indicate a division of ICT use in Japan, with smartphone messages used to contact socially-close supportive relationships and email used to expand and diversify messages (Miyata, et al., 2008).

NetLab's East Asian research suggests that "networked individualism" is more than a Western world phenomenon. The researchers find similar situations in Japan, China, Korea, and Singapore: multiple partial communities, using digital media, trains and planes to connect over long distances. Key differences between North American and East Asian networked individuals are the heightened importance of kinship ties and age seniority (Chua, 2011; Chua & Wellman, 2015, 2016).

Another longstanding divide has been the elderly who are less likely to use ICTs. Neves, et al. (2013) in Lisbon and Quan-Haase, et al. (2016, 2017) in East York suggest this gap is lessening. The widespread need for ICTs means the young are teaching the old, and the formerly young are growing older and bringing digital literacy with them.

SOCIAL CAPITAL

Many NetLab members are interested in interpersonal social capital: network ties that may be mobilized as resources. Keith Hampton, et al. (2016) show how ICTs provide heightened awareness of life events in the lives of both close and more distant acquaintances. Awareness of undesirable events can lead to stress. Women tend to report greater stress than men and from a wider range of events. Hampton (2016) argues that ICTs affordances of persistent contact and pervasive awareness are ushering in changes to the structure of community that may revive the constraints and opportunities of premodern communities. Through the ambient, lean, asynchronous nature of ICTs, awareness supplements surveillance with the informal watchfulness typified in preindustrial community.

Such results fit with experimental work focusing on how individuals use ICTs to maintain and build their personal networks in their daily lives. Thus, smartphones both enable or hinder the transfer of information and support within social networks. For example, smartphones can mitigate tele-cocooning by stimulating communication between weak ties (Boase & Ling, 2013; Kobayshi and Boase, 2015). At the same time, ICTs are associated with an increased use of public space, with people being more connected than a generation ago (Hampton, et al., 2015).

Other NetLab research looks at networked individuals using their ties for advancement. Indigenous entrepreneurs use various forms of social and cultural capital in their networks to mobilize resources (Côté, 2013). Marin (2012) reveals how information holders choose to share or withhold job information from network members who they believe to be suitable for known job openings. They are more likely to share job information with strong ties and when job openings are located in closed labor markets.

Networked information pervades health awareness and care. Gruzd & Haythornthwaite (2013) described a community in which both formal health providers and informal advisors used ICTs to discuss health topics. By contrast, those who seek alternative health care, such as naturopathy, rely on ties with friends and relatives for advice and connections and often do not tell their physicians (Wellman & Kelner, 2015).

NETWORKED STRUCTURES

Networked Scholars

The NetLab's Network Assessment and Validation for Effective Leadership (NAVEL) team spent more than five years participating in and simultaneously studying a large multidisciplinary and multi-institutional Canadian research network, GRAND.The project examined how scholars from computer science, social science, health sciences, and the humanities collaborated over five years. The study sheds light on research collaboration and demonstrates how networked organizations actually operate (Dimitrova, et al., 2015a, 2015b). While networked organizations are especially common in research, most discussions are more cheerleading and anecdote than analytic research.

NAVEL's research focused on how new digital technologies and network structures affect team performance and innovation. Researchers found a network whose uneven connectivity was associated with formal organizational position, academic seniority, and disciplinary background. Leading researchers--usually older and more senior--had twice the ties of their junior collaborators; computer scientists were more connected than academics in humanities and social sciences, and cross-disciplinary collaboration linked functionally close discipline (Dimitrova, et al. 2013; 2015c). To connect with each other, GRAND researchers relied mostly on email and in-person chats. Despite ICTs' facilitating of long-distance ties, researchers tended to connect and work with nearby scholars (Hayat & Mo, 2015; Wellman, et al., 2016).

As a longitudinal study, NAVEL offers insights on the evolution of research networks (Dimitrova, et al. 2015c; Hayat & Mo, 2015). Cross-disciplinarity, geographic dispersal, and institutional diversity fostered the creation of more volatile and easily dissolved ties. While networks did not substantially change, ties were frequently added and dropped—especially ties across disciplines, institutions, and locations. The researchers liked the intellectual challenges of cross-disciplinary collaboration and actively created new ties, but did not always sustain them. Both the scholars' social status in GRAND and the structural holes in their networks shaped their exchanges of advice and their collaborations. We caution that because such multidisciplinary, multilevel networks are more complex, they can be slower to produce traditional academic outputs and they cannot be evaluated only by traditional measures.

NAVEL's results echo the findings of two earlier NetLab studies of collaborative research networks of academic, government, and private sector participants that highlighted the continuing relevance of disciplinary boundaries (Dimitrova & Koku, 2009). Nor are such networking dynamics confined to the scientists. Another NetLab study of digital humanities suggested that in the humanities, large-scale collaborative networks had greater network density and integration, without necessarily increasing the level of in-depth collaboration typically found in the sciences (Quan-Haase, et al. 2015).

Networked Learning

Just as communities used to be (mostly) bound up in neighborhoods, formal education used to be bound up in school classrooms. Yet digital media and networked individualism are enabling school-agers and lifelong learners to obtain knowledge from a variety of sources, from Facebook and Google to massively open online courses. Haythornthwaite, et al. (2016) are leading the explorations of this area.

Networked Influence

In a networked society, social influence has become networked influence: it occurs in social networks and propagates through online communication networks (Gruzd & Wellman, forthcoming 2016). Working from this premise, Gruzd's coordinate Social Media Lab finds that while there are some pockets of political polarization on the Twitter social media platform, it also facilitates open, cross-party, and cross-ideological discourse (Gruzd, et al., 2016; Gruzd & Wellman 2016; see also Gruzd, et al., 2012; Miyata, et al., 2015).

Transnational Entrepreneurs

The Information Technologies and Transnational Entrepreneurship Project studied how ICTs and planes allow global connectivity. The "net and jet" helped Chinese immigrants to stay connected in North America and in their homeland, relying on glocalized networks and the internet to engage in transnational entrepreneurship (Chen & Wellman, 2009). Chen currently collaborates with University of Texas colleagues analyzing the relation of social media, social networks, and global media flows (Chen & Reese, 2015).

DEVELOPING NETWORK METHODS

Advanced methods have been a continuing thread in studying networked relationships. Bonnie Erickson pioneered the "position generator" to measure the resources people are people linked to and how differences in network contacts with different jobs have life consequences (Lin & Erickson, 2008).

Anatoliy Gruzd is developing automated text mining and visualization tools for uncovering and representing online social networks (Gruzd & Wellman, 2014). He and the associates at his Social Media Lab have put these tools to good use studying how academics, professionals, and ordinary people use social media and how social media are implicated in knowledge exchange, collaboration, and social influence processes. The continuing development of tools and methods enables and, in turn, is reinforced by the expanding research agenda of the Social Media Lab.

Concomitantly, Boase and Ling (2013) have incorporated digital trace data into their project designs, merging it with more traditional survey and interview data. Marin and Hampton (2007) have shown ways of simplify data collection using name generators while ensuring reliability. Bernie Hogan is developing novel data collection techniques that blend qualitative and quantitative approaches to understand how people perceive and act on social networks. He developed participant-aided sociograms with the Connected Lives team and later turned to online audit studies (Hogan & Berry, 2011). He has also blended this empirical work with a theoretical expansion of the social affordances concept (Hogan & Wellman, 2014). Hogan (2015) argues that instead of alphabetical or chronological order, information providers should use the logic of machine learning with data-as-graphs to train multidimensional systems.

The complex reality of the scholarly network studied by NAVEL enabled the development of multilevel, multimember modeling and sequencing analyses. These are useful tools for longitudinal studies of networked organizations and networked workers who are partial members of multiple teams (Mo, 2012; Mo & Wellman, 2016).

CONCLUSION

As a community of practice, the NetLab Network has had two main achievements. First, its researchers have made substantive contributions to the issues at the intersection of social networks, communication and computer networks. The accumulation of tacit and explicit interdisciplinary knowledge at the NetLab Network not only lends depth and sophistication to research results; it has reached a stage which enables the development of theory.

Second, NetLab has demonstrated that its model of scholarly collaboration works. Its members practice, analyze, and preach being networked. Their collaborative relationships span both disciplines and academic status and have connected a diverse network of scholars. Their informal, but serious collaboration enables bouncing off ideas and has proven especially conducive to novelty and creativity.

A recent book – *Networked: The New Social Operating System* (Rainie & Wellman, 2012) -- is an exposition of much of NetLab's intellectual capital and research lore. It brings together different strands of the work done by NetLabbers for the past four decades and adds other relevant contributions about social networks, interpersonal relations, the family, work, information, and creativity. The key thread running through the book is the "Triple Revolution": the turn to social networks, the internet and mobile connectivity and the way these revolutions affect everyday life. The authors contend that the Triple Revolution is building social relationships based on "networked individualism", a paradigm shift in the way people are connected: from relatively homogenous, broadly-embracing, densely-knit, and tightly-bounded groups to more heterogeneous, specialized, sparsely-knit, and loosely-bounded social networks. These developments serve as both a summary of research knowledge and a guide for future research. Above all, they demonstrate that the shared perspective binding the NetLab network together is not frozen in time but reflects the intellectual growth of its members. NetLab is well-positioned to make its next steps.

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KEY TERMS AND DEFINITIONS

Community: Tightly bound groups of people with shared interests and values, common identity, and a sense of belonging. Current approaches treat communities as delineated by interaction and commitment (e.g. virtual communities) rather than by location (e.g. neighbourhoods).

Networked Individuals: Connected individuals embedded in multiple partial networks instead of than being members of dense tightly bound groups.

Networked Organizations: Organizations where extensive use of computer networks and mobile technology is coupled with changes in group dynamics, communication, and authority.

Networked Workers: Rather than working in a single work group or independently from others, networked workers work in multiple, often distant, teams and projects.

Scholarly Networks: The networks of academics and researchers linked by one or more relations; such networks are increasingly becoming formalized, multi-disciplinary, geographically distributed, and reliant on technology.

Social Network Analysis (SNA): An interdisciplinary perspective which focuses on the patterns of relations among social actors and interprets these patterns as social structure.

Social Networks: A set of social actors - be they individuals, groups, organizations, or countries - and the relations among them.

Triple Revolution: Social transformation comprised of: (a) the change in social networks from people being embedded in tightly bound groups to people being embedded in multiple partial network (aka *networked individualism*); (b) proliferation of internet technology; and (c) spread of mobile technologies.

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Chapter 36
Online Dating/Dating Apps

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ABSTRACT

The use of communication technologies for romantic rendezvous is not new; for example, Dutton and Aron found that the use of computers for mediated-personal advertisement through visual and textual information for romantic assessment heightened the perception of attraction without significant differences between genders. In addition to the commencement of computer dating during the 1970s and 1980s, video-recording devices were also used to initiate trysts, but never became as popular as online dating is presently. Subsequently, a paramount question arises for CMC research: Why did computer dating and video dating not become as popular as online dating which is presently spreading worldwide? Future research should look at how closely online and offline courtship behaviors overlap each other, and research should also investigate the communication behaviors that individuals use on online apps compared to face-to-face interactions.

INTRODUCTION

Over the past several years, online dating services are increasingly becoming popular venues for finding romantic relationships. In 2012, Match.com reported that one in six marriages started online (Ramirez, Sumner, Fleuriet & Cole, 2015). In 2013, the online mating services brought $2.1 billion (Ginsberg, 2015) whereas compared to ten years ago, in 2004, the dating industry revenue was only $473 million. Nowadays, there are many online dating sites such as Match.com, eHarmony, and PerfectMatch.com, with over 50 million users combined (Consumer Rankings., 2012), and the online dating business keeps growing (Visual Economics Credit Loan blog, 2015). Online dating refers to web sites and apps that facilitate romantic relationships' initiation by offering users (1) access to the profiles of potential romantic candidates, (2) a communication channel to initiate contact, and (3) a romantic compatibility matching-algorithm to be paired for potential romantic initiation (see Finkel, Eastwick, Karney, Reis & Sprecher, 2012). Indeed, most online dating platforms are similarly structured (Rosen, Cheever, Cummings & Felt,

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2008), in general: users post a photograph and answer questions in regards to personal information and other relevant demographics; however, there is considerable variance among online dating forums with regard to users' level of involvement, interaction, and self-disclosure.

Despite the array of online dating sites and apps, a new online dating app entered to the online dating market, and it is taking over the entire online love business: Tinder. The new app just entered to the market in 2012, and, two years later, it reached approximately 30 million users, almost a third of the total online dating population (e.g., 96 million users) (Forbes, November 2014). Thus, the popularity of the app has rapidly grown. Tinder app innovates the usual online dating service explained above, by providing users a seemingly endless selection of photos of potential mates without the need to answer questionnaires or forms (Bertoni, 2014a); then, the algorithm of the app links users' contacts from Facebook profiles to provide photographs of potential romantic candidates. After solely looking at photos of potential mates, users swipe right if they like a person and, by the contrary, swipe left if not (Bertoni, 2014a); finally, if both parties like each other, the platform provides a parallel interface to send messages to each other to decide whether or not to meet in person and exchange personal contact information.

Besides the successfulness of online dating market, the online dating service has always been severely criticized for its 'overemphasis' on physical appearance. However, disregarding the communication context (i.e., Face-to-Face and Online), physical appearance is the initiator for communication behaviors in most of the cases. The online dating success trend has been widely explained by the new media pervasiveness argument or the idea that this service is prosperous 'only' or 'mostly' because the access to personal computers and smartphone is wide spread, then focusing only on related phenomena such as self-presentation, self-disclosure, and/or social anxiety. If new media pervasiveness explains this new social trend, why did commercial video-dating not become so popular during the 90s when the access to video cameras was also pervasive in the U.S.? Little attention has been directed to how online dating mirrors human perception of first impression while forming interpersonal relationships.

Therefore, the present chapter understand the role of human perception of physical appearance during first impression formation which may better tune with Tinder' interface; in other words, Tinder feels more natural to users compared to other dating apps, swipe to left or to the right feels better than 'browsing' profiles; in addition to the pervasiveness argument of new media and apps, this chapter explains Tinder' increasing popularity seems to match to interface architecture as well. Consequently, the concept of technological affordance tuning will be discussed to explain the success on online dating in addition to new media pervasiveness argument; however, the idea of affordance tuning is not widely discussed in the CMC research on online dating, and this concept is the main contribution from this chapter.

BACKGROUND

The online dating technology has been around since 1970, but the rapid rate of development of cheap, fast, reliable, and user personal computers with Internet made online dating technology to evolve from being just an online interface for personal romantic advertisement (see Byrne, Ervin & Lamberth, 1970), then to become an algorithm-based matching system (i.e., e-Harmony.com or Match.com) to finally a combination of both; with the inclusion of smartphone-based dating applications and GPS technology (i.e. Blendr or Skout), the new version of this CMC technology also became into satellite dating (Quiroz 2013). Nowadays, online dating users cannot only browse romantic candidate profiles, but also know where they are given information to decide whether or not meet them in person. But, if online dating

success is explained by the argument of new media pervasiveness solely, then why did commercial video-dating not enjoy similar popularity during the 1990s when the access to video cameras was also pervasive in the U.S.?

Then a new app entered to the market in 2012: Tinder. In only two years, in 2014, Tinder reached approximately 30 million users who have used this app to find a partner making, more than 15 million matches daily; then, users are checking out about a 1.2 billion profiles -14.000 per second- (Bertoni, 2014). While the entire U.S. dating business is worth somewhere between 5 and 6 billion dollars (Forbes, 2014), just Tinder is worth somewhere between $.1 billion and $.1.5 billion, and some big bank analysts said that Tinder could even top $. 5.5 billion in few years, which is almost the entire online market soon (Forbes, 2014). The app is very popular and is one of the top producing online dating apps.

This chapter argues online dating popularity responds more to how technology closely mirrors actual human interaction in the early stages of forming a romantic relationship than other (and earlier) dating services venues; furthermore: why did Tinder get that level of popularity in only 4 years, whereas other online dating sites have been around for more than a decade without obtaining the same users' preference? There exists a constant tension between tasks and technologies in interface design; Gaver (1991) accurately explains that a design based on only technology innovations is functionally awkward, and, by the contrary, a design just based on users' needs may lead to overlook technological innovations; indeed, the main purpose for artifact interface design should be to create a CMC architecture which reflects an interaction between human sensory systems and CMC affordances. Consequently, in order to answer the main queries of this chapter, nonverbal research on physical attractiveness and first impression formation with the concept of affordance tuning along the way will be discussed to explain online dating increasing engagement across the world, an idea which has been ruled out by scholarly research.

MAIN FOCUS OF THE ARTICLE

Issues, Controversies, Problems

Many individuals have assumed new, and even counter, identities in their pursuit for online romantic relationships (Alapack, Blichfeldt, & Elden, 2005). The Internet and CMC (Computer-Mediated Communication) have become suitable forms of communication between individuals looking for controlled forms of relational engagement (Hardey, 2004); the online dating phenomenon reflects the same motivation that seeks romantic outcomes (Whitty, 2008; Heino, et al., 2010; Kang & Hoffman, 2011; Finkel, Eastwick, Karney, Reis, & Sprecher, 2012); Ramirez, Summer, Fleuriet, & Cole, 2015) such as pursuing to attain a long-term relationship commitment (Mahfouz, Philaretou & Theocharaous, 2008).

However, the observable human behaviors associated with online dating have traditionally been isolated to textual inferences. For example, online dating has been research on the basis of Walther's (1996) 'Hyperpersonal' model which aims to understand how users take and advantage from CMC affordances to overcome the absence of nonverbal cues (Walther, 1996, 2007). Thus, in CMC, users create and exchange messages in physical isolation from receiver, masking involuntary cues which make users perform overattributions based on stereotypical impressions of their partners without qualifying the spontaneity of such impressions. In other words, as senders, users do not show their *"their natural physical features and non-deliberate actions into the receiver's realm of perception"* (Walther, 2007, p.

2541, Italics added); then, it can be inferred that online dating fits better for users' dating goals in terms of having more control on first impression formation.

For many individuals, the thought of going online to pursue a romantic relationship seems different and unorthodox (Anderson, 2005). In a study attempting to measure attitudes related to Internet romance, numerous results indicated varied levels of romantic satisfaction. For individuals with high levels of *Internet affinity*, or the desire to interact via the Internet, their perceptions of romantic relationships were seen as positive and enduring (Anderson, 2005). Research suggests that there is a relationship between levels of perceived realism and individual perceptions of online romantic relationships. Surprisingly, the results did not support a positive relationship between levels of perceived realism and online romantic relationships. Anderson (2004) discovered that there would be a positive relationship between amount of time (hours per week) on the Internet and perceptions of online romantic relationships. Anderson (2004) found that a high degree of Internet use was instrumental in establishing positive perceptions of online romantic relationships. Anderson (2004) noted that individuals must adjust their behaviors to the new environment created by online dating. Further, individuals engaging with online relationships must adopt new forms of nonverbal behaviors in order to offset the absence of traditionally implemented offline cues.

Just as with face to face relationships, online relationships are governed by certain codes and standards (Hardy, 2004). *Netiquette* asserts itself as the ruling body for all forms of romantic online exchange (Hardy, 2004). Research dedicated to online romances has reported that online dating services allow for high volumes of information to be transferred between sender and receiver (Hardy, 2004). Unlike print forms of dating services such as the use of newspaper classifieds, Internet services allow individuals to disseminate a plethora of biological facts at a faster rate (Hardy, 2004).

One of the greatest forms of romantic information dissemination is based on nonverbal elements. According to Hardy (2004), the posting of one's photograph onto the web is a very personal decision. For some the posting of a photograph takes away from the *otherworld* experience they are trying to manifest through online interaction. Individuals that choose to eliminate their photo seek to maintain a sense of relationship based on emotional and intellectual criterion and not physical characteristics (Hardy, 2004). For others, the exchanging of photographs act as a mechanism for the reduction of feelings related to ambiguity and uncertainty (Hardy, 2004). The practice of sending a picture electronically allows both parties to construct a more vivid, while still nonverbal representation of the other person. Further, by sending a picture, both parties are better prepared for face to face interaction (Hardy, 2004).

Social relationships start from first impression formation (Richmond, McCroskey & Hickson, 2007), and, simultaneously, first impression is formed through physical attractiveness assessment. Consequently, dating is not the exception for physical attractiveness as the basis for first impression formation (see Richmond, et al., 2007; Tidwell, Eastwick & Finkel, 2012); Eastwick & Hunt, 2014). Indeed, nonverbal research in interpersonal relationships suggests that physical attractiveness is what determines initial communication approach (Richmond, et. al., 2007). But, attractiveness assessment is individually performed and visually driven, it is in the eye of the beholder (Richmond, et. al., 2007); for example, in Eastwick and Hunt (2014) measured romantic acquaintanceship in three different times in three separated studies with a total of 309 undergraduate participants, the results suggested that the romantic evaluation of potential mates is more unique to a person that consensual over time.

Physical attractiveness primarily sets off first dates in online settings as well (see Walther, 2007; Kang & Hoffman, 2011; Finkel et. al., 2012; Ramirez, et al., 2015).The problem arises when first impression formation is mediated by computer technology because it extrapolates and enhances attractiveness in a hyperbolic way: during the receiving stage in the communication system, users perform an overreliance

(idealize) on others' traits because they only have access to the available pictures and textual information and messages which prompts minimal similarity; on the other hand, in the sender communication stage, individuals selectively self-present in a controlled and social desirable fashion; while as a communication channel, CMC facilitates editing, discretion, and convenience to form impressions (see Walther, 1996, 2007). As a matter of fact, physical attractiveness is found to be the most valued aspect in online dating (see for a review Whitty, 2008; Rosen, Cheever, Cummings, & Felt, 2008; Turner & Hunt, 2014); for example, Ramirez, et. al., (2015) found that perceptions of higher levels of intimacy, informality, composure, and social orientation were positively predicted by the number of photographs that users had on their profiles. Therefore, attractiveness is the strongest predictor for online relationship initiation (Witthy, 2008; Walther, 2008; Finkel, et al., 2012; Ramirez, et al, 2015). Consequently, the important role of physical attractiveness for dating explains the central role of personal pictures in online dating interface architecture, but this is an idea not widely discussed in the scholarly literature.

CMC offers a virtual environment in which the physical isolation prompts anonymity and makes users experience more disinhibition; for example Lapidot-Lefter and Barak (2012) examined the effect of anonymity/non-anonymity, visibility/invisibility, and eye contact/absence of eye contact in an experimental design with 142 participants (71 men and 71 women) from ages 18 to 34 years during shorts debates through CMC; thus, a factorial experimental design was conducted, and the results suggest that lack of eye contact was the primary contributor to online disinhibition effects. As a consequence from acquiring control of the new language system through CMC, individuals are able to openly express their feelings and emotions with one another. According to Alapack et al. (2005), the courtship behaviors created by the evolving language system tend to limit romantic feelings such as awkwardness and conflict. Moreover, the use of tactical punctuations during romantic interludes causes the online environment to become strikingly similar to that of the real world (Alapack et al., 2005).

Besides the currently broad access to personal computer and smartphones that is also a factor to the increasing popularity of online dating, it is worth to consider that any technology device become popular when its use is more close to naturalness (Xie & Newhagen, 2012); in other words, individuals tend to use more the devices that are feel natural to perform a given task. The concept of affordances refer to the process in which individuals perceive the objects in their environment in terms of its potential for action, without significant intermediate stages that require memory or inferences. For example, a chair is perceived in terms of its 'seatability'; hence, people perceive the affordance of 'seatability' (Gaver, 1991). Accordingly to Gaver's example, an affordance is determined in terms of the attributes of both actor and object; subsequently, there should be perceptual information for an existent affordance. Ergo, affordances are basically determined by the physical properties, shape and scale of artefacts that are more or less easy to be perceived by specific human perception processes, and first impression formation process seems to fit better with online dating.

Online dating affordances give users a broad range of choices to 'control' self-presentation in terms of physical attractiveness and personal information that permits impression management behavior. Hence, online dating interface architecture seems to line up in parallel to Gaver's (1991) requisites of affordance because for interface design the following postulates should be considered: 1) the artifact physical attributes should be compatible with those of the actor, and, in online dating, the visual perception and assessment of physical attractiveness is paired with the central role of personal pictures in this platform; 2) the information of the artifact' attributes are available in a manner compatible with a perceptual system of the actor, and this CMC technology is a visually driven device to perform romantic assessment; and 3) the attributes and the action should be culturally and personally relevant, and, in online dating, the

profiles are individually accessed, but culturally valued, as physical appearance evaluation is performed. The affordance tuning for technology design seems to be more appropriate in Tinder in which users do not need to fill in long questionnaires, and simply go visually during attractiveness assessment to then asking questions to candidates, as it happens during FtF settings.

SOLUTIONS AND RECOMMENDATIONS

As online romantic conversations begin to evolve and take shape, scholars must continue to observe and examine online relational phenomena through the use of online dating apps which have stronger effects on individuals due to its perceived 'naturalness' for its 'proximity'. Through CMC affordances such as the use of emoticons and other tactical punctuations, nonverbal communication plays a crucial role in the development of Internet-based courtship behaviors and romantic online relationships. Online dating and online apps have changed the way that people pursue romantic relationships; it is not only important for scholarly research to understand how users exploit CMC affordances to overcome its limitations as Walther's model proposes, but also it is paramount to include the analysis of how those affordances specifically tune to human perception process making in it more or less 'popular', or more or less 'interactive' which is also part of the market successfulness of any technology, as it can be inferred while trying to answer the question about why video dating did not become as successful as online dating did.

FUTURE RESEARCH DIRECTIONS

Future research should look at how closely online and offline courtship behaviors overlap each other by introducing the affordance tuning conceptualization and nonverbal research. In addition, future research should investigate the communication behaviors that individuals use on online apps compared to face-to-face interactions; for example, Hunt, Eastwick & Finkel (2015) compared the length of acquaintanceship [first impression formation] of 167 couples taken from previous longitudinal studies, and they found a negative interaction between physical attractiveness and the time couples got to know each other (i.e. up to 9 months). In other words, the longer individuals had known each other, the less probability for choosing a mate by the attractiveness criterion, but most likely by psychological similarity such as personality traits. By the contrary, in the online dating context, Ramirez, et al. (2015) investigated what is the association between the amount of time spent online before meeting the potential candidate FtF, a hierarchical regression model was conducted in five dimensions (i.e., intimacy, composure, formality, task social orientation, dominance) where a curvilinear association among the first four was found, and it indicated a significant association to suggests that online daters benefit from the interface if the time period of online interaction is brief. Basically, the longer time spent on online platform decreases the motivation to meet face-to-face because it dampen the perceptions of closeness because candidates start to seek more online information about a candidate. However, there is no longitudinal study that simultaneously includes both dating settings (i.e. FtF and Online) to compare how the manner in which a romantic relationship starts may impact further romantic relationship outcomes in the long term; since the current state of research lacks of this type of study, it is difficult to establish strong claims in favor or against online dating for the long run.

CONCLUSION

As online romantic conversations begin to evolve and take shape, scholars must continue to observe and examine online relational phenomena through the use of online dating apps, which will be the next ubiquitous trend in terms of technology use in the upcoming years due to the wide spread smartphone presence (Gerlich, Drmheller, Babb & D'Armond, 2015). Through the use of personal pictures, emoticons and other tactical punctuations, nonverbal communication plays a crucial role in the development of Internet-based courtship behaviors. The popularity of online Tinder is better calibrated to interpersonal attraction than the values-infused and text-heavy quality of the typical online dating site or app, which places users in a critical shopping mindset rather than an orientation based solely on attraction. Moreover, research on online dating should include interface design understanding to bring in the level of 'affordance tuning' to human sensory system to perform a specific task (i.e. dating) to assess CMC popularity and impact on human behavior.

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KEY TERMS AND DEFINITIONS

Affordances: "The perceived properties of the things that determine just how they could possibly be used" (Norman 1998).

Away Messages: The messages that one uses to indicate that they are away from the computer or unavailable to communicate online.

Computer Mediated Communication: The use of computer or computer technology to communicate with other individuals.

Emoticons: Nonverbal expressions that are expressed via text.

Internet Affinity: The desire to initiate a romantic relationship via the Internet.

Netiquette: The etiquette and manners that individuals use while on the Internet.

Online Dating: CMC technology designed to facilitate romantic relationships initiation by anticipating face-to-face interaction through the access to personal profiles without owners' awareness.

Other World: The notion that something is not real.

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Chapter 37
Online Prosocial Behaviors

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ABSTRACT

Prosocial behaviors in the cyber context (i.e., the internet, text messages) can be traced back to when the internet was just a message board, used to share open source software. Following these early investigations of prosocial behaviors, clinicians recognized that the internet might remove barriers to help seeking. Recent investigations have provided support for the internet as a place to seek help among various populations. Prosocial behaviors in the cyber context also have benefits for the givers as well, including health benefits, personal satisfaction, and reputational increases. This chapter draws on multidisciplinary research to review prosocial behaviors in the cyber context.

INTRODUCTION

Over three billion people use electronic technologies (e.g., cell phones, the internet) everyday (Internet Live Stats, 2016). Although there are many investigations and news stories about negative online behaviors, less attention has been given to positive online behaviors. There are many opportunities to receive help or to perform prosocial acts through electronic technologies. This chapter focuses on online prosocial behaviors. The chapter includes eight sections:

- Section one provides the definition of offline and online prosocial behaviors.
- Section two examines the unique characteristics of the cyber context and how such characteristics are conductive to prosocial behaviors.
- Section three focuses on various online prosocial behavior, including helping through electronic groups, online mentoring, online donations to charities, virtual voluntarism, and helping in other electronic contexts (e.g., social networking sites).
- Section four investigates the value of online prosocial behaviors to the giver and receiver.
- Section five provides theoretical explanations for why people engage in online prosocial behavior.

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- Section six describes solutions and recommendations for organizations wanting to harness electronic technologies for various helping opportunities.
- Section seven presents suggestions for future research on online prosocial behavior.
- The last section provides concluding remarks regarding the chapter.

BACKGROUND

Prosocial behaviors are defined as voluntary acts directed toward people or society (Eisenberg & Miller, 1987). Such behaviors may include helping, sharing, donating, and volunteering. Online prosocial behaviors can take various forms, including donating time and attention to electronic discussion boards and Wikis (e.g., Antin, 2011; Butler, Sproull, Kiesler, & Kraut, 2007), helping among corporate employees (e.g., Duranova & Ohly, 2016), helping players in computer games (e.g., Molyneux, Vasudevan, & de Zuniga, 2015), online mentoring (e.g., Cheng, Hanuscin, & Volkmann, 2016), sharing and contributing to open source software (e.g., Lakhani & Hippel, 2003), virtual voluntarism (e.g., Kim & Lee, 2014), and making charitable donations to organizations online (e.g., Bennett, 2006). There are various characteristics of the online environment that are favorable for helping online.

CHARACTERISTICS OF ONLINE PROSOCIAL BEHAVIORS

Online prosocial behaviors have some characteristics that set them apart from the same behaviors offline. Search engines make it easier to find opportunities to help or receive help online (Sproull, Conley, & Moon, 2013). It is easier to give or receive help online because one's physical appearance or personal attributes do not influence other's opinions (Brennan, Moore, & Smyth, 1992). Individuals can use fake names or screen names and hide their identities online, which reduces stigmas associated with seeking help (Wright & Li, 2012). The online environment offers flexibility to individuals wanting to help or give help, allowing them to give help or receive help even with restricted schedules. There is high controllability over online prosocial behaviors. The online environment allows givers to choose when they want to help and if they want to help again without feeling pressured (Sproull et al., 2013; Wright & Li, 2012).

Although there are noticeable differences between online and offline prosocial behaviors, there are similarities. The relationship between the giver and receiver of prosocial behaviors in either environment can include strangers (e.g., Sproull et al., 2013), friends (e.g., Cornejo, Tentori, & Favela, 2013), and business colleagues (e.g., Duranova & Ohly, 2016). Prosocial behaviors are rewarding for givers in either social context (Butler et al., 2007; Eichhorn, 2008). Furthermore, prosocial behaviors can occur through formal and informal organizational institutions (Wright & Li, 2011). There is typically no expectation of direct reciprocity of prosocial behaviors in offline and online contexts (Sproull et al., 2013).

PROSOCIAL BEHAVIORS IN THE CYBER CONTEXT

This section presents a review of the literature on opportunities for prosocial behaviors via open source software and Wikis, electronic support groups, online mentoring, electronic fundraising and crowdfunding, virtual voluntarism, and other technologies, such as social networking sites (SNS) and online gaming.

Open Source Software and Wikis

Online prosocial behavior began with IBM's sharing of their open source software code and the SHARE user group (i.e., an online association designed to provide technology professionals with continuing education). People can use the internet to volunteer and contribute code, documentation, and technical support to open source projects (Sproull & Kiesler, 2005). In 1991, a Finnish student posted a program on the internet and invited others to contribute their own code. This program was the beginning of Linux. Its development still continues today and is largely voluntary. Other source code information is available for Mozilla, StarOffice, Apache webserver, Python, and the free BSD operating system (Barcellini, Detienne, & Burkhardt, 2009; Raymond, 1999). Some investigations have focused on people's motivations for providing help to open source code projects, with findings revealing that people were more likely to contribute to these projects if they valued the goals of the program and believed their time would benefit themselves and others (Hertel, Niedner, & Herrman, 2003; Lakhani et al., 2003). The sharing of open source software continues into the 2000s with improved technology, such as smartphones and Web 2.0 (Barcellini et al., 2009).

Similar to the sharing of open source software is the contributions people make to Wikis. Wikis or Wikipedias are websites that allow people to collaboratively edit its content (Antin, 2011). Antin (2011) examined the characteristics associated with contributing to Wikis. He found that assumptions about the type of person who contributes to Wiki content, either hacker or geek stereotypes, affect whether people participate. People were more likely to contribute to Wikis when they feel accomplished, felt like they were part of a community, and believed the work allowed them freedom (Kuznetsov, 2006).

Electronic Support Groups

Clinicians recognized that the internet removes the boundaries and stigmas associated with help-seeking often present in the offline environment. Clients can receive support and advice about their illnesses over the internet without the fear of being judged. Although one of the first studies (i.e., Schneider & Tooley, 1986) on online help seeking did not specifically investigate online prosocial behaviors, it was one of the first to examine electronic technologies, specifically computer-based support groups, to help adults quit smoking. This study set the precedence for future investigations on electronic support groups.

Researchers have continued to investigate electronic support groups. In one study, Finholt and Sproull (1990) investigated prosocial acts through electronic groups among cooperate employees. Employees engaged in a variety of prosocial behaviors related to both work and outside of work activities. Research continues to focus on how electronic support groups contribute to employee satisfaction and organizational commitment (Duranova & Ohly, 2016; Ragsdale & Hoover, 2016). Other research has focused on providing support to special populations. In particular, Brennan and colleagues (1992) found that an electronic network helped caregivers of someone with Alzheimer's disease feel supported by individuals "who really understood what they were going through" (p. 668). Similarly, Hassett and colleagues (1992) found that an electronic support group increased disabled individuals' feelings of social support from other community members.

The benefit of social support and help received through electronic support groups has been recognized in other populations as well, including sexual abuse survivors (e.g., Finn & Lavitt, 1994), people living with AIDs/HIV (e.g., Mo & Coulson, 2013), individuals with disordered eating (e.g., Stommel & Meijman, 2011), individuals with epilepsy (e.g., Wicks et al., 2012), caregivers of premature infants

(e.g., Thoren, Metze, Buhrer, & Garten, 2013), parents of children with cancer (e.g., Coulson & Greenwood, 2012), hearing impaired individuals (e.g., Thoren et al., 2011), breast cancer patients (e.g., Chen, 2012), and couples dealing with infertility (e.g., Malik & Coulson, 2010). Findings from these studies revealed that electronic support groups are successful at connecting and supporting individuals within each of these populations. Research has continued to support the benefits of online support groups for various populations.

Online Mentoring

There are advantages for the mentoring of students and underrepresented populations online, such as providing access to professional expertise and assistance that may not be available in the mentees' community (Knapczyk, Hew, Frey, & Wall-Marencik, 2005). Mentor-mentee interactions can occur more frequently and at convenient times online (Ensher, Thomas, & Murphy, 2001). The online mentoring process also offers greater privacy and anonymity.

Given that women are underrepresented in technology related fields, like science and engineering, Bennett and colleagues (1998) hypothesized that online mentoring may be beneficial to female adolescents interested in these fields. Their findings revealed that female adolescents felt supported by their mentors and that their confidence had increased. Studies examining online mentoring provide support for improving the professional development of mentees through online mentoring programs (Cheng et al., 2016; Hooley, Hutchison, & Neary, 2016; McAleer & Bangert, 2011). Online mentoring has been used for various populations, such as college students (e.g., Barczyk, Buckenmeyer, Feldman, & Hixon, 2011), new teachers (e.g., Hutchison & Colwell, 2011), women entering management positions (e.g., Loureiro-Koechlin & Allan, 2010), adjunct faculty (e.g., Rogers, McIntyre, & Jazzar, 2010), and mental health professionals (e.g., Lee & del Carmen Montiel, 2010). These studies support the use of online mentoring.

Electronic Fundraising/Donating

With the increasing availability of the internet, it has become a convenient method to make and collect charitable donations. The American Red Cross raised $1.3 million for the Kosovo crisis through their website and $110 million was raised through online donations to help the victims of the September 11 attacks (Waters, 2007). Donations raised online for the 2004 Asian Tusanmi exceeded those raised through traditional methods (i.e., calling to pledge money). After the 2010 Haiti earthquake, the donations raised online or through text messages exceeded $30 million within the first month (Heath, 2010). Other researchers have examined the motivations behind donating to electronic charities. Olsen and colleagues (2001) found that successful nonprofit organizations raised funds by expressing to the donors how the gifts will help specific people. Furthermore, Bennett (2006; 2009) and Eller (2008) found that holding a positive attitude toward a population in need and having prior knowledge of the population were related to donating more money to that population.

Another mechanism for online donations is crowdfunding. Crowdfunding involves raising money from the general public to fund a project (Chen, Thomas, & Kohli, 2016). It works by having someone initiate the idea or project to be funded (Ordanini, Miceli, Pizzetti, & Parasuraman, 2011). Next, individuals support the idea and then the system for collecting donations brings these people together to execute the idea or project. There were $5.1 billion raised in 2013 through crowdfunding (Broderick, 2014).

Regardless of where money is donated, people are making monetary contributions online to man-made and natural disasters, projects, and ideas.

Virtual Voluntarism

Many websites advertise various online voluntarism opportunities (Spencer, 2002). One of the first investigations to examine virtual voluntarism, the Virtual Volunteering Project, assessed the experiences of almost 200 agencies (Cravens, 2000). Findings from the project revealed that clearly written task descriptions and good communication are essential for keeping volunteers engaged with the organization. Haase and colleagues (2002) further investigated the characteristics of individuals who participated in virtual voluntarism. Volunteers were typically well educated, watched less television, and engaged in an active lifestyle. Other researchers (e.g., Butler et al., 2007) have examined ways to keep volunteers active through online organizations, with findings revealing that websites should be easily accessible to volunteers and that organizations should make their opportunities more fulfilling for volunteers.

Some researchers have considered how organizations can harness the power of social media for virtual voluntarism. In one study, Raja-Yusof and colleagues (2016) examined the activities that volunteers engaged in via social media. The major activity was knowledge sharing, with less time spent on training, fundraising, and problem-solving. Other research has focused on volunteer characteristics. In particular, Kim and Lee (2014) found that social capital and subjective norms predicted volunteering via SNS. The popularity of SNS has created many opportunities for volunteering. Furthermore, organizations should understand how they can attract and maintain volunteers committed to their organizational mission.

Other Electronic Technologies

The popularity of SNS, such as Facebook and Twitter, and online games has generated researchers' interest in prosocial acts through these technologies. Some investigations have provided evidence that gamers are more likely to help other players when they are altruistic and engage in offline prosocial behaviors (Ferguson & Garza, 2011; Molyneux et al., 2015; Wang & Wang, 2008). Sudzina, Razmerita, and Kirchner (2011) found that playing online games helped alleviate daily stress when these individuals received help through Facebook games. Other investigators have examined broader forms of online prosocial behaviors. For instance, face-to-face prosocial behaviors was associated positively with prosocial behaviors via SNS, chat programs, email, and text messages (Wright & Li, 2011).

VALUE OF ONLINE PROSOCIAL BEHAVIORS

There are benefits of online prosocial behaviors to the receiver. For example, receivers report health benefits from their participation in online support groups (e.g., Brennan et al., 1992), feel stress relief after receiving online gifts through Facebook games (e.g., Sudzina et al., 2011), and receive support and gain confidence from online mentors (e.g., Loureiro-Koechlin & Allan, 2010). Receivers benefit from the creation of relationships with users in online communities (Cummings et al., 2002). These online relationships offer receivers social support and advice. There is also evidence that online prosocial behaviors benefit the helper. Helpers gain personal satisfaction and support within their online communities and health benefits through virtual voluntarism (e.g., Butler et al., 2007; McAleer & Bangert, 2008;

Mukherjee, 2010). Furthermore, contributors to open source software support groups reported learning and reputational benefits after helping others with questions (Hertel et al., 2003; Lakhani & Hippel, 2003).

THEORETICAL FRAMEWORKS

Social Cognitive Theory

The social cognitive theory suggests that online prosocial behaviors are learned by observing other people (Bandura, 1977). Newcomers may visit a discussion group for a while before posting, allowing them to get an idea about what messages are viewed as helpful. This information is then utilized when posting messages. If the post is rewarded with praise, newcomers might further contribute to the community. Supporting this idea, McKenna and Bargh (1998) found that a positively evaluated response contributed to newcomers' active involvement in the electronic discussion group. Positive reinforcement encourages contributions to the electronic community.

Co-Construction Theory

The co-construction theory was proposed to explain the construction of offline and online identifies. Adolescents construct their online identities similar to their offline identities (e.g., Boneva, Quinn, Kraut, Kiesler, & Shlovski, 2006; Huffaker & Calvert, 2005; Whitlock, Powers, & Eckenrode, 2006). The co-construction theory has been applied to online prosocial behaviors. Wright and Li (2011) explained that online prosocial behaviors occur because people generalize their prosocial disposition to the digital environment.

Both the social cognitive and co-construction theories explain why individuals engage in and experience online prosocial behaviors. Both theories provide a valuable framework for understanding the continued involvement in prosocial behaviors and under which conditions people ask for help online.

SOLUTIONS AND RECOMMENDATIONS

While online prosocial behaviors may not receive as much attention as harmful online behaviors, these behaviors are important to society. Online prosocial behaviors are important and need to be recognized for their benefits. The quality of help received online is an important factor for organizations to consider. In their review of prosocial behaviors through electronic discussion groups, Sproull and colleagues (2013) argued that the quality of help received online should be examined as it might help determine the value to the helper and receiver. Bad advice does not benefit the receiver and it can ruin the helper's reputation. Receiving good advice may relate to the desire to seek help again and determine whether individuals will give advice at another time. Online prosocial behaviors can promote social justice, assist individuals in need, heal and help the wounded, and elevate the level of good in the world. As such, online prosocial behaviors should be recognized for its benefit and promoted.

FUTURE RESEARCH DIRECTIONS

Most research on online prosocial behaviors is cross-sectional. Consequently, changes overtime in online prosocial behaviors are not well understood. Understanding attributional patterns of the helper and receiver is another important direction as attributional patterns relate to future behaviors. Such a research direction might allow researchers to predict when individuals will ask for help and when individuals will give help online.

Individual differences are also important to consider in regard to online prosocial behaviors. Certain characteristics, such as those with high social and emotional competence, empathetic concerns, self-esteem, and the desire to be part of the group may help to explain why individuals act prosocially online. Cultural values may also be important to consider. Collectivism may encourage online prosocial behaviors to maintain group cohesiveness, whereas individualism may encourage the use of online prosocial behaviors to achieve personal goals. Cross-cultural and intra-cultural investigations linking cultural values to online prosocial behaviors may shed light on the characteristics associated with such behaviors.

CONCLUSION

There are a variety of opportunities to help and receive help in the multi-faceted online environment, including contributing to open source software and Wikis, online mentoring, virtual voluntarism, online donating/fundraising and crowdfunding, and providing support or receiving support through online support groups. People act prosocially toward others or ask for help online for a variety of reasons. Although research on online prosocial behaviors is developing, many areas await investigation. Online prosocial behaviors balance individuals' online experiences.

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KEY TERMS AND DEFINITIONS

Co-Construction Theory: This theory proposes that people's identities are constructed in similar ways online and offline.

Online Donating/Fundraising: Online donating and fundraising involves raising money or accepting donations via electronic technologies and the internet.

Online Mentoring: Online mentoring involves someone (the mentee) receiving knowledge on a topic or career via electronic technologies and/or the internet by an expert (the mentor).

Online Prosocial Behaviors: Online prosocial behaviors involve helping, sharing, donating, and volunteering that is carried out via electronic technologies and the internet.

Online Support Groups: Online support groups allow people with the same challenges to connect via electronic technologies and/or the internet.

Open Source Software: Open source software is software in which the source code is available to others for modification or enhancement.

Prosocial Behaviors: Prosocial behaviors are acts that involve helping, sharing, donating, and volunteering.

Social Cognitive Theory: This theory states that people's knowledge and behaviors are related to their observations of others.

Virtual Voluntarism: Virtual voluntarism involves using electronic technologies and/or the internet to assist an organization.

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Chapter 38
Online Social Networking Behavior and Its Influence Towards Students' Academic Performance

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ABSTRACT

Online social networking (OSN) is an online application that has grown rapidly in prevalence and popularity in recent years. This chapter synthesizes the literature review concerning use of OSN in school, college, and university, and academic performance of students. It offers definitions of OSN, followed by the status of current knowledge about the use of OSN and academic performance of students. Based on the secondary sources, it concludes the entry with recommendations for future research direction on the relationship between use of OSN and academic performance.

INTRODUCTION

Online social networking (OSN) is an online application that has grown rapidly in prevalence and popularity in recent years. Millions of Malaysian youngsters, teenagers, students (either at school, college or university's level) use OSN websites such as Facebook, Twitter, Myspace, Friendster and LinkedIn every day. Besides, Malaysian higher education also has adopted OSN on a wider scale and young Malaysians are very active users of OSN (Zakaria, Watson, & Edwards, 2010). In other words, the use of online social network has become necessary among younger generation.

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The emergence of online social network has become a major trend over the years with growing popularity amongst the younger generation (Onuoha & Saheed, 2011). When online social networking becomes more popular, literature, however, suggests that there is an ongoing debate on the role of online social networks in the academic performance of users.

This article synthesizes the literature review concerning use of OSN in school, college and university, and academic performance of students. It offers definitions of OSN, followed by the status of current knowledge about the use of OSN and academic performance of students. Based on the secondary sources, it concludes the entry with recommendations for future research direction on the relationship between use of OSN and academic performance.

BACKGROUND

Online social networking sites (OSNs) are websites that give users a range of services based on web technologies that allow individuals to build a public or semi public profile with relationships system, have a list of other users with whom they share a connection, and finally, view and navigate through the list of users' connections with those who share a connection in the system (Boyd & Ellison, 2007).

OSNs are also defined as a range of activities enabled by social technologies or social media tools include blog, microblog, wiki, social networking site, video sharing site and online discussion board or forum, and operationalized by a group of people (Hamid et al., 2009). It enables users to socialize and create networks online. Examples of OSNs that are used on a regular basis by millions of people nowadays are Facebook, Twitters, MySpace, Friendster, Youtube and Skype. Ahmed and Qazi (2011) meanwhile cited that, the most successful and largest social networking site is Facebook with more than 500 million members had been found as active users of Facebook in July 2010. In Malaysia, social interaction in cyberspace by using social networking has been adapted by many people and has changed their communication (Mustafa & Hamzah, 2011).

We define online social networking as the latest online communication tool that allows users to create a public or private profile to interact with people in their networks, share their profile information, communicate with others, and share data and information within that system.

The social technologies can support interaction among students by allowing them to actively participate in a discussion. The students can work collaboratively in an online social environment to solve problems with their peers, or to organize social events. The collaborative production's principle embedded in social technologies enable learners and teachers to share and publish artifacts produced as a result of the learning activity (for example, course materials such as course syllabus, course notes and assignments). In this regard, the use of social technologies has changed the demand of education.

Online social networking can be classified into five categories (Fraser & Dutta, 2008), namely, (i) egocentric networks - act as a platform to build a network of friends; (ii) web communities - collecting members with identity ties based on interest, gender, race, nation, religion and others; (iii) opportunistic web – the members gathered for business purpose or professional relationship using OSN site such as LinkedIn; (iv) passion-centric network – gathered people who share interests or hobbies (communities of interest); and (v) media-sharing site – this site is defined based on its contents (such as Youtube for those who want to share videos).

Students are increasingly using these social networks for friends' news feeds, personal updates, events and activities, notes, and messages. According to Michael, Robyn and Kate (2013) the widespread use of media among college students from texting to chatting on cell phones to posting status updates on Facebook may be taking an academic toll. They found media use, in general, was associated with lower grade point averages (GPAs) and other negative academic outcomes. Thus, this has led to a rise of below question:

Can the extensive use of OSNs in the younger generation affect students' academic performance?

The issue of whether OSN give positive or negative impact on students' academic performance is often dependent on the larger issues identified with the overall use of OSN sites such as individual self-discipline and self-regulation (behavior in terms of time spent on- and off-line), psychological effects and user adaptability (Egedegbe, 2013).

STUDENTS' PRACTICES OF OSN AND BEHAVIOR

The most used features by OSNs users are: uploading and sharing photos and videos, comments on other profiles, friends and private messages between users. In this context, users of OSN sites also share a number of documents, and interact and communicate with each other. What makes the OSNs unique, not because they allow students or users to meet others in the network, but because they make possible for students to manage and make visible their own social network (Fardoun et al., 2012).

The teenagers and youth especially students have embraced online social networking as one method to connect with their friends, share information and showcase their social lives (egedegbe, 2013). In general, the students spend a lot of time on OSN sites creating their profile, doing research concerning their academic assignments or works, chatting with friends and posting pictures of event they attended. Young et al. (2009) found that students keen on interacting with others in order to exchange information about their interests, to discuss about interesting or new topics and follow news about certain topics on OSN sites.

USE OF ONLINE SOCIAL NETWORKING

Online social networking can be regarded as a platform allowing teachers and students to communicate and collaborate on school subjects and projects outside the classroom (Khedo et al., 2012). According to Khedo et al. (2012), teachers can post school related works on these online communities and students can enrich their learning experiences by teaming up with their class mates to work on assignments and projects. These networks can also go beyond the classroom walls by uniting multiple classrooms from different schools, thus creating a richer environment for collaboration and knowledge sharing.

Hamid et al. (2011) have investigated the impacts of the use of OSN on enhancing student engagement and interaction from the students' perspectives. Their findings revealed that students showed positive inclination towards the use of OSN in facilitating their learning. The OSN benefited the students in enhancing their engagement and interaction, in promoting critical thinking, discovering new knowledge, tracking their own learning progress and being a platform to be more vocal.

In general, benefits of OSN use for students' education purpose among others are as follows:

1. The use of OSN has significant potential to support and enhance in-class teaching and learning (Arnold & Paulus, 2010; Techehaimanot & Hickman; 2010; Kabilan et al., 2010);
2. Increase student interaction with other students and their lecturers via electronic medium;
3. Increase student-to-student and student-to-lecturer interaction outside of traditional class time (Arnold & Paulus, 2010; Gray, Chang, & Kennedy, 2010);
4. Increase students' satisfaction with the course;
5. Improve students' learning and writing ability;
6. Provide greater access to information and information sources.

Other benefits associated with the use of OSN for other purposes are (Mozee, 2012; Connolly, 2011; Zwart et.al, 2011; Rosen, 2011):

1. Encouraging creativity among and between individuals and groups;
2. Creating a sense of belonging among users of common social media tools;
3. Providing more choices to promote engagement among different individuals and groups;
4. Reducing barriers to group interaction and communications such as distance and social or economic status;
5. Increasing the technological competency levels of frequent users of social media.

According to Rosen (2011), the daily use of all online social media technologies for those born between 1965-1979 (Generation X) consumed approximately 13 hours of social media per day; those born between 1980-1989 (Net Generation or Generation Y) consumed approximately 19 hours of social media per day; and those born between 1990-1999 ('I Generation') consumed approximately 20 hours of social media per day.

ACADEMIC PERFORMANCE

There has been considerable discussion regarding the frequent use of OSN sites by high school and college students, and the possible effect of those tools on students' academic performance (Connolly, 2011; Hargittai & Hsieh, 2010; Karpinski, & Duberstein, 2009). With the increased number of young users, it is presumed that OSNs may have some impacts on college students' academic performance, lifestyle, and personal development (Tham & Ahmed, 2011). The frequent involvement of students (at school, college and university level) who constitute a huge percentage of young people in online social networking has, however, led to deliberations on how their academic performance could be affected due to their taking part in this activity.

Based on their findings, Onuoha and Saheed (2011) recommends that: (1) for students who find the use of online social networks distracting to academics, there is need to reduce the time spent on these networks; and (2) time spent on online social networks should be devoted more to academic than social matters in order to make maximal use of its education potentials.

Academic performance usually appears in research into education and educational psychology (Rouis, Limayem, & Salehi-Sangari, 2011). According to Rouis et al., there are two main approaches that offer different visions of academic performance, that is, (i) approaching a specific goal but avoiding adverse outcome offers an alternative, and (ii) goal achievement focused on the task or final results (Valle et al., 2009). Since OSNs use is considering as a leisure activity that interrupts students' academic performance, an effect is presumed on students' overall academic results or grades of the students. In this context, the conceptualization of academic performance is results focused, and therefore focuses only the final results or grades of the students.

THE RELATIONSHIP BETWEEN THE USE OF OSN AND ACADEMIC PERFORMANCE

There is a growing concern whether OSN use is contributing to a decline in academic performance by school, college or university students. Many students stated sparing time with media or online social networking sites take away time from completing homework. This issue can be viewed as a form of displacement. Students saw OSN use as being a hindrance to academic performance when it displaced the quantity of time spent studying. Karpinski (2009) showed that college students who use Facebook often spend less time studying and have lower grade point averages (GPAs) compared to students who have not signed up for the social networking website. Thus, the relationship between the use of OSN and academic performance of student is one issue that is essential to be measured based on various degrees the level of OSN use and the academic performance level of the user.

Regard to the relationship between the use of OSN and academic performance, the findings of some past studies are listed as following:

- Stollak, Vandenberg, Burklund, and Weiss (2011), Rouis, Limayem, and Salehi-Sangari (2011), Karpinski and Duberstein (2009), and Canales, Wilbanks, and Yeoman (2009) found a negative effect; that is, higher use of OSN typically leading to lower academic performance as measured by grades;
- Ahmed & Qazi (2011) and Hargittai and Hsieh (2010) found either no-to-little relationship between the use of OSN and student academic performance;
- Pasek and Hargittai (2009), Junco, Heibergert, and Loken (2011), and Rizzuto, LeDoux, and Hatala (2009) found a positive effect; that is, the use of OSN leading to an increase in student academic performance;
- In his article, Social Networks in Nigeria, Oche (2010), stated that the recently released results for the National Examination Council (NECO) showed that 87% of the candidates failed English Language and Mathematics which the author attributed to use of Facebook;
- Vanden Boogart (2006), in a similar study also found out that lower GPAs is associated with heavy use of Facebook (i.e., more time spent on Facebook);
- Kolek and Saunders (2008) in a study of students from a public Northeast research university found out that there was no correlation between Facebook use and GPA;
- Hahhad M. (2013) study using sample which consisted of undergraduate students enrolled in fall 2012 courses at California State University of Monterey Bay concludes that there was a weak correlation between GPA and time in regards to the three variables age, gender and major;

- Junco (2015) in his recent studies on undergraduate students showed that seniors spent significantly less time on Facebook and spent significantly less time multitasking with Facebook than students at other class ranks. Time spent on Facebook was significantly negatively predictive of GPA for freshmen but not for other students. Multitasking with Facebook was significantly negatively predictive of GPA for freshmen, sophomores, and juniors but not for seniors.

Other factors that are also should be considered on measuring the relationship of OSN and students' academic performance include the frequency and intensity of social media usage; the personality type of the social media user (for example, extroverted, introverted); the socioeconomic and cultural background of the user; the ability of the user to self-regulate their behavior in terms of time spent on- and off-line; the differences among the social networking sites in terms of their content, purpose, and structure; and the academic ability of the social media user (Mozee, 2012).

CONCLUSION

Online social networking sites are not only emerging as important tools in today's schools, but they also provide very popular out-of-school computer activities among students and/or young adults. It represents a potential technology that can be exploited to enhance learning in order to help students in their education. The academic performance can have long-term consequences for society and the individual in terms of overall quality of life (Phusavat, Ketsarpong, Ooi, & Shyu, 2012). The research literature indicated that for some students the use of social media can be beneficial and/or harmful to their academic performance, and for other students it appears to have no effect. The school teachers and college and university's lecturer need to look at the relationship between students' practices on social network sites and their academic learning, and to keep creating a vision of continual technology integration in their classrooms (Greenhow & Burton, 2011). Online networks can be used for academic purposes such as peer-to-peer knowledge sharing and collaboration. In this respect, the school teachers and college or university's lecturer need to recognize the power of OSNs in college students' academic learning. In future, using mixed methods educators could understand how online social networking changes their educational attainment and students' academic performance.

FUTURE RESEARCH DIRECTIONS

Future research should (1) identify the level use of OSN among students; (2) examine the effect of of OSN' use to academic performance as measured by grades; and (3) investigate the relationship between the use of OSN and student academic performance.

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KEY TERMS AND DEFINITIONS

Academic Performance: The academic performance is defined by students' reporting of past semester CGPA/GPA and their expected GPA for the current semester. The grade point average or GPA is now used by most of the tertiary institutions as a convenient summary measure of the academic performance of their students. The GPA is a better measurement because it provides a greater insight into the relative level of performance of individuals and different group of students.

Facebook: Facebook is a popular online social networking site or service that offers an online platform on which users create profiles, generate and share contents and information, and interact with other contacts.

Friendster: Friendster is an online social network site where we can meet people online, find new and old school friends and play games.

MySpace: MySpace is online social networking sites that allow users to create webpages to interact with other users. Then, users are able to create blogs, upload videos and photos, and design profiles to showcase their interests and talents.

Online Social Networking Sites: Online social networking sites (OSNs) generally refer to Internet-based locations that allow individuals and groups to interact. Specifically, it refers to those Internet-based services that: promote online social interaction between two or more persons within a bounded system for the purposes of friendship, meeting other persons, and/or exchanging information; contains a functionality that lets users create public or semi-public personal profile pages that contain information of their own choosing; serves as a mechanism to communicate with other users; and contains mechanisms that allow users to search for other users according to some specific criteria. Examples of the most visited OSNS are Facebook, Twitter, Youtube, Friendster, Myspace, and LinkedIn.

Online Social Networking: Online social networking is defined as the latest online communication tool that allows these users to create a public or private profile to interact with people in their networks.

Social Media: Technologies that facilitate social interaction, make possible collaboration, and enable deliberations across stakeholders.

Twitter: Twitter is an online social networking and microblogging site or service that enable users to send and read tweets (text messages).

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Chapter 39
Parental Mediation of Adolescent Technology Use

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ABSTRACT

Adolescents are major consumers of interactive technologies (e.g., cell phones, social media). They are motivated to use these technologies to maintain their social relationships in a convenient and private way. The private nature and ease of connectivity afforded by interactive technology has resulted in various parental concerns (e.g., victimization, content) about adolescent technology use. To mitigate these parental concerns, some parents have begun to implement parental mediation strategies. Research has primarily focused on describing the different parental mediation techniques parents implement, parent and adolescent perceptions of parental mediation, and potential barriers to the implementation of parental mediation.

INTRODUCTION

Adolescence is a developmental time period marked by physical (e.g., puberty), psychological (e.g., identity formation), and psychosocial (e.g., negotiation of parent-child relationships) changes (Erikson, 1950, Grotevant & Cooper, 1986). Puberty is typically seen as the beginning of the adolescent developmental time period, although there is some disagreement regarding when adolescence ends (Bynner, 2007). Hall (1904), an early developmental scholar, posited that adolescence continued into the early twenties, and some current scholars have supported this proposition because the developmental tasks of adolescence are continuing into the mid-twenties (Shwartz, Côté, & Arnett, 2005). Consistent with these historical and contemporary conceptualizations (Bynner, 2007; Hall, 1904; Shwartz et al., 2005), in this chapter adolescence is defined as the time period between the onset of puberty and until the individual reaches their mid-twenties.

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Contemporary adolescents have grown up with access to a variety of technologies. The majority of adolescents (13-17 years old) in the United States have access to cell phones (88%) and computers (87%), and 92% of adolescents report going online daily (Lenhart, 2015). Adolescents are the most frequent users of social media and 71% report using more than one social media site (Lenhart, 2015). Parents, too, are technology consumers with 91% reporting that they use the internet and 83% using social media. Technology appears to have become a normative aspect of family life, but parents and adolescents use technology differently (Vaterlaus & Tulane, 2015). Parents primarily use technology for instrumental purposes (e.g., cell phones to track location of child), while adolescents use technology for social reasons (e.g., cell phones to build social relationships).

As interactive technologies (e.g., cell phones, social media) have become a common feature during adolescence, parents have reported concerns about these technologies. Concerns about adolescent technology use have included worry about the potential psychological outcomes from viewing content (e.g., violent or pornographic), the risk of victimization, and access to illegal activities (e.g., illegal file sharing; boyd & Hargittai, 2013). Because of these concerns for children and adolescents, some limited government policy has emerged regulating website use among minors (Costello, McNiel, & Binder, 2016). For example, the United States' Children's Online and Privacy Protection Act (COPPA; Federal Trade Commission, 2016) requires parental permission for websites/online services to collect or use personal information from children under the age of 13. This particular policy has been criticized because it does not account for the privacy risks for adolescents older than 13 (Costello et al., 2016) and it is difficult to regulate with minors commonly falsifying their ages to access websites (O'Keeffe & Clarke-Pearson, 2011). "As legal regulations in this [technological] sphere are difficult to formulate and enforce, policy makers rely substantially on increasing risk awareness among parents and delegating to them the responsibility for protecting children from online risks." (Kirwil, 2009, p. 394). To mitigate the potential negative effects and facilitate the potential positive effects of adolescent interactive technology use, some parents have made attempts to be involved in their adolescents' technology use. These parental attempts have been researched under the term *parental mediation*, which refers to parental interventions and interactions with their adolescents regarding technology use (Livingstone & Helsper, 2008; Vaterlaus, Beckert, Tulane, & Bird, 2014).

BACKGROUND

The early research on parental mediation focused on parent's attempts to mediate children's television viewing (Austin, 1990; Nathanson, 1999). Dr. Amy Nathanson (Nathanson, 1999), of The Ohio State University, has been a leader in identifying the methods parents have used to mediate children's television viewing. Dr. Sonia Livingstone (Livingstone & Bober, 2006), of the London School of Economics and Political Science, is a pioneer in researching the role of parental mediation with interactive technologies—publishing on parental mediation of children and adolescent's internet use. Additionally, Dr. Laura Padilla Walker and Dr. Sarah Coyne (Padilla-Walker & Coyne, 2011), of Brigham Young University, have made recent contributions to the understanding of the implementation of parental mediation with adolescent interactive technology use.

The evolution of technology has led to technological convergence, which allows a single media source to be accessed from several devices. Brooks-Gunn & Donahue (2008) explained:

Thanks to convergence, a teen can watch a television show on a computer long after the show has aired on television and can use a cell phone to surf the internet. Children, particularly adolescents, thus have almost constant access to media—often at times and in places where adult supervision is absent. (p. 3)

Because interactive technologies facilitate private access to a variety media and digital social opportunities, parents have voiced their concerns about adolescent interactive technology use (Boyd & Hargittai, 2013) and some have sought ways to reduce the potentially negative effects of adolescents use through parental mediation (Livingstone & Helsper, 2008; Vaterlaus et al., 2014). The term parental mediation represents several different strategies for parental involvement in adolescent technology use. It is important to note that not all researchers in this area of study have adopted the term parental mediation. For example, some prefer "proactive media monitoring" because the implemented parental strategies "may not mediate media effects rather, they may prevent them from occurring in the first place or may protect [adolescents] against them" (Padilla-Walker, Coyne, Fraser, Dyer, & Yorgason, 2012, p. 1154). Regardless of the broader term used to describe parental involvement in their children's technology use, researchers have identified congruent strategies parents use which include: active mediation, restrictive mediation, and co-viewing (Livingstone & Helsper, 2008; Nathanson, 2001). This chapter summarizes different parental mediation strategies, details parent and adolescent perceptions related to parental mediation, and explores the challenges in implementing parental mediation.

CURRENT SCIENTIFIC KNOWLEDGE IN PARENTAL MEDIATION

Parental Mediation Strategies

Parental mediation of adolescent interactive technology use has been investigated with both quantitative (Livingstone & Helsper, 2008) and qualitative (Vaterlaus et al., 2014) research methods. The term parental mediation is representative of a range of strategies parents use to influence their adolescent's technology use. Nathanson's (1999, 2001) early work with parental mediation and children's television viewing provided some broad strategies that parents implement, which include: (a) active mediation, (b) restrictive mediation, and (c) co-viewing. Parents implement variations of these television parental mediation strategies for adolescent interactive technology use (Livingstone & Helsper, 2008; Vaterlaus et al., 2014). The adapted parental mediation strategies for adolescent interactive technology use can be discussed in terms of active mediation, restrictive mediation, and monitoring strategies.

Active Mediation

The process of active mediation has been described as parents engaging adolescents in "discussions regarding questionable content in the media, and offer[ing] strategies and ways in which children might be more aware of this content, or might avoid it" (Padilla-Walker et al., 2012, p. 1154). At the heart of this strategy is parent-child discussion. The parental mediation strategy of co-viewing (e.g., watching television with a child; Nathanson, 2001) or co-use may not intuitively fit within broad category of active mediation because co-use could include little discussion. Livingstone and Helsper (2008) provide support for inclusion of co-use within the category of active mediation:

Parents and children may watch television together with little conversation (i.e., co-use), perhaps with the parent also reading the paper while the child does their homework in front of the screen. However, to sit together in front of the computer while the child goes online, or even to be in the same room, makes co-use more active, for conversation about the online activity, including interpretive or evaluative comments or guidance, is more likely. (p. 589)

Livingstone and Helsper (2008) reported that active mediation was the most widespread technique parents ($n = 905$) implemented for mediating adolescent internet use. Active mediation was evidenced by parents talking to their adolescent about their internet use or by watching the screen and staying in the vicinity of the computer while the adolescent was on the internet. Vaterlaus and colleagues (2014) asked parents ($n = 80$) and adolescents ($n = 113$) to describe how parents mediated adolescent interactive technology use (i.e., internet and cell phone use). Parents and adolescents reported that the second most frequent mediation technique was active mediation—parents mediated by asking their adolescent who they were communicating with or what they were accessing via technology. Participants also indicated that parents were friends with their children on social media sites and in some instances used the internet together. Padilla-Walker and colleagues (2012) reported in their longitudinal study that active mediation was the most common approach among a sample of 276 of mother-adolescent dyads, but the mother's use of the strategy decreased as the adolescent aged. Parenting qualities were found to be predictive of the use of active mediation in a study with 478 families (Padilla-Walker & Coyne, 2012). Parents who demonstrated connection (e.g., responsiveness to adolescents needs) and regulation (e.g., emphasize the importance of rules) were more likely to implement increased levels active mediation when compared to other parents.

Restrictive Mediation

Parents who use restrictive mediation block access to interactive technology or implement limits on adolescents interactive technology use (Vaterlaus et al., 2014). In a qualitative study, parents and adolescents reported that restrictive mediation included preventing adolescent ownership of cellphones or blocking specific features (e.g., text messaging, apps) on technology (Vaterlaus et al., 2014). Others reported implementing content (e.g., internet filters), time (e.g., internet access blocked after a certain time), and location restrictions (e.g., computer located in a public place). Padilla-Walker and Coyne (2011) identified that parents who had the parenting quality of regulation (e.g. emphasize the importance of the rules) implemented higher levels of restrictive mediation. Also, in a longitudinal study with mother-adolescent dyads, Padilla-Walker and colleagues (2012) found that restrictive mediation strategies decreased as the adolescent aged.

Livingstone and Helsper (2008) discussed restriction in terms of interaction restriction (i.e., preventing peer-to-peer social facilitation through technology by banning email, instant messaging, or like features) and technical restriction (i.e., blocking activities through the use of filters or parental controls). The practice of restricting interactions was the only parental mediation technique Livingstone and Helsper (2008) identified that was associated with decreasing adolescents' online risks. The researchers cautioned that the sociability facilitated by the internet is a major appeal among adolescents, so blocking interactions may be keeping "teenagers safe at a cost" (p. 597). Lee (2013) identified similar benefits for the implementation of restrictive mediation with Korean mother-adolescent dyads ($n = 566$). Maternal

implementation of restrictive mediation was associated with decreased time spent online and lower online risks among adolescents.

Monitoring

The practice of monitoring is defined as "checking up on the child's [internet] activity, covertly or overtly, after use" (Livingstone & Helsper, 2008, p. 589). This was the most frequently reported parental mediation technique in the Vaterlaus et al. (2014) study—participants reported that monitoring involved parents checking adolescents' digital footprint, which included checking things like internet history, text messages, and pictures. In terms of cell phone use parents and adolescents specifically talked about parents monitoring the number of minutes and amount of data used on the cell phone bill. In their comparison between online risks and various parental mediation strategies, Livingstone and Helsper (2008) found no significant relationship between monitoring internet use and decreased online risks for adolescents. Further, there is some evidence that the more parents monitor adolescent internet use the more adolescents do to prevent parent's attempts to uncover their online activities (Livingstone & Bober, 2006).

Perceptions of Parental Mediation

Parent-Adolescent Discrepancies

Differences have been documented in reports of parental mediation of adolescent internet use between parents and adolescents in the same household (Livingstone & Bober, 2004; Wang, Bianchi, & Raley, 2008). Vaterlaus and colleagues (2014) asked parents and adolescents to report the implementation of parental mediation of adolescent internet use within the same household. Mothers and fathers reported significantly more parental mediation of adolescent internet use when compared to their adolescents' reports. Similarly, Fletcher and Blair (2014) reported that some families experience conflicted parental authority when technology rules are not clearly communicated to the adolescent—resulting in parents and adolescents having different perspectives of parental mediation of adolescent technology use. Livingstone and Bober (2004) postulated that these differences between parents and adolescents may result from generationally different perceptions of the technology rules in the household. Parents may report the official rules without addressing the potential exceptions, while adolescents interpret the rules differently because of the exceptions granted by parents. Adolescents seem to follow their own interpretations of parental technology rules.

Privacy, Authority, and Trust

Parents and adolescents have different perspectives regarding the purpose and use of interactive technologies (Vaterlaus & Tulane, 2015). Oksman and Turtiainen (2004) reported discrepancies between Finnish parents' and adolescents' motivations for cell phone ownership. Parents view adolescent cell phone ownership as a way to increase security (e.g., monitoring teen's location) and adolescents are motivated by wanting to use the device to stay in contact with their friends. New technologies are often preferred by adolescents because of the privacy they afford. For instance, Oksman and Turtiainen (2004) concluded, "For teenagers, text messaging is a quiet and simple way to maintain their social network

without their parents' knowledge" (p. 336). Adolescents may oppose parental mediation strategies because the practice could be perceived as a violation of privacy:

Children relish the opportunities the internet affords them—for identity play, relationships, exploration and communication—and may not wish to share this experience with their parents. (Livingstone & Bober, 2004, p. 43)

Granting adolescents access to interactive technology and then implementing parental mediation could also be perceived as a violation of parental trust. Vaterlaus and colleagues (2014) qualitatively explored adolescents' perceptions of parental mediation practices. Approximately half of the adolescents (47%) indicated that parents had the authority and responsibility to mediate their adolescents' interactive technology use, but then explained how parental trust needed to be part of the equation. Adolescents clarified that parental mediation techniques should be implemented when an adolescent gained access to a new technology and then mediation practices should decrease as the adolescent gained parental trust. Adolescents also recommended that parents communicate with them openly about parental mediation and include adolescents in establishing the parental mediation practices in their home.

Challenges in Parental Mediation

Digital Generation Gap

Parents do experience challenges in their attempts to regulate their youth's media use because of the privacy afforded by new technologies and the technological expertise required with the evolving technologies (Livingstone & Helsper, 2008). Vaterlaus and Tulane (2015) concluded that there are generational differences between parents and adolescents in their conceptualizations of the purpose and use of technology (e.g., instrumental vs social purposes), where they learn about technology (e.g., parents often rely on children to teach them), and in knowledge of how to use technology. A difference between parents and adolescents in knowledge about how to use technology is referred to as a digital generation gap (Livingstone, 2003, Vaterlaus & Tulane, 2015). One study documented that late adolescents ($n = 555$) perceived that they knew significantly more about how to use interactive technology (i.e., cell phones, social networking, email, and video chat) than their parents (Vaterlaus, Jones, & Tulane, 2015). Parents ($n = 604$) in the study also rated their own knowledge about interactive technologies significantly lower than their late adolescents' knowledge.

The presence of a digital generation gap could challenge the traditional top-down (parent to child) socialization patterns in families, which may make it challenging to implement parental mediation strategies (Correa, 2014). Parents often report that they do not know what their children are doing online and feel at a loss in how to help them use the internet in positive ways (Livingstone & Bober, 2004). Having more technological knowledge may allow adolescents to evade parental attempts at mediation. For example, a study conducted with teens in the United Kingdom, reported that the teens had implemented efforts to maintain their privacy from their parents through deleting emails, clearing internet history, or minimizing screens when someone came into the room (Livingstone & Bober, 2004). Parents' lower levels of technological expertise may limit the types of mediation that they implement or prevent the implementation of parental mediation at all. Parents implement a variety of attempts to mitigate the potentially harmful impacts of adolescents' internet use, but it appears that parents have a preference of

using co-use over approaches that may require more technological expertise (i.e., restriction or monitoring; Livingstone & Bober, 2004). Fletcher and Blair (2014) interviewed 20 adolescents (seventh grade students) and their mothers regarding mothers' authority over their adolescents' interactive technology use. Mothers who reported limited expertise with a technology were more likely to report that they did nothing to mediate their adolescent's use of that technology.

Parental Mediation in Later Adolescence

One of the major tasks during adolescent development is developing autonomy from parents (i.e., becoming independent while still maintaining connection with parents; Zimmer-Gembeck & Collins, 2003). Following completion of high school many adolescents pursue post-secondary education. Approximately 20.2 million students were expected to attend American colleges and universities in the fall of 2015 (National Center for Education Statistics, 2015). This often involves moving away from home, but does not mean adolescents stop relying on their parents for support in various areas. Adolescents over the age of 18 continue to rely on their parents for economic and emotional support (Aquilino, 2006) and adolescents may continue to benefit from parental involvement in their interactive technology use (Vaterlaus & Tulane, 2015). In their review of technology use among late adolescents (18-25 years old), Coyne, Padilla-Walker, and Howard (2013) suggest that it would be challenging to monitor adolescents' technology use when they leave for college because of proximity limitations.

Vaterlaus, Beckert, and Bird (2015) queried 82 college students (18-25 years old) and 72 parents regarding parental mediation practices in late adolescence. College students (and their parents) who lived with their parents reported low levels of parental mediation of late adolescent cell phone (7%) and internet (11%) use. Similarly, college students (and their parents) who lived away from home also reported low levels of parental mediation of cell phone (28%) and internet use (13%). Participants who reported parental mediation of college students' technology use indicated that the same strategies (i.e., monitoring, active mediation, and restriction) that have been identified in research with younger adolescents were employed. Furthermore, Vaterlaus et al. (2015) asked participants who reported no parental mediation to explain why parental mediation was not implemented. Some parents and college students reported that parental mediation did not happen because parents lacked the technological capabilities to mediate internet or cell phone use. Parent-child trust was thought to be earned while an adolescent was in high school and the earned trust eliminated the need to implement parental mediation when the adolescent entered college. Coyne and colleagues (2013) posited that parental mediation might be conceptualized as parental control, which could be interpreted by college students as parental intrusion. The Vaterlaus et al. (2015) study focused on adolescents who pursued post-secondary education and presently it is unclear if adolescents who seek different opportunities following high school graduation have similar experiences with parental mediation.

FUTURE RESEARCH DIRECTIONS

The majority of the research on parental mediation has centered on descriptions of the different techniques parents use and fewer studies have investigated the actual influence of parental mediation on adolescents' outcomes. Future research should prioritize studies focused on evaluating the effectiveness of different parental mediation techniques in reducing negative behavioral outcomes for adolescents.

If specific parental mediation techniques are found to reduce risks associated with adolescent interactive technology use, researchers should then identify ways to aid parents in overcoming the barriers to implementing parental mediation techniques. It appears that parents' limitations in technological ability serves as a barrier to implementing some of the parental mediation techniques. Research focused on methods for increasing parents' technological abilities may be a way of decreasing the digital generation gap and increasing parental mediation. Finally, researchers and practitioners should then create, implement, and evaluate interventions and educational programs for parents and adolescents to increase the use of effective parental mediation techniques.

CONCLUSION

Interactive technology use has become an integral aspect of adolescents' lives. Parents do have concerns about adolescent interactive technology use and, because legal regulations on interactive technology are difficult to create and regulate, policy makers rely on parents to take responsibility for keeping their adolescents safe from these risks. Some parents have implemented various parental mediation strategies (i.e., active mediation, restrictive mediation, and monitoring) in an attempt to prevent negative consequences for adolescents. There remains much to be learned regarding the effectiveness of parental mediation at decreasing the potentially negative consequences and increasing the potentially positive consequences associated with adolescent interactive technology use.

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KEY TERMS AND DEFINITIONS

Adolescence: The human developmental time period between childhood and adulthood.

Active Mediation: A parental mediation technique where parents use parent-child discussion and participation in their adolescents' technology use to alert adolescents to risks associated with interactive technology.

Digital Generation Gap: A difference between parents and adolescents in knowledge about how to use interactive technology.

Interactive Technology: Technology that digitally facilitates interaction between people or allows for user content creation or manipulation.

Monitoring: A parental mediation technique where parents view adolescents' activity (e.g., internet history, text messages) on interactive technology with or without the adolescents' knowledge.

Parental Mediation: Parental interventions and interactions with their adolescents regarding technology use implemented to promote positive technology use.

Restriction Mediation: A parental mediation technique where parents block access to interactive technology or implement limits (e.g., rules) on adolescents' interactive technology use.

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Chapter 40
The Qualities and Potential of Social Media

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ABSTRACT

In recent years social media have been clearly identified as playing a significant part in facilitating, if not causing a number of political revolutions and unexpected election results. Similarly, social media has also been considered as a way to improve organizational performance. In business and management, social media is seen as a way to empower customers and users, improve service levels through feedback loops, and generally offer an improved service users' experience of bureaucracy. In this chapter, the qualities and potential of social media can be understood to cause social change are examined. First in the background discussion to social media, new technologies are discussed. Then the four key areas of the characteristics of social media (the contemporaneity of communications, productive audiences, its dialogical and network nature, and its searchable and "taggable" nature) are explored. Finally, a number of possible trends in social media development and extrapolation are identified. From these (the self-leveraging network, deeper personal profiles and the Universal ID and identity, and hyper locality), they are extrapolated to the future.

INTRODUCTION

Technology has long been thought to bring about change in human behavior. This varies from minor changes in individual behavior to larger societal level transformations. Twitter and a variety of other social media have been considered as playing a significant part in facilitating, if not causing, recent political revolutions in certain North Africa and Middle Eastern countries in which long standing political regimes established in the post-colonial period were overthrown often by internally driven anti-systemic movements. In a number of instances the overthrow has resulted in less stable states (Khamis & Vaughn, 2011). Similarly, social media has been credited heavily in the spread and organization of

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the various occupations and civic unrests that occurred in Western societies under the auspices of the Occupy movement (Gleason, 2013). Occupy is a globally distributed network of anti-systemic groups broadly opposed to what they perceive to be systems of economic inequality and the pan governmental legal instruments that facilitate such inequality. A significant volume of commentary on blogs and in newspaper columns has clearly identified social media (often accessed by a mobile phone) as one of the driving forces and key tools of these uprisings (Marzouki, 2011).

Similarly, in commentary on less headline-grabbing events, we also find social media as credited with a change causing potential and social media has also been considered as a way to improve organizational performance (Curran, O'Hara & O'Brien, 2011). In business and management social media is seen as a way to empower customers and users, improve service levels through feedback loops and generally offer an improved service users' experience of bureaucracy. In this article we examine how the qualities and potential of social media can be understood to cause social change.

BACKGROUND

Social Change

Collective human life is structured by social practices; they define accepted behavior and how we act in different circumstances. Sociologists often understand such social practices as changing and shifting in response to social dynamics, logics and developments as well as external drivers (Giddens, 1990). We may understand technology as a major agent in driving such social change though there is disagreement in the manner in which such change occurs (Leaning, 2009) and whether such change is socially beneficial. One argument is that social media are contributory to the general decline of collective action in social life - social media contribute to the atomization of society and a decline in social capital – the binding connections between individuals. An opposing position contends that social media and similar technology actually contributes to social capital since there "is clear evidence that social capital has been on the ascent in the past decade: in the form of networks in cyberspace" (Lin, 2001). That is, the interpersonal connectedness facilitated by social media is beneficial and indeed social media afford communities opportunities to internally 'bond' or change in a positive, affirming manner.

Social Media

Social media refers to a range of World Wide Web (hereinafter referred to as 'web') applications that facilitate communication between individuals. Numerous technical sources identify the ancestry of social media in web 2.0 technology. Many of the features considered unique to social media (such as interest-driven communities, peer commentary and horizontal rather than hierarchical information flows) were present in early internet communication systems. Indeed much contemporaneous commentary on social media echoes statements made about the internet in the 1990s and early 2000s.

New Technologies

In analyzing technology we often seek to find characteristics, features or qualities that were not present in whatever technology went before – social media must do something that previous media simply did

not do. The cause of this perception lies in the marketing and financing of new technologies; there has to be a unique selling proposition of a technology, it has to offer a feature that solves a problem that previous technologies did not. However, this runs counter to the way in which technology is developed. Technology does not progress in terms of major changes, it moves forwards cautiously rather than in leaps and bounds. We might argue that technological innovations occur on a continuum; new technologies slightly improve a particular aspect of what went before but they rarely take things in a new direction entirely. A new technology may do the task we want performed better but only very rarely does it perform a new task.

Moreover, we should recognize that technological history is often not a single, linear pathway (Nicholson, 2007). While from our current perspective a technology may seem to be the result of a continuous path of development we find that there are often many developments that leading to technological culde-sacs. We may see the development of technology as occurring in a similar fashion to natural evolution - many different approaches to problems are tried out, some succeed but many fail. However, the important aspect is that each instance of technology is designed as an end in itself, to solve a problem or meet a need. Technologies are not (normally) developed as a stepping-stone to a clearly defined future technology. However, when we examine technology in hindsight that is exactly what they appear to be. Technology is not consciously moving towards a specific goal, rather it is changing and transforming and fighting for survival in an environment of limited resources (Ziman & Ziman, 2003). Thus if we look at social media we find that many of the features are actually improvements upon already existing patterns of communication rather than 'true' innovations. Different forms of social media may share certain features in common and seem to be advances of earlier technologies but whether they are radically different from previous forms of technology and communication is contestable.

THE CHARACTERISTICS OF SOCIAL MEDIA

If the argument that social media do possess new characteristics is correct then we can start to identify the particular areas in which social media is an improvement on what went before. In this article we focus on four key areas:

- The contemporaneity of communications;
- Productive audiences;
- Its dialogical and network nature; and
- Its searchable and 'taggable' nature.

While these characteristics were present in previous internet enabled media (and even earlier in some cases) they are modified, adjusted and combined in new ways in social media that allow us to see social media as a new technology.

The Contemporaneity of Communications

The contemporaneity of communications refers to the way in which social media are constant in people's lives and how they afford the user continuous routes of communication. Initial social research on internet communications articulated a divide between those technologies that afforded synchronous communica-

tions (live, real time discussions such as the various chat systems) and those which afforded asynchronous communications (turn taking systems such as new forums and email lists).

Social media confound this simple division. This occurs for two main reasons: first, many social media platforms incorporate both synchronous and asynchronous communication systems allowing users to both discuss issues in a serial manner asynchronously while also engage in synchronous communication – thus Facebook allows serial communication through status updates and comments but also to directly message a fellow user and engage in synchronous communication if they are logged in at the same time. Second, social media platforms are accessed through a range of hardware platforms including desk-bound personal computers, tablet devices and mobile devices. Accordingly social media is far more accessible and invasive into contemporary personal life than previous communications systems. While social media do not really offer anything new in terms of sheer communicative practice – they still offer an interface through which we can communicate – the means of accessing and communicating through the media is significantly advanced. Because of the penetration of computing devices into work, home and personal spaces and the presence of 'always on' 3G (and more recently 4G) mobile device networks, communication using social media is constant and 'network presence' is increased.

Using social media through 'always on' devices means that we are almost continually in communication. Communications are not stored and delivered to us on a particular occasion but relayed directly to us via social media platforms on mobile devices. Communication becomes cotemporary and we are deemed ever-present in the network.

Productive Audiences

While the amateur production of media content has long been possible through low cost media technology, social media add the dimension of being able to distribute this content easily. Many social media platforms offer the user the ability to upload media content. While there has been much concern (with considerable justification) about users disseminating commercial content without full recompense being made to the copyright owners, what is most striking is that there are significant volumes of media content produced and uploaded without any financial reward for the user/producer. This represents a marked shift from the previous conception of the relationship of media producer to audience.

In the previous older model there was a clear line between those producing media content: professionals who had undergone a period of training and development and part of a media industry – and those consuming it, the audience. Though there has been a reconsideration of the passivity of the audience of the audiences and audiences are no longer considered as passive as once thought even for old media, social media are thought to offer a new dimension of activity. In some instances these productive activities are aligned to their consumption and engagement with professionally produced content (phenomena such as fan media, parody and 'mash up' of professional media content into new content) but many people also produce their own entirely new content (Jenkins, 2006).

Dialogical and Network Nature

Social media are inherently social; they permit users to communicate with one another easily. While many forms of media allow users to communicate with other users and a significant number of pre-web 2.0 internet communication platforms are explicitly based on this, in social media this is elevated to a new level. The manner in which this occurs is through the integration of intra-user communication into other

forms of association. This occurs in three main ways. First, social media allow communication between users who have engaged in content dissemination or consumption of content uploaded by others. Thus, many of the social media platforms dedicated to content dissemination such as YouTube or Flickr permit users to post comments tied to specific media texts and to 'rate' the posted texts. A consequence of this is that sustained discussions emerge around texts and often veer into new areas with links to other texts being posted. Second, social media permit communication by prior existing communities that have a presence online. Innumerable geographical, interest-based, friendship and other forms of associational groups that exist off-line also have presence in social media. Moreover these groups are extended in new ways by their being online – users are made aware of prior existing groups and are able to join them and learn of their activities easily. Third, users are in multiple networks and users function as 'nodes' between separate networks. Social media allow users to facilitate new associations and forms of sociality. A consequence of this is the emergence of new networks and groups that only exist through social media.

Searchable and 'Taggable' Nature

The 'taggable' nature of media content refers to the way in social media allows users to add descriptors or 'tags' to media content so that it becomes identifiable and findable by themselves and other users. For example, wireWAX (a taggable video startup) allows interactive media content to be overlayed on YouTube streaming media. The benefit of the 'tagging' aspect is that the manner of description of an object stored online becomes far more personal and familiar to the individual. In this manner the user does not have to become skilled in the arcane and technical means of description. Accordingly, the labelling of content becomes far more democratic, personal, useable and epistemologically 'local' what Vander Wal refers to as 'Folksonomy' (Vander Wal, 2005). This is the opposite of technical taxonomy where a single authority determines classification: folksonomy is a bottom up approach to defining information and content. As such the practice affords strong resonance with grassroots and anti-hierarchical interpretations of the impact of new and particularly social media.

SOCIAL MEDIA CAUSING A CHANGE

We consider the above noted differences as resulting in four practices that can facilitate social change. These practices are: folksonomy, virality, collective intelligence and the emergence of 'long tail' patterns of production.

Folksonomy

As we noted above, social media allows users to add tags to digital content. Such tagging permits new realms of information to build up around digital content. Of particular interest is the impact this has upon classifications of digital content and data. As the amount of tagged data rises, it begins to pose a threat to the existing definitions and descriptions given to the data when it was first uploaded. If people add their own descriptions and do so in numbers, then the importance of the original description gradually declines.

This is affords new ways in which information can be identified and found. Media theorist Dennis McQuail noted that electronic media caused a change in how information was stored, disseminated and accessed. McQuail (McQuail, 1992) was in turn developing ideas proposed in 1986 by Bordewijk and

van Kaam (Bordewijk & van Kaam, 1986). They proposed that interpersonal information transfer works in one of four ways:

- Allocution (from a central point to individuals - as in broadcasting);
- Conversation (exchange of information between peers);
- Consultation (where information is stored in a location and individuals retrieve it - as in a library system); and
- Registration (where those in the centre record information from different end points).

McQuail contends that in an age of new media the traditional model of allocution is challenged by the model of consultation. We now longer passively receive information but can go in search of it. However, as many have pointed out how data is defined, labelled and stored has a significant impact upon whether it can be retrieved. Historically data has been classified by experts in the field, such as librarians, often using complicated systems. What tagging does is allow individuals to add their own labels. The consequence of this is that expert systems of information description are challenged by one driven by non-expert users – folk – to use the colloquialism. Folksonomy is the description of information by the people who use it and the consequent challenge to the power structure of those who have historically labelled it.

Virality

If folksonomy is a challenge to those who label information, virality is often considered a challenge to those who have traditionally controlled the pathways of information flow. The idea of virality emerges from network society theory - a broadly sociological approach to understanding the density and multi-directional forms of communication present in the contemporary world. It was developed in the work of (amongst others) Manuel Castells (Castells, 2011a, 2011b). In addition to the significant amount of academic commentary, network theory has also attracted much popular commentary. This commentary has constructed the network society in both positive and negative ways.

One ‘vision’ has been the interpretation of contemporary society as being highly integrated with individuals being part of many different communities of networks. We are part of work communities (our colleagues), family and friendship communities and geographic communities (our neighbors) and many historical communities (people in places we have lived in before or met) which social media permits us to remain in even if we leave the physical site of its original creation. Of course such links were possible in the pre-social media age and the pre-internet age. But the links are made far easier to maintain in the social media age and certain qualities of social media applications and sites such as Facebook make locating and contacting old acquaintances far easier. On top of this technologically facilitated ‘social network’, new changes such as the proliferation of platforms and platform independent content means that content can now easily flow across the network.

In previous eras, information tended to follow quite strict pathways through society. Old media forms such as newspapers and television afford a unidirectional flow of information from a central point outwards. The internet and other forms of new media challenged this in the 1990s and 2000s and social media has greatly accelerated the challenge. Information now easily crosses between social networks and it does so that patterns of flow now appear chaotic and not managed or planned. Indeed they seem to spread not

with a rational, intelligent plan behind them but with a biological or chaotic pattern. This resemblance to the biological spread led to the coining of the term viral to explain the spread of a piece of film, image or other media file. The link to biological phenomena is strengthened when the idea of virality is linked to the concept of a 'meme'. In the work of evolutionary biologist Richard Dawkins (Dawkins, 1989), a meme is a concept or idea that 'floats free' of its originating discourse and spreads with a society or culture in a similar way to how successful genes spread across populations. If specific discreet units of media are considered memes then the idea of a viral pattern of distribution becomes stronger.

Virality as a form of media distribution has proven to be a significant upset to those historically in control of media. While entertainment clips that spread virally are not considered of much consequence, virality achieves more significance when the spread information conflicts with dominant systems of representation and challenges the existing political order. In such instances virality becomes a subversive social practice that adds a political dimension to social media.

Collective Intelligence

A wiki is a type of website that allows the collaborative production of information. Possibly the best known wiki is Wikipedia. The Wikipedia website contains information that has been gathered and systematically organized in a collaborative manner by multiple users. The collective of collaboration and information sharing (which is sufficiently dynamic and also co-ordinated) over physical distance, results in properties which may be seen as 'smart' or 'intelligent'. This spawns emerging capacities beyond the individual components. Collective intelligence involves the ability to receive, transmit, utilize and share flows of information. Sociologist, Kingsley L. Dennis, argues that successful wikis (such as Wikipedia) make 'smart' decisions since they embody forms of an emerging hybridized collective intelligence – where the weaknesses of the individual are compensated by the contribution of the many.

James Surowiecki (Surowiecki, 2005) identified that in many instances collective decisions by many non-experts produce better results than those by individual experts. For Surowiecki, crowds can be 'wise' but they also need to be diverse and beyond physical homogeneity in order to be so. Dennis suggests that there are therefore degrees of 'intelligence' to be found in collectives that are diverse, distributed and heterogeneous yet sufficiently connected to share affiliations similar to information flows. The 'new agora' that wikis offer is informed through a synchronization of material in tandem with communication and digital technologies. As Wagner (2009) notes, by using wikis and related technologies, significant insights may be drawn from many small chunks of knowledge that carry relatively little meaning individually but become exceedingly meaningful when combined.

Long Tail

The 'long tail' is a description of the way in which retailing in the contemporary world allows small businesses that produce a niche product can exist in a world of mass production. The term describes the statistical phenomenon of a chart showing frequency distribution of a low number of instances of many cases. Such a chart will detail a dataset which has a number of cases with a high number of incidences and a gradual decline in the occurrence across the rest of the cases. The chart will have a small number of cases with a high number which forms a peak on the left of the chart and a gradual decline in the occurrences to the right forming a 'long tail'.

The 'long tail' was popularized in Chris Anderson's text (Anderson, 2007) when he noted that it described a number of new internet business such as Amazon which sold a high volume of a very small number of products but a small volume of a large number of products. Anderson proposed that companies could make money by selling very little of many different products; a challenge to the traditional wisdom of retailers of selling a significant amount of a very limited stock range.

The 'long tail' describes how media content in the social media environment is consumed and produced. There are a number of texts that achieve high audience numbers – successful internet memes as described in the virality section above; yet there are many media texts that never achieve a large audience. What is interesting is that there are a significantly high number of these.

There are innumerable videos on YouTube with few viewers, many blogs go unread by more than a handful of readers and the vast majority of Twitter streams have only a very small number of followers. This does not lessen the importance of these media; rather it simply indicates that very different consumption patterns of social media. The 'long tail' is a description of contemporary consumption patterns which owe much to the impact of the characteristics of social media.

FUTURE RESEARCH DIRECTIONS

While future gazing is always a problematic and a questionable activity, we identify a number of possible trends in social media development and extrapolate from these to the future.

The Self-Leveraging Network

The rich data in networks offers marketing professionals many opportunities for targeting potential customers more intelligently. While this has been possible for a number of years through the use of algorithms that detect patterns of interaction between users and data assets and then target the user with new assets, a number of companies are now developing this approach in a more intelligent or strategic manner. For example, the start-up *Insightfully* has developed an application that takes information from a person's Twitter and LinkedIn accounts and identifies potential relationships based upon data and previous encounters. The application (or simply 'app') explores the interaction between a person and their networks by calculating how much the network assists the person and how much the person assists the network. In this way it exploits extant data in new ways delivering nuanced information that can be used to assist the person in leveraging their networks.

Deeper Personal Profiles and the Universal Identity (ID)

The social media market is currently very heterogeneous - numerous platforms abound and users maintain many different accounts on these platforms. An increasing problem for platform providers is users not completing profiles. Users often only partially complete the various steps and this has an impact upon both the value of the data (partial data is far less valuable to advertisers) to the social media company and value to the user. In addition to inaccurate information being targeted at them, partial profiles often result in far less traffic and awareness among peer communities.

During 2010, Facebook initiated *Facebook Connect* – this allowed users to use their Facebook login on third party sites. This was followed by *Open Graph API* which has now been adopted and developed by numerous other organizations. Such practices presage the advent of what we may term the Universal ID or login – a system in which we use one login to access all our personal data stored across a range of platforms and organizations. This would facilitate being able to access and straddle multiple platforms and systems without multiple login processes.

Hyper Locality

When electronic mass media emerged during the early 20th century one of the main fears was that the world would become homogenized - a mass media, largely produced in the United States of America and western Europe would dominate all aspects of culture and would eventually drive out local, traditional values. Such fears are still felt today and significant effort is placed on preserving local cultures.

However, there is a gradual trend towards the production and dissemination of localized content. It is this aspect that is predicted to grow. Indeed given the productive qualities of social media content will become increasingly local to the individual. This serves to bring the technology 'closer' to the individual; social media will serve to assist in the narration and engagement not with a distant other (as corporate and state news seeks to do) but with our everyday lives.

CONCLUSION

We have examined how the qualities and potential of social media can be understood to cause social change. It is evident that during the last few years, social media has caught the public interest in a way that few technologies have achieved. While social media can be seen as the media used to be social, it has also become a powerful force since it has shaped government elections, impacted business decisions and altered the landscape of what news is and how it is reported. Social media has indeed become part of our everyday life.

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KEY TERMS AND DEFINITIONS

Collective Intelligence: The weaknesses of the individual are compensated by the contribution of the many.

Contemporaneity of Communications: Refers to the way in which social media are constantly in people's lives and how they afford the user continuous routes of communication.

Folksonomy: The description of information by the people who use it and the consequent challenge to the power structure of those who have historically labelled it.

Long Tail: A description of the way in which retailing in the contemporary world allows small businesses that produce a niche product can exist in a world of mass production.

Social Media: Refers to a range of World Wide Web applications that facilitate communication between individuals.

'Taggable' Nature of Media: Refers to the way in which social media allows users to add descriptors or 'tags' to media content.

Virality: The tendency of information to be circulated rapidly and widely from one Internet user to another; the quality or fact of being viral.

Wiki: A unique type of website that eliminates physical distance between the reader and the producers of the information.

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Chapter 41
Short History of Social Networking and Its Far-Reaching Impact

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ABSTRACT

This chapter describes the evolution of social networking together with its supporting technologies. Most popular social networking service providers, such as Facebook, Tencent, Twitter, and Sina Weibo are described with their market and financial data. The new business and new social relations built on social networking platforms are introduced and their impacts are discussed. The future trends of social networking are also illustrated based on the potential development of related emerging technologies. The objective of this chapter is to help readers understand the impact of technology on the functioning, evolution, and variation of socializations.

INTRODUCTION

Social networking is a platform built with information technology that supports virtual socialization (Lenhart & Madden, 2007). Although social networking has a short history compared with the long history of human socialization, it is growing fast and its impact on our life has not yet been fully realized and understood.

For thousands of years, face-to-face socialization is the major form to build social relations (Grusec & Lytton, 2012). Communities are formed locally, economy is developed locally, education, entertainment and religious activities are all performed locally. People interact with each other through physical contact and physical communications. Virtual communication appeared with the birth of mail service (Scheele, 1970). We have been using this kind of virtual communication for hundreds of years. However, virtual communities are rarely formed with surface mail, because mail correspondence usually happens between only two people, which are not enough to form a community. Recall the saying "One person is single, two persons are couple, and three persons form a society", we can say that a regular mail service between two people forms no virtual community.

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Virtual communication, virtual social group, and virtual community become a reality with the advancement of information technology, especially internet-based technology. Social networking was first introduced about 40 years ago. In less than half a century, it has become an important part of our lifestyle, and moreover, it is still evolving and penetrating into every aspect of our life and our society (Papacharissi, 2010). Its future impact will be profound.

This chapter describes social networking's different perspectives. The main objective is to help readers understand the technology potential and limits of social networking, its impact and its possible future. The remaining of this chapter is organized as follows. We first describe the background knowledge, including the evolution of social networking together with its supporting technology and the latest research development in this area. Then, we analyze the major social networking services and their features. Next section describes the new business and new socialization built on top of social networking, and their impact on social relations and social dimensions. Future research directions and conclusions are presented finally.

BACKGROUND

Social networking began with the introduction of computer network (Warschauer, 2004). The early form of virtual group is the email mailing list. Email is a communication mechanism established originally on mainframe computers in 1972 (Merritt, 2012). Later, this mechanism is introduced into personal computers on the network. A simple email communication between two users might not be too much different from the traditional surface mail communication, because it only involves two users and no social groups or social relations are formed here.

However, an email mailing list service provides an unprecedented mechanism to group users together and form virtual communities. Users do not need to meet face to face and could share their feelings, information, and ideas, remotely. With the support of email attachment, pictures, documents, and links to information or data on the Internet could be shared within the group. Although mailing list is an asynchronous communication mechanism, it is better enough to shadow the traditional mail correspondence. Despite the fact that many modern social networking services have emerged in the past ten years, email mailing list is still widely used in business, education, and some organizations. One of the most famous mailing lists is Linux Kernel Mailing List that connects Linux developers and users and forms the Linux community. This virtual community was established in 1995 and had over 14 thousand members in 2008 (Chu, 2009), and it is still actively used as the main platform for Linux community members to post announcements, ask questions, and address issues.

Besides email mailing list, there are also some other asynchronous social networking services, which include newsgroup, discussion forum, and bulletin board. These mechanisms are similar to mailing list: one user's post could be published openly online or broadcasted to the group members. Newsgroup, discussion forum, and bulletin board are usually built into a web portal or a specific web service. For example, discussion forum is an important component of distance education software (Branon & Essex, 2001). Another example is Baidu Tieba, China's largest communication platform that allows users to set up, join in, and search different discussion forums. The service is provided and supported by Baidu, China's search engine.

With the advancement of hardware technology, software applications are also improved. Due to the increase of computer network speed and personal computer processing power, synchronous communications became possible in 1990s. Accordingly, synchronous social networking services emerged.

Because synchronous communications could provide more convenient mechanisms to connect people together, more and more users switched from asynchronous communication platforms to synchronous communication platforms.

Instant messaging is one of the most popular synchronous communication methods used in late 1990s (Lewis & Fabos, 2005). It allows real time text transmission and information sharing. The most successful example of instant messaging service is Microsoft's Messenger, which was released in 1999 and widely used in 2000s. It was basically integrated with Microsoft's Windows Operating Systems and anyone with a Microsoft account can use it. In 2013, Microsoft's Messenger was merged into Skype's instant messaging system after Microsoft acquired Skype. Once, the users of Microsoft's Messenger had reached over 300 million.

Original social networking services only support text transmission. With the evolution of information technology, audio and video transmissions also became possible in the 2010s. For example, Microsoft's Sky Group Call is one of the most popular video conference services. Latest social networking services include more than text, photo, audio and video sharing. Other business and entertainment features are also incorporated. These features will be detailed in the following sections.

Research in social networking has been actively conducted in the past years. The work includes the study of communications through emails (Yu et al., 2008), mobile phones (Matic et al., 2012), instant messaging (Leskovec & Horvitz, 2008), and online social media (Kwak et al., 2010). For example, mobile communication data is used to study social network structures and social relations (Yu et al., 2013); emails are used to understand communication patterns (Malmgren et al., 2009); and social media is used to study recommendation systems (Carullo et al., 2015).

These studies revealed interesting facts about virtual relations and virtual communities (Chianese et al., 2015; Rheingold, 2000). Social networking in professional communities are also extensively studied. For example, Yu, Guan, and Ramaswamy (2016) studied the communication patterns of Linux virtual community; Russell (2013) studied the social relations of LinkedIn, Google+, and GitHub professional groups.

THE COMPETITIVE SOCIAL NETWORKING SERVICES

As with any other business domain, social networking services are evolving. Currently, a few internet giants are dominating the social networking service industry, while many others are fighting aggressively to obtain their market share. It is worth of studying the business strategy, service feature, user base, and financial status of different social networking services in order to better understand this industry.

Facebook

It is fair to say that Facebook is currently the most popular social networking platform. Facebook was launched on February 4, 2004. Its founder is Mark Zuckerberg (Kirkpatrick, 2011). The basic features of Facebook allow a user to build a profile, connect with friends, share photos, videos or other information, and join virtual groups. According to Alexa.com, Facebook is the second most visited website worldwide, only next to Google. Although Facebook is banned in a few countries, including China, Iran, North Korea, Syria, and Cuba, there are over a billion monthly active users on Facebook platform. The impact of Facebook goes beyond our daily life. From domestic issues to international affairs, virtual

communities on Facebook are playing more and more important roles. Table 1 shows the growth of Facebook in terms size, MAU (monthly active users), revenue, and net income.

Facebook is one of the most valued tech companies based on market capitalization. Other highly valued tech companies include Apple in computer hardware industry; Goggle in search engine; Amazon in e-commerce; and Microsoft in software industry. We can see that Facebook is the only high valued tech company of USA that is specialized in social networking services. Moreover, Facebook is still growing, with a 3.7% user growth rate in 2015.

Tencent

Tencent is China's internet company. Its founder is Pony Ma (Tse, E. 2015). Tencent provides many business services, such as gaming, news media, finance, sports, and entertainment. However, the most important service provided by Tencent is social networking. Tencent's first social networking service is Qzone (QQ). Qzone was originally a PC-based instant messaging service. Later it was made available for mobile devices. Qzone is mostly used in China with over 800 million active accounts. It has become a platform for Chinese remote socialization.

The latest social networking service developed by Tencent is called WeChat, which is a pure mobile-based social media platform. WeChat is not only used in China, it is globally notable. WeChat was launched in 2011. In less than five years, it has got over 650 million users by 2015. Different from Qzone, the number of WeChat users grows fast internationally. Currently, most international users are in Southeast Asia, India, and Africa. But more and more users from America and Europe are joining in this social networking platform.

WeChat provides text messaging, voice messaging, broadcast messaging, video calls, and data sharing services. Other features include walkie talkie, group chat, shake, and friend radar. Because of its popularity, more and more users have switched from Qzone to WeChat. It is worth to note that both Qzone and WeChat have developed across the social networking domain. They have become platforms for ecommerce, gaming, and financial transactions.

Table 1. The growth of Facebook

Year	Number of Employees	MAU (billion)	Revenue ($ million)	Net Income ($ million)
2008	850	0.1	271	-194
2009	1,218	0.2	777	35
2010	2,127	0.5	1,974	641
2011	3,200	0.8	3,711	1000
2012	4,619	1.0	5,089	1694
2013	6,337	1.2	7,872	1,491
2014	9,199	1.4	12,466	2,925
2015	12,691	1.6	17,928	3,669

Data source: Various web sites on the Internet

Tencent is the most valued tech company in China. Domestically, it is competing with Alibaba on various internet-based services, such as online payment, online taxi-dispatch, music, sport, and entertainment. Globally, it is competing with Facebook on social networking services.

Twitter, Sina Weibo, Tumblr, and Others

Twitter is a social networking service that enables users to broadcast short messages to their followers. It was launched in 2006 and went public in 2014. Twitter is currently the most popular micro blogging service worldwide. Twitter has a limit on the size of the text message and usually only text could be sent. Image, audio, video, or other data formats are not supported.

Sina Weibo is mainly China's microblogging service. Like Twitter, users of Sina Weibo could choose to post messages publicly or broadcast messages only to their followers. Tumblr is Yahoo's social networking service. Similar to Sina Weibo, Tumblr users could post images, audio or video files.

Table 2 compares Twitter, Sina Weibo, and Tumblr. It should be noted here that Tumblr is still a private company. No revenue data and net income data are available to the public.

Besides Facebook, Tencent, Twitter, Sina Weibo, and Tumblr, there are also many other social networking services. The commonly used ones include LinkedIn for business and professional networking, Renren (China) for campus networking, Habbo for teenagers socialization, and VK (Vkontakte) used mainly in Europe.

From Desktop to Mobile

The latest trend in social networking service is that the platform is shifting from desktop computers to mobile devices. Some pure mobile-based apps were developed and launched recently. In a short period of time, these apps have attracted the majority of social networking users.

Instagram is an online mobile photo-sharing, video-sharing, and social networking service that enables users to take pictures and videos, and share them either publicly or privately on the app (Holmes, 2015). Instagram was launched in 2010 and acquired by Facebook in 2012. It has over 400 million users in 2015.

Momo is China's another widely used mobile social networking app. It is location-based and allows users to chat with nearby friends and strangers. Momo's main feature different from WeChat is stranger socialization. For example, users could use Momo to look for lost pets, find new friends in a new area, and form a travel group on site. Momo currently has over 80 million monthly active users. It is worth to note that Alibaba, China's internet giant, is one of Momo's major shareholders. With the support of Alibaba's e-commerce, Momo has successfully commercialized its social networking services.

Table 2. Comparisons of Twitter, Sina Weibo, and Tumblr

	Twitter	Sina Weibo	Tumblr
Number of Employee	3,639	2,915	368
Monthly Active Users	305 million	236 million	226 million
Revenue	1,403 million (2014)	$477.9 million	na
Net income	-$578 million (2014)	$34.7 million	na

Data source: Various websites on the Internet

Snapchat is a mobile video messaging app. Its users could set a time limit for how long recipients can view their snaps (photos or videos). After time out, snaps will be deleted from the server. Snapchat is mainly used by teenagers. By 2015, Snapchat has over 200 million active users. Currently, Snapchat is still a private company and its major investors include Yahoo, Alibaba, and Tencent.

Alibaba's first mobile social networking service, Laiwang, is proved to be unsuccessful, because it lost the battle with Tencent's WeChat in China. However, Alibaba did not give up its dream of social networking services. Besides investing in emerging social networking services, such as Momo and Snapchat, lately, Alibaba has upgraded its mobile payment system, Alipay app with a social networking feature. Although it is hard to evaluate this business decision now, it is worth to note that due to the large user base of Alipay (400 registered users, 270 active monthly users), Alibaba's new effort of providing social networking service could be proved successful.

Besides aforementioned mobile social networking apps, there are also many others, including Vines, Foursquare, Pinterest, Spotify, Hootsuite, and more. For social networking services that are supported by both desktop computers and mobile devices, Table 3 summaries the distribution of their users on these two platforms. For other social networking services not listed in Table 3, they have close to 100% mobile users. It is clear to see that mobile devices have almost completely replaced desktop computers for socialization. Because of the shift of user preference, companies are also adjusting their business strategies. For example, it is reported that Tencent has dropped Qzone's Windows 10 development. Instead, Qzone's new development will be focused on mobile devices.

ECONOMIC AND SOCIAL IMPACT

Social networking is a business. Making profit is the goal of most social networking services. Currently, both Facebook and Tencent have successfully commercialized their services. Online advertisement is the major source of revenue. Collecting membership fees is another way to monetize virtual social relations. In addition, social networking reduces the cost of some business operations, such as marketing and payment transactions. New e-commerce models have emerged on social networking platforms. Two of these e-commerce models are micro business and ceWebrity business.

Micro business could be built on top of Facebook or WeChat platforms, where a user could sell products or services to his/her friends on the contact list. Products/services information could be posted online or could be broadcasted to friends. This kind of business model certainly reduces the cost of marketing. In addition, micro business could grow fast if the user's friends are willing to share the advertisement with their friends and their social groups, and so on and so forth. Micro business is rather common on WeChat platform, partly because Tencent's payment system is integrated into WeChat, which simplifies the payment transactions.

Table 3. Distribution of desktop users and mobile users of the popular social networking services

	Facebook	QZone	Weibo	Tumblr	LinkedIn
Desktop	32%	26%	15%	46%	26%
Mobile	68%	74%	85%	54%	74%

Data source: Various websites on the Internet

CeWebrity business could be built on top of Twitter or Sina Weibo platforms. This business is mainly operated or marketed by a celebrity on the Web, who could have thousands or millions of followers. The products or services are usually sold to the followers of the celebrity through broadcasting advertisement on social networking platforms. Because Twitter has a text size limit and does not support photo or video sharing, currently, it is not ideal for ceWebrity business. However, ceWebrity business grows fast on Sina Weibo's platform. Another common platform for ceWebrity business is YouTube. Celebrities on the Internet could post their products or services information on YouTube to make them available to the public, and especially to their subscribers. In this sense, YouTube is also a social networking platform similar to Instagram.

The effect of social networking goes beyond business. It affects every aspect of our life, including education, healthcare, entertainment, and more. Various new social groups and social relations are built on social networking platforms. Members in the virtual community can share their feelings, ideas, and experiences. They could also seek helps and advices from other community members. Users could play together, work together, and shop together. Using entertainment as an example, social networking has been used as a platform for live music shows. Moreover, other apps could be integrated into social networking apps, making it more convenient for social networking users to do different things, such as booking a ticket or paying utility bills.

Social networking not only broadens the horizon of our social relations, but also provides us better opportunities to develop mutual understandings in various social dimensions. Cross border and cross cultural relations could be easily developed with social networking. Through interacting with people of different cultures and different belief, we could better value other's living system and lifestyle. Social networking provides a cost-effective way to foster the respect of diversities. The traditional social dimension development is achieved through reading books, watching TVs/movies, browsing the internet, traveling, joining clubs, and participating in various events. Social networking provides additional mechanisms for social dimension development. It enables us to join remote cultural groups and form remote cross-cultural relations easily, allowing us to live in a virtually diverse environment. Therefore, in general social networking has a positive influence on individual's development of universal ethical principles, which are essential for us to resolve social and cultural conflicts and reduce social and cultural inequalities.

With the expansion of social networking services, people are joining in more and more virtual groups and spend more time on virtual socialization. For example, there are over 600 million groups on Facebook. Both Facebook, Qzone, and WeChat allow users to setup their own groups. Latest data shows that Facebook users spend twenty more minutes on it a day and China's WeChat users spend more than forty minutes on it a day. These numbers are expected to grow as people depend more and more on social networking. The latest development in this area shows that different social networking services are trying to connect their services together in order to build more communities and larger communities. For example, WeChat has been integrated with LinkedIn, allowing WeChat users to invite their LinkedIn contacts to join WeChat.

FUTURE RESEARCH DIRECTIONS

It is reasonable to say that we are living in two worlds now, a real world through which we interact and communicate with others physically, and a virtual world which is built on top of social networking. In our virtual world, we interact and communicate with others remotely. Technology has helped us build

this virtual world, and it will continue to improve our experience of virtual socialization. The technologies that are under development and might have great potential to enhance social networking services include VR (Virtual Reality), IoT (Internet of Things), and SE (Smart Environment).

VR (Virtual Reality) is the emerging technology that can simulate the physical environment and bring close-to-real experience for the users. For example, with the help of physical devices, such as special screens, head phones, and sensory devices, users could feel existing in a different environment like real. IoT (Internet of Things) is the network to connect all physical objects online, which also means these objects can be controlled remotely by users. With this technology, physically separated users are connected more closely, which allows physical interactions through remote objects. SE (Smart Environment) is the idea to build an environment with embedded sensors, displays, and computing devices. The main purpose of SE (Smart Environment) is to seamlessly merge human being into the environment, making us easy to feel, understand, and control the environment.

VR, IoT, and SE are closely related when they are going to be utilized in social networking. Although these technologies are still on their early stages of development, they are believed to be part of the driving forces for next economic boom. Once these technologies are matured and incorporated into social networking services, the impact could be revolutionary. Potential applications include gaming, virtual sport, entertainment, and more. Technology and internet giants, like Microsoft, Google, Facebook, Tencent, and Alibaba, are all actively investing in these technologies.

CONCLUSION

In this chapter, we discussed the evolution of social networking together with its supporting technology. We also described the most popular social networking services, their features, and their business status. The new business and new social relations that are built on social networking platforms are described. The economic and social impact and future potentials of social networking development are also illustrated.

Now days, technology is an integral part of our daily life. We are utilizing technology, and at the same time technology is affecting our lifestyle. Social networking is a perfect example showing how human activities and human society are affected by technology.

We are living in a changing world and changing society: the borders between countries are disappearing and the distance between people is shortening. The world is getting smaller. As for the future, we really do not know how it will look like. But, we can imagine. With the advancements of technologies, our imagination could become real.

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KEY TERMS AND DEFINITIONS

Asynchronous Communications: A communication mechanism that does not require the sender and the receiver to be online at the same time. A delay of response is allowed and expected for this kind of communication.

Celebrity on the Web: Someone who is famous on the Internet.

CeWebrity Business: An e-commerce business operated and/or marketed by a celebrity on the Web. The products or services are usually sold to the followers of the celebrity through social networking.

Desktop Computers: A personal computer that is mainly used in a single location. Two representative desktop computers are IBM PC and Apple Mac.

Internet of Things: A technology that connects physical objects online so that users can control these objects remotely.

MAU (Monthly Active Users): A social networking service metric that counts the number of users who perform at least one activity (sending a message or reading a message) on the platform in one month period of time.

Micro Business: An e-commerce business built on top of social networking services, in most cases, mobile social networking services, where a store owner sells products/services to his/her friends in the app's contact list.

Mobile Devices: Smartphone and tablet computers that could be carried and used anywhere. Usually wireless network is needed for mobile devices to be connected to the Internet.

Smart Environment: The idea to build an environment with embedded sensors, displays, and computing devices so that users can better understand and control the environment.

Social Networking: A service based on internet technology that allows users to communicate and socialize remotely.

Synchronous Communications: A communication mechanism that requires the sender and the receiver to be online at the same time. An immediate response is expected for this kind of communication.

Virtual Community: A group formed on top of a social networking service. In most cases, group members have the same interest but are remotely located.

Virtual Reality: A technology that can bring close-to-real physical experience for the user.

Virtual Socialization: People socialize through using computer-based technology. No face-to-face interactions and communications are needed.

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Chapter 42
Social Media and Business Practices

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ABSTRACT

This chapter presents an overview of social media and its application in various business domains. Social media platforms are increasingly becoming important for business growth. This chapter introduces the social media platforms, their various definitions, and their reach. It describes different types and business models of the social media platforms. This chapter discusses how the social media platforms could be used in all the business domains with examples. This chapter will be useful to the students of general management, organization studies, strategic management, and social sciences.

INTRODUCTION

In today's competitive environment, businesses are continuously exploring ways by which customers can be better engaged to sustain long-term growth (Aral, Dellarocas, & Godes, 2013). Because of the unpredictable and wide dispersion of social media (SM) platforms, businesses today face many challenges that did not exist a few years ago (Dong & Wu, 2015). SM platforms are economical and user-friendly and facilitate the consumption, generation, and sharing of user-generated content by the consumers (Sigala & Marinidis, 2009). As most of their targeted customers are present on various SM platforms, businesses are aligning their strategies and tactics to incorporate these platforms at all levels. This shift toward SM platforms can be determined by several factors including declining response rates vis-a-vis traditional customer engagement methods, technology development through customer participation, open communication of customer preferences, low cost of information dissemination, and the demographic shifts toward use of new technologies (Gillin, 2007).

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SM platforms offer an easier and more cost-effective way for businesses to reach customers, and consequently strengthen brand awareness through numerous applications and tools (Rodriguez-Donaire, 2012). Using SM platforms, businesses can define or re-define relationships with both new and old users, respectively, and develop communities that interactively collaborate to identify issues and solutions for both themselves and businesses (Meredith & O'Donnell, 2011). Businesses appear to believe that such SM initiatives are justified because of their potential to generate profits, for instance, through advertising (Aral et al., 2013). Businesses can improve branding and direct more traffic to its web site utilizing SM advertising.

Furthermore, customers can add value by generating their own content to influence the purchase decisions of others through peer-to-peer communications. SM platforms enhance the communication power of individuals by providing different avenues without demanding much effort of the users (Curran & Lennon, 2011). Apart from creating and sharing knowledge, users can create or join various communities with other like-minded individuals based on their similarities of interest and purpose. Also referred to as virtual communities, they help users create personal relationships in an enabling environment through emotion-laden discussions (Rheingold, 2000). These communities have resulted in new opportunities for businesses (Brodie, Hollebeek, Juri, & Ili, 2011). Some of the activities undertaken by businesses include sharing of content, interaction with customers, gathering customer feedback, provision of customer services, and effective collaboration with employees or business partners, and so on. (Bowden, 2009). Furthermore, SM has not only strengthened the existing relationship between businesses and users but also resulted in innovative changes in traditional communication methods, thereby enhancing the capability of businesses to better interact and dialog with users.

In light of above, this chapter attempts to explain SM in greater detail and as delineated by various business practices. This understanding of the use of SM by businesses is preceded by a discussion on the definition of SM platforms, their different types, and the associated business models.

BACKGROUND

Social Media

The definition of SM has been evolving over a period of time. According to Terry (2009), it refers to "digital technologies emphasizing user-generated content or interaction" (p. 508). User-generated content supported through SM is "a mixture of fact and opinion, impression and sentiment, founded and unfounded titbits, experiences, and even rumor" (Blackshaw & Nazzaro, 2006: 4). The content available on these SM platforms consists of various pieces of online information which are generated and shared by users about brands, products, and services. Often SM is referred to by its channel characteristics, either identifying directionality of messages (Kent, 2013) or using particular tools such as Facebook or Twitter for engagement and communication (Howard & Parks, 2012).

Although there is a lack of a formal and concise definition, SM is often defined as Internet-based applications that transmit user-generated content. Some definitions are simply based on the nature of communication in SM. For instance, Russo, Watkins, Kelly, and Chan (2008: 22) explain SM as "those that facilitate online communication, networking, and/or collaboration." Kaplan and Haenlein (2010: 61) offer a similarly definition of SM as "a group of Internet based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated

Content." In the same manner, Lewis (2009: 2) noted that SM simply serves as a "label for digital technologies that allow people to connect, interact, produce, and share content."

In addition, Aula (2010: 43) defines SM as a place where customers can communicate directly with their favorite organizations and gather more information about the organizations' products instead of simply providing a platform for individuals to stay in touch with their family and friends.

These definitions could easily be applied to other communication technologies, such as e-mail, thereby missing the unique technological character that distinguishes SM.

Furthermore, a more extended and complex definition of SM is as follows:

(a) the information infrastructure and tools used to produce and distribute content; (b) the content that takes the digital form of personal messages, news, ideas, and cultural products; and (c) the people, organizations, and industries that produce and consume digital content (Howard and Parks, 2012: 362).

Kent (2010: 645) broadly defined SM as

any interactive communication channel that allows for two-way interaction and feedback, further by their potential for real-time interaction, reduced anonymity, a sense of propinquity, short response times, and the ability to "time shift," or engage the social network whenever it suits each particular member.

The definitions become broader by combining SM and social network sites (SNSs). Boyd and Ellison (2007: 211) seminally defined SNSs as

web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system.

The social network is "one of the most typical features of social media in addition to the content aspect" (Enders, Hungenberg, Denker, & Mauch, 2008: 200).

SM allows individuals to meet strangers, but rather they enable users to articulate and make visible their social networks. It also allows users to "enhance their profiles by adding multimedia content or modifying the look and feel of their profiles" (Hanna, Rohm, & Crittenden, 2011: 266).

As discussed, definitions in earlier literature, SM have been defined by specific features, minimizing their unique communicative properties. To sum up all definitions, a new definition of SM given by Carr and Hayes (2015: 50) is as follows:

SM are Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others.

As observed above, the definitions are diverse and continuously evolving. This chapter will use SM platform as an inclusive term and in an operational sense.

SM Platforms

SM platforms can be differentiated on the basis of technology, content, and functions. They represent different online sources: review website, blogs, discussion boards, chat rooms, and social networking sites, for creating and sharing of information and knowledge about businesses and their products/services (Blackshaw & Nazzaro, 2006). Kietzmann, Hermkens, McCarthy, and Silvestre (2011) identify seven fundamental building blocks in understanding SM in what has come to be known as the honeycomb model: identity—the extent to which customers choose to reveal their identities; presence—the extent to which customers know whether others are available; relationships—the extent to which customers relate to each other; conversations—the extent to which customers communicate with each other; groups—the extent to which customers are ordered or form communities; reputations—the extent to which customers know the social standing and content of others; and sharing—the extent to which customers exchange, distribute, and receive content. Irrespective of the name of the SM platforms, one can differentiate them on the basis of these functional blocks.

SM platforms can be categorized into the following types (Lietsala & Sirkkunen, 2008): SNSs (LinkedIn, Facebook, MySpace), collaborative productions (Wikipedia), content creation and publishing (blogs, v-blogs, podcasts), content sharing (Flickr, YouTube), virtual worlds (FarmVille, Second Life), add-ons (Slide, Friends for Sale), and social commerce (Tripadvisor, Groupon, and Facebook Connect).

The number of SM platforms' users, worldwide, is continuously increasing at a phenomenal rate. It is predicted that in 2016 there will be around 2.13 billion SM users around the globe, up from 1.79 billion in 2014. Almost two-thirds (64%) of these users use or will use such SM platforms at least once a day through their computers. However, users are now increasingly using their smart phones to access SM platforms (Nielsen, 2014). Almost 47% of smart phone owners visit SM platforms every day. Furthermore, they are logging their presence with their profiles and connecting on to multiple SM platforms. While Facebook remains the largest SM platform, users are now taking to other social platforms such as LinkedIn, Pinterest, and Instagram.

REVENUE MODELS OF SM

SM platforms were thriving primarily on user-generated content and did not focus much on revenue generation in the early phases of their growth. With the increase in the number of SM platforms with hyper-specialized focus, the modes of revenue generation are also evolving. In literature, the most discussed revenue models are advertising models and subscription models (Enders et al., 2008; Vukanovic, 2011; Wang, Ye, Zhang, & Nguyen, 2005). The other models are: licensing of content and technology to third parties, selling goods and services to the community, and voluntary donations (Canzer, 2006; Lietsala & Sirkkunen, 2008; Zeng & Reinartz, 2003).

Advertising-Based Models

Advertising in SM platforms is now an approach that is as commonly adopted by businesses as advertising in traditional media such as newspapers and magazines. SM platforms have begun to incorporate brand pages, ad videos, and additional user-generated content for revenue. In addition, users and businesses can create their own profiles or brand sites using SM platform to advertise their particular

products or services. On SM platforms, two types of advertising can be observed: affiliate models and banner advertising. In banner advertising, fees are charged by the platforms in exchange for the display of advertisements on their websites (Canzer, 2006). Facebook and YouTube are well-known examples of banner advertising. In affiliate models, SM platforms direct traffic to an "affiliate" website and, in turn, might get a percentage of revenues from the resulting sales. The popular Japanese social networking site Mixi allows users to rate and review books, games, and other items and connects users directly to Amazon Japan with one click to facilitate the purchase of those items or to listen to music which can later be bought from the iTunes store. Facebook, for example, offers businesses the option to construct individual groups in return for a sponsorship. For SM platforms relying on an advertising model, it is essential that the intended audience be large and highly differentiated to increase revenues. Thus, the key revenue driver for this model is the number of users.

Subscription-Based Model

Some SM platforms charge users for accessing content which is generated on their site. This model requires users to subscribe by paying a specified amount for accessing content (Enders et al., 2008) on the platform. In some practices, this is referred to as the Freemium model, in which users have two choices, either to subscribe to a basic free account package which guarantees a limited amount of content/services or a pro account, at an additional cost, that provides enhanced features. For example, LinkedIn initially offers free subscription only for limited features, but for advanced features a subscription fee is charged. Sometimes users are not willing to pay a subscription fee for a service just because of a lack of trust. A certain degree of user trust is needed because users need to be convinced for them to be willing to pay for a service (Wang et al., 2005). For that, SM platforms provide free trials for users to comprehend the service offering. A good example of a subscription-based model is The Auteurs, an SM platform built around classic films. Users need to subscribe for accessing movies. The crucial driver in subscription-based models is the creation of high levels of unique customer value, which then determines their willingness to pay for a service. The attractiveness of content becomes a significant factor when companies want to charge their customers for what is essentially free content.

Another model similar to subscription model is Pay-per-item model where users need to pay SM platforms for accessing particular content of interest to them. For example, iSTockphot offers audio, video, and photos from its user stock and charges a fixed amount for each. Such SM platforms could recommend or sell user-generated content as part of their own stock on a pay-per-item terms. YouTube, another example, sells videos as per a pay-per-item model. Users need to pay a particular amount mentioned in the video itself.

The platforms either serve as a host wherein users upload their content as in YouTube and Flickr or provide additional features for the additional fees as in Linkedin. In both the cases, user-generated content is key.

Licensing of Content and Technology to Third Parties

Licensing content to third parties may also be a source of revenue because of the tremendous growth in user-generated content on SM. An SM platform can be licensed to other businesses who want to employ similar features or services for their individual use. Twitter, for example, gains more than 15% of its sales, that is, around $47.5 million through such arrangements. It is generated by the licensing of

its massive quantity of data to analytics businesses. Although this model is not as popular and profitable as advertising and subscription, it has the potential to grow into a huge revenue stream for Twitter. Sometimes it contains provision for the licensing of content on a revenue sharing basis between itself and content generators. YouTube, for example, primarily compensates the content creators through a program called Content License Agreement, and through revenue sharing arrangement a certain amount of money is made from some videos by both YouTube and the content creator.

Voluntary Donations

In this type of model, SM platforms can use the freely available user-generated content, like that of small girl singing on the street or musician performing, for donation from others. For this, a significant number of SM platforms such as blogs, wikis, online video, and online music users ask for donations using a donate-button available on these platforms for various purposes including content access, platform maintenance, and web hosting (Goh, Heng, & Lin, 2013). This facilitates web development such as open source and user-driven innovations. For example, Wikipedia gets moneys from donations from users and other individuals. Every year, there are banners asking users to donate some money to the Wikimedia Foundation, the non-profit organization which runs Wikipedia. A common feature of such SM platforms is that they run their operations with limited funding (often thanks to pro-bono time invested by volunteers and users).

Selling Goods and Services to Community

SM platforms have large audiences because of their networking and community mobilization capabilities and this creates an opportunity for businesses to promote and sell products or services directly to these users. SM platforms incorporate gaming techniques on their networks, driven by the monetary opportunities that they present. The sale of virtual goods will remain the primary source of revenue for these platforms. Some SM platforms, for example, allow the sale of online virtual games and virtual accessories to their users. For instance, the Mypurchase service of MySpace offers a platform to creators to sell their music, taking a portion of sales revenues in exchange.

To summarize, these revenue/business models used by SM are very new approaches, and more empirical research is required to optimize these model for better returns. Many SM platforms are now trying to integrate various revenue models to maximize revenues. For example, SoundCloud, an audio sharing platform, uses a combination of subscriptions, selling goods, and revenue sharing models. Furthermore, businesses are trying to integrate SM platforms into their activities. In the next section, use of SM platforms for various business functions is described.

SM PLATFORMS IN BUSINESSES

Many businesses use SM platforms as an advertising channel only because they are accessed by the public at large. Hence, the most evident application of SM platforms in business is to use them for different kinds of online promotional activities (Mangold & Faulds, 2009). Mangold and Faulds (2009) stated that SM platforms are an opportunity to construct brands, exhibit leadership behaviors, enlarge resources, achieve new audiences, and find new sources of ideas. Direction (2011) proposed a collective

benchmark for businesses by classifying whether they can gain benefits from SM platforms or not after incorporating them into their business functions. An essential set of related questions is how businesses should engage and communicate with customers through SM platforms (Jussila, Karkkainen, & Leino, 2011). Andriole et al. (2010) enumerated six latent factors that are influenced using SM platforms, and that ultimately affect business performance: (1) collaboration and communication: capacity to coordinate discussions, to audit communication streams, and to reach more people faster; (2) rapid application development: capacity to engage experts, customers, suppliers, and company employees to modify and to develop applications easier and faster; (3) customer relationship management: solving customer service issues, using forums, wikis, and others, mine customer data effectively, ask for customer feedback, reach more customers, and communicate effectively with customers; (4) innovation: exchange of ideas between experts, fuelled by user-generated content and mass co-creation, capability to improve success rates, to produce efficiently; and (v) knowledge management: capabilities to share, retrieve, organize, and leverage knowledge. Some researches (Bruhn, Schoenmueller, & Scheafer, 2012; Hoffman & Fodor, 2010) show that businesses have already employed SM platforms for value proposition by incorporating it into their various business activities including marketing, recruiting, product innovation, and customer service. Needless to say, SM platforms will not become effective until they are used creatively, with a systematic approach and day-to-day effort toward building confidence in the brand and a loyal user community.

Customer Engagement

Brodie et al. (2011) defined customer engagement as "a psychological state that occurs by virtue of interactive, co-creative customer experiences with a business." Because of these inherent interactive characteristics, SM platforms may connect customers and businesses by facilitating conversation and providing user-generated content, thus fostering customer engagement. In addition to this, customers who actively participate in online activities on SM platforms are regarded as highly valuable for a business. This provides benefits in terms of customer commitment, trust, customers' emotional connect, and loyalty (Brodie, Ilic, Juric, & Hollebeek, 2013). SM enables customers as well as non-customers to contribute in marketing mix decisions and value adding (Sashi, 2012). User-generated content from SM platforms can significantly improve customer loyalty and satisfaction, particularly as customer requirements transform over a period of time (Lorenzo-Romero, Constantinides, & Brünink, 2014).

Max Bupa[1], India's premier health insurance company, uses its engagement platform, Get Help, on Facebook to provide services to customers daily. This innovative platform enables customers to buy a health policy using their Facebook account, interact and share their experience with Max Bupa, and also get instant customer service at their convenience, anywhere, anytime. This has resulted in an increase in positive conversations with complaints decreasing by more than 60%. The turnaround time has consequently decreased by 50%.

Brand Awareness

The brand is a symbol, feature, or any other observable mark of a product or company that differentiates it from others. They are markers of recognition and composite social phenomena (Schau, Muñiz, & Arnould, 2009). Nowadays, branding is considered as an ongoing social process (Fueller, Schroll, Dennhardt, & Hutter, 2012). The social character of brands and the significance of engagement in co-creating brand value (Fueller et al., 2012) reinforce the role of SM platform as a brand awareness channel. The participa-

tory potential of SM enables the users to affect brands in multiple ways. The recent researches might not focus on brand reputation but on related concepts such as customer trust, emotional appeal, and brand attitude and they are showing positive effects overall (Van Noort & Willemsen, 2011). Brand reputation is a measure of how users feel about, talk about, and act toward an organization's brand (Tsimonis & Dimitriadis, 2014). Users are more likely to choose businesses with a positive brand reputation and are willing to pay more for their products. Applying SM strategies for branding can definitely help businesses. To attract more consumers, businesses are constructing their presence on SM platforms after receiving in-depth information on where and how they or their brands are positioned on SM platforms (Hutton & Fosdick, 2011). Furthermore, it is found that users' online purchasing decision is dependent on the brand perception while using the SM (Chen & Xie, 2008). The online reviews serve as critical approach in measuring brand sentiment (Stelzner, 2012).

For example, India International Jewellery Week (IIJW), an initiative to showcase India's finest jewellery, has built awareness through SM platforms as the biggest international jewellery festival in India. Various communication strategies are adopted to create brand awareness for IIJW on SM platforms. IIJW-related images and coverage of live events are uploaded on Facebook. The use of hashtags like #IIJW and tagging the celebrities are also used for promoting the event. As a result, 1166 people saw IIJW live online and its Twitter followers increased by 50% in a span of 5 days. In addition to this, #IIJW was used by 581 users and about 6,98,920 people were reached through Twitter which accounts for 1,454,957 impressions.

Marketing

Marketing is defined as an effort to find the requirements of specific communities and delivering the desired service/product to them. Earlier businesses used various conventional marketing approaches to identify such communities and assess their requirements. Today, exclusive dependency on traditional media for marketing is inadequate for businesses to survive. In addition to creating online presence, businesses need to know how to interact with their customers online. SM platforms provide opportunities to expand relationships between users and businesses (Hlavinka & Sullivan, 2011; Lipsman, Mudd, Rich, & Bruich, 2012; Mangold & Faulds, 2009). Chi (2011: 46) defines SM marketing as a "connection between brands and consumers, offering a personal channel and currency for user centred networking and social interaction." Many studies define SM platforms as a new marketing tool (Berinato & Clark, 2010; Paquette, 2013) and appropriate for awareness building, influence, and the attainment of marketing objectives that help improve marketing communication effectiveness and make for better marketing impact (Lipsman et al., 2012). Kumar, Bhaskaran, Mirchandani, and Shah (2013) hailed SM marketing as a customer-loyalty-building and promotional tool. As supported by available literature, if SM platforms are used effectively, brand advocates can be controlled and exploited which would result in both strategic and operational benefits (Chan & Guillet, 2011).

For example, Fork You Too, a casual dining cafe in Delhi NCR, decided to go to SM platforms for restaurant marketing campaigns. They created a campaign around Bollywood movie posters with a Fork You Too–style twist on Facebook, Twitter, and Instragram. The content was strictly aligned toward food, drinks, cuisine, and events with a quirky and fun factor. As a result, Fork You Too has a fan base of more than 25,000 which increased their fan base 12 times on Facebook. They have 200 plus followers on Twitter and 250 plus followers on Instagram.

Product Design and Development

Product design and development is defined as a process which starts with identifying customer requirements and ends with converting these into a product. Customers often share their thoughts and feeling on product or event through SM platforms. Hence, SM platforms have empowered customers to circulate their creations and opinions and thus add new content. It has also become a new method for businesses to collect people's opinions and understand their preference. User-generated content may embed customers' experiences of a product, with information on product engagement (e.g., product features) and other related information (e.g., shopping experiences; Chua & Banerjee, 2013). The strategic use of SM platforms for developing product features and form user-generated content is a comparatively new area that connects marketing and product design and is a fine example of how two formerly distinct business functions are brought together by the advent of SM (Ng, 2013).

Starbucks, a coffee house, has demonstrated its versatility in engaging customers through various SM platforms, such as MyStarbucksIdea, Facebook, Twitter, and Foursquare (Gallaugher & Ransbotham, 2010). Starbucks closely followed the principle of "design with customers" in defining the role of customers, allowing them to play the role of creators and evaluators of ideas. As a result, Starbucks received more than 120,000 product ideas, 41,000 experience ideas, and 24,000 involvement ideas all posted on MyStarbucksIdea. Starbucks has more than 36 million likes on the Starbucks corporate page and has more than 180,000 users talking about it. Seventeen million users have visited this page on Facebook. It has 18,7000 tweets on its corporate blog with 5.95 million followers following and focusing on the Starbucks' brand on Twitter, and more than 40 million followers on Foursquare.

Sales

From the sales/business function perspective, previous studies have shown that direct communication between customers and suppliers is essential in capturing the expectations with regard to a product or service and the desired requirements (Moncrief, Marshall, & Rudd, 2015). Marshall, Moncrief, Rudd, and Lee (2012) argue that the SM platforms provide the required information to customers and share strong evidence to support the positive linkages between use of SM platforms and business success. Furthermore, it is evident that online reviews on SM platforms positively influence product sales. The prevailing positive and negative sentiments emerging out of online conversations have a significant impact on sales (Sonnier, McAlister, & Rutz, 2011; Tirunillai & Tellis, 2012). Businesses need to embrace SM platforms and related technology strategies in sales for gaining a competitive advantage (Stockdale, Ahmed, & Scheepers, 2012).

LuLu Mall, one of the most happening malls in the state of Kerala, India, launched an NRI Shopping Festival to attract NRIs, tourists, and the general public to the mall during its promotion period. The main tool used for this purpose was SM platforms to create a buzz around the events and to reach out to potential shoppers. The Facebook page and Twitter handle were updated with these promotional posts on a daily basis. The promotional content was posted on Facebook page of LuLu hypermarket, Dubai. This page had more than 40,247 fans from the Indian subcontinent including Kerala. As a result, LuLu mall increased its sales by 29%. There was also a growth in the number of Facebook likes and fans: 1,51,164 likes to 1,77,268, an increase of 26,104, with reach among fans of 53,99,573 and an impression of 86,83,222.

Promotion

A promotional approach often refers to direct marketing, advertising, and interactive marketing to encourage their products/services (Thackeray, Neiger, Hanson, & McKenzie, 2008). With the arrival of advanced technologies on SM platforms, there is an enhanced potential for promotion by businesses (O'Reilly, 2005). In the case of social promotion, this information is about product-related behaviors, ideas, and services (Thackeray et al., 2008). Mayzlin (2006) examined user-generated content which is a combination of business promotions and user recommendations using analytical models and found that it can still be influential despite the obvious promotional aim by businesses in such online settings.

MindShift Interactive, a leading digital marketing and research firm, completed a comprehensive SM campaign for HomeShop18's new "Shopping Makes Me Happy" jingle. The promotional campaign was built on Twitter revolving around happiness and excitement among key opinion leaders with influencers exchanging tweets with reasons/people that made them happy. As a result of this, HomeShop18 surprised people with vouchers to increase the happiness quotient. This garnered an overall outreach of 23 million users across SM, trending for more than 24 hours across India.

FUTURE RESEARCH DIRECTIONS

Aral et al (2013) highlighted four major areas of research: design and features, strategy and tactics, management and organization, and measurement and value from the perspective of three levels of analysis—users and society, platforms and intermediaries, and firms and industries. Although some of the above-identified gaps are being explored, the area of research-related SM platforms is still largely unexplored. There is also a need for research in terms of differences between information-rich and information-poor countries. Many businesses are located in the developing world and are targeting customers from both domestic and foreign markets and whose use of SM platforms is different. There is a need for research specifically focusing on businesses' adoption of SM platforms in the information-poor contexts of the developing world.

SM platforms are also breeding ground for negative sentiments vis-a-vis products. An impulsive customer can damage the brand despite it being his or her own mistake. Given the dynamic nature of SM platforms, the risk mitigation strategies need to be robust and implementable. The other challenges involved include the lack of control over the content on the platforms owned by others and the control over users in terms of access and nature of content to be viewed. There is a need for research in the creation of risk mitigation frameworks based on empirical data available.

Further research is also required for developing methodological solutions to deal with the representativeness of the SM data. As the user-generated content is limited only to the users on the SM platforms, this might not be identical to the overall population. Because not all the SM platforms share the background information about the users, generalized validation of SM data for the populations needs to be strengthened.

CONCLUSION

SM is increasingly becoming an important component that is impacting different business functions. Despite the larger number of users, most SM platforms are primarily generating revenue from advertisements and through affiliate relationships. Businesses can use SM platforms for customer engagement, brand awareness building, marketing, product design and development, sales, and promotion. For each of these areas of business, extant literature was presented along with the examples. Future research in this domain should look at at least four areas design, strategy, management, and measurement from the perspective of users, platforms, and firms. A focus on the developing world as the context will enrich the field by showcasing the differential adoption strategies adopted by or available to businesses. The development of risk mitigation frameworks will be helpful to businesses in dealing with the negative sentiments and other risks associated with the emotional outburst of users. The representativeness of SM data is still an open question and further work to strengthen the methodological rigor will benefit the field greatly.

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KEY TERMS AND DEFINITIONS

Advertising Model: A revenue model for SM platforms in which brand pages and ad videos containing product/service information are created on the platform.

Brand Awareness: It is a measure of how identifiable the brand is for target customers.

Brand Community: It is a structured composite of social relationships among the admirers of a brand.

Brand Reputation: It is defined as a measure of how customers react to brand (what they think about the brand, how they talk about it and how their inclination towards the brand).

Customer Engagement: Defines the behaviours evoked in a customer by a specific brand that are over and above a basic connect.

Online Product Review: It is an account on SM of a customer's personal experience vis-a-vis a product.

Revenue Sharing: It means that the revenue made from user generated content, SM platform share some part of it to content creator.

Social Media: Online platforms in which users can create and share the content.

Social Media Marketing: It is a term which describes the actual activities involved in using SM platforms for marketing purposes.

Social Promotion: It can be defined as direct marketing, advertising, and interactive marketing using SM platforms to encourage the sale of products/services.

Subscription Model: In this revenue model, the subscription fees charged for accessing content or services available on SM platform constitute the revenue source.

ENDNOTE

[1] All examples for this chapter are sourced from www.socialsamosa.com.

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Chapter 43
Social Media Credit Scoring

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ABSTRACT

This chapter provides an overview of credit scoring and discusses how credit scoring is evolving within the context of social media. The main focus of the chapter is how financial institutions have begun incorporating a credit applicant's social media activity such as Facebook and Twitter into the risk associated with a financial loan. Traditional financial organizations such as FICO to relatively new start-up companies such as Lenddo are highlighted; the way in which these companies are incorporating big data sources such as social media data into their loan-making decisions are discussed.

INTRODUCTION

Credit scoring is a method of modeling potential risk of credit applicants. It involves using different statistical techniques and past historical data to create a credit score that financial institutions use to assess credit applicants in terms of risk. Credit scoring is essentially a type of classification problem: which credit applicants should be considered good risks and which applicants should be considered bad risks.

A scorecard model is built from a number of characteristic inputs. Each characteristic is comprised of a number of attributes. In the example scorecard shown in Figure 1, age is a characteristic and "25–33" is an attribute. Each attribute is associated with a number of scorecard points. These scorecard points are statistically assigned to differentiate risk, based on the predictive power of the variables, correlation between the variables, and business considerations.

For example, in Figure 1, the credit application of a 32 year old person, who owns his own home and makes $30,000, would be accepted for credit by this institution. The total score of an applicant is the sum of the scores for each attribute present in the scorecard. Lower scores imply a higher risk of default, and higher scores imply lower risk.

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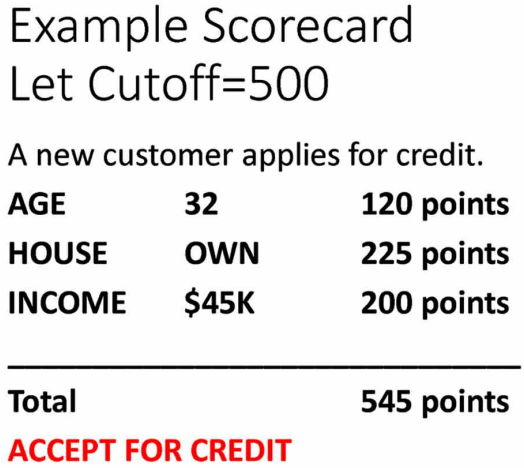
Figure 1. Example scorecard



Characteristic Name	Attribute	Scorecard Points
AGE	Up to 25	100
AGE	26-33	120
AGE	34-45	185
AGE	45+	225
HOUSE	OWN	225
HOUSE	RENT	110
INCOME	Up to $10K	120
INCOME	10K-25K	140
INCOME	26K-35K	160
INCOME	36K-50K	200
INCOME	50K+	240

Credit, as it has evolved since the 1950's, it is cold and impersonal, completely based on numbers--what you owe, what you've paid, how much money you have. The numbers all get hacked down to one number: a credit score. The bigger and more complex the global financial system gets, the less it cares about anything other than the applicant's credit score. Banking institutions are becoming less and less personal with online and mobile banking applications. Very few people know the local bank manager at their hometown bank anymore. A credit applicant's personal story is not taken into account when applying for a financial loan. The credit applicant's "character" fits into the bank's algorithms about as well as peanut butter fits into the workings of a Swiss watch.

One consequence of this system is that it is biased against poor people, people with no bank accounts or very little credit history ("thin files") and young people. These types of applicants cannot obtain credit because they cannot generate the financial metrics that would providence evidence to determine if these applicants should be granted or rejected for a financial loan. It is these several billion people who would be the most enthusiastic first customers of a new kind of credit based less on numbers and more on character. The need to market to and provide credit to these types of applicants marks the emergence of a social media credit score.

This chapter will describe how banks and financial organizations are starting to incorporate big data sources, such as data from social media websites, into the credit lending process. A discussion of how more established organizations, such as FICO and SAS, are incorporating big data in their scorecard methodology will be given. A description of two start-up companies which are using electronic and big data sources such as social media to provide banking services and grant loans will be discussed.

BACKGROUND

The statistical methods used to categorize objects into groups can be traced to 1936 in Fisher's publication (Fisher, 1936). Durand (1941) was the first to use Fisher's methodology to distinguish between good

and bad loans. Using this research, the founders of credit scoring, Bill Fair and Earl Isaac, built the first credit scoring system for the United States in 1958. Although credit scoring has been in use since that time, it is only recently that credit scoring has become widespread.

There are some older, yet still very relevant, credit scoring resources that discuss the statistical issues in developing a credit scorecard (Siddiqi, 2006; Thomas, Oliver, & Hand, 2005; Hand & Henley, 1997). These references provide a traditional framework that credit analysts have used in the past to develop credit scores.

As with any other business sector that is highly data dependent, the credit scoring world has felt the impact of the big data phenomenon that is sweeping through modern businesses (Lohr, 2015). Banks are moving away from using traditional statistical techniques to build a credit scorecard. Financial organizations are combining the traditional techniques with new big data technology and big data analytics to build their scorecards. With the rise of companies using social media data as a tool to build better predictive models, financial institutions are integrating big data sources in calculating credit risk (Fei et al., 2015). Recently, even Facebook is hinting at entering the social media credit arena. Facebook has recently made its Messenger application the ability to make financial payments, similar to Apple Pay. What is interesting about Facebook's decision is that it will allow Facebook to collect data on their customer's financial payments and coupled with the already-abundant social media data it has, this decision allows Facebook to become a stand-alone financial lending institution that can incorporate character into the credit score (Maney, 2016).

Wei et al. (2015) provide the most contemporary and comprehensive review of incorporating social media data into an applicant's credit score. The article examines credit scoring models that are built with and without social media data in order to study whether the incorporation of social media data into a credit score provides an advantage to financial lending companies. The article also examines whether potential credit applicants change their social media profiles and perhaps start making more strategic social media connections once a credit applicant knows they are being assess based on their social media activity and persona. And, lastly the paper examines how incorporating social media provides a more even-level playing field for some of those disenfranchised groups that have been traditionally overlooked.

MAIN FOCUS OF THE ARTICLE

In the last several years, financial institutions have begun exploring ways to incorporate an applicant's social media activity such as Facebook and Twitter into the risk associated with a loan. The main advantage for a financial institution using such expanded data sources is the shorter time frame to deploy a credit scoring model. In a traditional credit scoring scenario, it can take 12 to 18 months to update a scorecard model with new data. This time lag results from lenders having to verify the new data, determining if the new data impacts other departments of the institution, and taking time for employees to learn how to use the new information to make decisions on credit worthiness, pricing and cross-selling (Adams, 2012).

Another advantage of using big data sources such as social media data is that social media data allows financial institutions with a broader view of the applicant's background other than traditional data sources, such as the bank's own customer data. The type of data collected from social media sources is wide and varied and provides insight into an applicant's lifestyle and behaviors. Social media data can provide can provide genuine demonstrations of behavior that point to an applicant's capability and

likelihood of meeting repayment terms. For those applicants with "thin files" or young people, utilizing social media data to establish a credit footprint may be a sensible idea (Thomas, 2015).

By using big data sources and the associated big data analytics, a bank can increase:

- **Efficiency:** Is essential to banks that collect and analyze vast volumes of data. Accessing and analyzing various types of structured and unstructured data as soon as it is captured is essential in staying relevant to electronic banking customers.
- **Profitability:** Big data sources allow a bank to reach customers in ways that were never possible. By using online banking and social media applications, a bank can correspond with a customer at precisely the right time through online campaigns and messaging.
- **Customer Interactions:** Many banks are using big data and social media sources to shift their focus from product-centric to customer-centric. The bank's goal is to understand what the customer needs from each banking interaction so that each point of contact with the bank will be ideal. Big data analytics mine millions and billions of rows of customer and transaction data in order to develop specialized campaigns and offers for the customer.

A specific facet of big data is information collected from social media. Using social media data is still an evolving avenue for many financial organizations. Social media is one of the most effective ways to find out what customers like and do not like, as well as the type of banking relationship the customer expects from the financial institution. Social media can be used as a marketing tool for a bank; in a recent article, Ally Bank utilized social media exclusively to promote retirement products (DePaula, 2015). The aim of the social media campaign was to encourage younger people to start thinking about and saving for retirement but also to engage a retiree crowd over the age of 65. Some of the social media campaigns Ally developed was to give away $150 gift cards to generate interest in savings accounts on Pinterest, created Google hangouts and Twitter chats so that people could talk about retirement and savings, and created YouTube videos. The benefit of creating a social media marketing campaign for Ally is that the interest does not immediately dwindle like a traditional television or radio ad. Bank customers have the ability to keep the conversation going.

Another aspect of social media that banks are leveraging is customer activity on social media sites; this would be used to calculate part of their credit score. Banks hope to use social media activity to develop a sort of social media credit score. This concept is based on the traditional credit score, but it is very difficult to define exactly how to calculate a social media credit score. Currently, a social media credit score concerns how others in your social network view you. For example, what would be the impressions of a bank official if he were to research you? Are you an influential person -- that is, do you have the power to persuade others in your social network to buy a product you recommend, or sign up for a particular service? Are you positive or negative regarding the social media decisions you make? Financial institutions are currently turning the answers into these questions to develop a financial measurement and use that measurement either as a component of traditional credit scores or as the sole credit worthiness measurement of a customer.

What exactly constitutes social media activity? Below is a list of common social media outlets that banks access to develop a social media credit score.

- **Facebook:** The world's largest social media site is a wealth of information for anyone permitted access using the 'friend' status. Anyone who is a friend can see your profile and information unless the appropriate privacy settings are activated.
- **Twitter:** 140 characters can say a lot about someone, as this messaging system proves. Many Twitter fans tweet about themselves daily. Searching Twitter can reveal any comment a person has made about themselves or someone else.
- **LinkedIn:** LinkedIn is an online resume network. You can post current and past jobs, active organizations, and awards.

One way that financial institutions are measuring a customer's social media influence is using a Klout score. Klout is a social credit score (Wagstaff, 2012). Klout measures an individual's influence online, with influence defined as the ability to drive others to action. When online content is produced, Klout looks at how the individual's network responds to that content. Klout takes in data from social networks and gives an overall score based on online influence. The data is from public networks such as Facebook, Twitter, Google+, LinkedIn, and Foursquare. Klout process about 3 billion pieces of content and connections daily and produces a new, accurate score for each Klout member every morning (Fernandez, 2011).

In the sections that follow, we will examine how organizations are incorporating big data sources such as social media into their banking and credit scoring applications.

FICO

FICO is a leading analytics software company, helping businesses in 90+ countries make better decisions that drive higher levels of growth, profitability and customer satisfaction. The company's groundbreaking use of big data and statistical algorithms to predict consumer behavior has transformed entire industries. FICO provides analytics software and tools used across multiple industries to manage risk, fight fraud, build more profitable customer relationships, optimize operations and meet strict government regulations. Probably the most well-known analytical tool is the FICO score, the standard measure of consumer credit risk in the United States.

FICO has recently started experimenting with incorporating social media data into their credit scores. FICO has determined, using big data algorithms to analyze social media, that if a potential credit applicant has used the word 'wasted' in their profile that it has predictive power of whether the applicant is going to repay a loan or not (Hardekop, 2015). However, just because FICO has figured out this 'nugget of gold' in the big data landscape, it does not mean that FICO is using social media data to construct a credit score. In fact, FICO does not use social media data to calculate a credit score due to regulatory restrictions. However, FICO is piloting a new score called FICO Score XD that does incorporate big data sources. This credit score is aimed at the cohort of individuals that the Introduction section discusses; people who have no credit history or are invisible to the credit scoring system. FICO Score XD incorporates mobile phone, utility, and rent payment histories, property and tax data are also incorporated into the credit score. According to Christina Goeth, a FICO spokeswoman,

FICO Score XD is currently designed to only score consumers that are not scorable with traditional credit data. The algorithm checks to determine if a traditional FICO Score can be generated first, and if it can, the traditional score is returned to the lender. If it cannot, FICO Score XD provides a second chance to get approved. The goal of FICO Score XD is to expand access to credit. (Selyukh, 2016)

SAS

SAS is well known for its analytical software. SAS offers a series of products aimed at credit risk managers, such as SAS Credit Scoring for Banking and SAS Real Time Decision Manager. Credit Scoring for Banking mines and organizes data, then uses that information to develop consumer scorecards and perform compliance with Basel II requirements for management of credit risks for pools of loans. Decision Manager produces real-time recommendations via data channels such as websites, call centers, and ATMs to aid a bank in making credit management decisions such as loan approvals and credit card increases. To further speed updates and expansion of data used in scoring, SAS's High Performance Analytics searches data sets that include billions of information items to locate correlations between different data sources that can be combined to accelerate the development of new predictive scorecards.

Lenddo

One of the larger players in the social media credit scoring business is Lenddo. Lenddo is one of the more established companies, with its inception in 2011. The co-founders of Lenddo realized that more than one billion people in developing countries were starting to move into the middle class and would need access to credit (King, 2014). The initial intent of Lenddo was to offer small, targeted loans to individuals in developing countries. The purpose of the loans was to give the rising middle class in developing countries access to credit, as many individuals in these countries lack credit histories because there is no financial infrastructure for an applicant to establish a traditional credit history. The purpose of Lenddo loans must be to enrich the customer's life through education, healthcare, or home improvement. These loans could work well for an individual who wants to take a career-development class, but lacks cash and cannot qualify for a traditional loan due to a lack of credit history. The applicant can leverage what he or she does have -- a connected network of online friends and colleagues.

Lenddo uses non-traditional data sources to compute applicant's credit scores. Lenddo uses only social media data to determine the creditworthiness of applicants (Anderson & Hardin, 2014). To apply for a loan, the first step in Lenddo is to create a profile and upload a photo to the website. Then, the individual connects to social networks and invites friends and family to be part of what Lenddo calls the "trusted network." Lenddo uses a social network algorithm to evaluate the "trusted network" and develop a Lenddo score. The higher the Lenddo score, the more access to loans an applicant will have. If the applicant is granted the loan, the applicant's entire social network is kept informed of the applicant's payment history (Anderson & Hardin, 2014).

Moven

Moven, formerly known as Movenbank is currently generating excitement with their use of social media data in a banking environment. Moven is a completely online and mobile company; its motto is "no paper, no plastic, no hidden fees" (King, 2012). The bank has no physical locations and will not issue any physical debit or credit cards. The premise behind Moven is that it will control the digital front end of the customer relationship and partner with traditional banks to handle the deposits. Moven provides financial services through a mix of mobile and web modes such as banking applications enabled using smart phones.

The founding of a company like Moven is in response to banking customers living in a digital age. A recent study showed that it is not only millennials that are wanting personalized, anytime, anywhere services from their banking relationships. Cisco conducted a survey of over 7,000 individuals in 12 different countries and found that there was a gap between the consumer behavior and their current bank's ability to offer personalized and convenient services and products (Cisco, 2014). To understand and respond to digital customer's better, Moven is providing applications that offer real-time banking advice and incorporate social media data into the development of a credit score.

Moven recently developed a smartwatch application that gives a customer real-time banking information and budget advice. The new timepiece version of the app provides a stripped-down analysis of the wearer's spending habits. For example, as a customer walks out of Starbucks, the applicaton provides an alert telling how much was just spent and whether the customer is in good shape budget-wise or should start using the office Keurig. The application's spending meter turns red, green or yellow depending on how much the customer has spent overall in the current month versus the previous month (Crosman, 2015).

Moven is using social media profiles including Facebook, LinkedIn, and Twitter to determine personality traits about a consumer which might help to predict their ability and willingness to payback credit. Movenbank uses the personal information stored in social media sites such as Facebook to construct a one-on-one personal financial relationship with the customer. Online engagement methods such as messaging will also encourage customers to increase money in their savings accounts.

Moven has developed a product called CRED™ score, which combines traditional scoring elements and social media data. Moven seeks to determine a sort of digital credibility standing of a customer using their social media information. Taking into account an individual's traditional credit score in addition to a customer's use of digital payment channels, social connectivity and money management beliefs, CRED™ score assesses risk as well as a customer's financial potential. Unlike a credit score, CRED™ score is designed to be a sort of financial health or wellness score, like a calorie counter on your phone – a score that goes up when a customer gets better at saving or managing their money (Moven, 2016) . CRED™ score is trade-off for individuals who use it, where individuals have to be willing to share their social data to participate in building better financial health.

FUTURE DIRECTIONS

As we become more and more of a digital society through online banking and shopping, there are several areas of technology that will see drastic changes in the financial field.

- **Storage:** Hard drives, jump drives, and servers will soon be items of the past. New emerging technology will be needed to collect, store, preserve, manage, and analyze unstructured streaming data that social media outlets produce.
- **Commerce:** In time, all credit agencies and financial organizations may use social media information as a component of a consumer's credit score. As more shopping moves online and physical money such as $10 and $20 bills are vastly becoming digital 1's and 0's, it will more important to calculate the financial risk of individuals.
- **Software Developments:** In the next few years, we will see the development of distributed computing technology, such as Hadoop, to perform serious scalable computing. New advances in big

data analytics will be developed to deal with the flood of web data produced from clickstreams from a website with millions of users.

More credit data is available than ever before through unstructured data sources and social media outlets. The challenge for banks and other financial institutions is to quickly capture that data and make decisions. Similarly, the credit industry has never experienced such a growth of available data. The challenge will be to invent innovative credit scorecard models that can rapidly adapt to changing data in real-time.

CONCLUSION

Modern data processing systems have ensured that virtually all banks and financial institutions have rich data sources to mine. However, merely having volumes of data is no longer a source of competitive advantage. Data has become a commodity and therefore needs to be honed and enriched further to derive that extra advantage needed to differentiate results. Therefore, to form and sustain a differentiator strategy, the existing data has to be supplemented with unstructured and social media data sources to give the overall information a whole new dimension.

The rapidly expanding social media arena provides a new source of information flow. Tapping into the collective intelligence and sentiments of the crowd through aggregated mining of their social posts provides clues to consumer thought. At a bank, the concept of the 360-degree view of the customers ascends to an entirely new level in the context of accessing their social media interactions.

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KEY TERMS AND DEFINITIONS

Credit Score: A measure of risk associated with how likely an individual is to re-pay a financial loan.

Hadoop: Open source software that stores and analyzes massive unstructured data sets.

Klout Score: A Klout score is a numerical measure on the scale of 1 to 100 that measures how influential an individual is in an online social network setting. The higher the Klout score the more influential the individual is considered. For example, is a person influential in getting others to buy a product or sign up for a service.

Social Media: A web-based social outlet. Social media may be in the form of online websites that allow individuals to communicate and establish social networks such as Facebook and web-based videos like those viewed on YouTube.

Social Media Credit Score: A measure of social risk that is created using information from social media outlets.

Structured Data Source: Data that contains an identifiable structure. Structured data is typically stored in traditional databases with identifiable rows and columns.

Tweet: A posting on the social media site Twitter that consists of 140 characters or less.

Unstructured Data Source: Data that has no defined identification such as e-mails, images, text and web logs, and videos. Unstructured data is data that is not contained in a database.

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Chapter 44
Social Network Analysis and the Study of University Industry Relations

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ABSTRACT

The aim of this chapter is to give an overview of the use of social network analysis in the study of university industry relations. The structure of networks can be analyzed through the lens of social network analysis. This methodological approach is briefly described, and its fundamental concepts are presented. The chapter reviews the applications of this approach on the study of university industry relations. Different structures in the relations may result in different innovation outcomes, and the use of SNA may be particularly useful to understand differential outcomes. This chapter is based on a review of available literature on the topics. The chapter aims at systematizing the information and knowledge related to the application of SNA on university industry networks, highlighting the main research pathways, the main conclusions, and pointing to possible future research questions.

INTRODUCTION

The methodological approach of Social Network Analysis (from now on, abbreviated SNA) can bring many benefits for the study of university and industry relations (from now on, abbreviated UIR). Relations between university and industry are important in innovation studies because they can be considered as an innovation network, in the sense that the interactions established by their participants have more or less defined innovation goals (Mansfield & Lee, 1996). SNA is the study of social structure (Wellman & Berkowitz, 1988). It describes a group of quantitative methods for analysing the ties among social entities and their implications (Wasserman & Faust, 2007). With the use of SNA it is possible to explore and to better understand different innovation outcomes involving UIR, by analysing the different measures and the structure of the social network. In this work the SNA methodological approach is described and its fundamental concepts are presented. The paper then reviews the applications of this approach on the

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study of the relationships between university and industry. The paper aims at systematizing the available information and knowledge, highlighting the main research pathways, the main conclusions and pointing possible future research questions.

BACKGROUND

UIR is an increasingly important and researched phenomena. Theoretically and structurally, the theme is linked to the study of the innovation process and to the need of understanding it and influencing it. Linear perspectives of the innovation process placed the university at the beginning of a linear sequence of innovation and the firm at the end of it, largely ignoring the interaction between the two types of institutions. New, interactive, dynamic, complex perspectives see the innovation process as a system involving many institutional actors, as a network of relations and as a complicated web of knowledge exchange and utilization. Science and technology are increasingly complex and costly and no single actor commands the necessary resources, relying on multiple sources of information and knowledge exchanges that are crucial for a successful innovation process. In this context, and considering the many types of relations and actors that may be possible in the innovation process, the relationships between academia and industry stand out as particularly relevant, because of the type of institutions that participate and the nature of the information and knowledge that is exchanged. The literature on UIR has raised many issues on the theme, and debates are ongoing, which can be found in some review articles (Baldwin & Green, 1984; D'Este & Patel, 2007; Perkmann et al., 2013). Only some of the issues and debates will be explored here, namely those researched by SNA concepts. They will be referred in more detail in the following section, along with the presentation of the results of the literature review, which is the main focus of this work.

SNA is the study of social structure using a group of quantitative methods. It analyses ties among social entities and looks for key players and group patterns. SNA uses concepts that are related to the structural properties of the network and indicators that are related to relational properties of the network. The most used concepts related to structural properties of the network in UIR studies are the concepts of density, component, and subgroups. The most used social network analysis concepts related to relational properties of the network are the concepts of degree centrality, betweenness centrality and geodesic distance.

The concepts related to structural properties of the network are basic and important concepts that characterize the overall structure of the network. Through the concept of density (which indicates the level of connection between all the nodes of the network) it characterizes its global cohesion. Through the concept of component (which indicates the existence of large groups inside the network) and through the concepts of subgroups or cliques (which indicates the existence of smaller, cohesive, specifically defined groups) it characterizes its internal structure. The combination of these indicators and an adequate interpretation of their meaning provides useful descriptions and characterizations of the network, in terms of the position of their nodes and constituents. The characterization is frequently complemented with visual aids, namely through sociograms. Sociograms are diagrams composed of nodes and lines. The nodes are the actors of the network and the lines are the connections between the actors. The concepts related to relational properties of the network are often at the centre of the analytic procedure, and are used in several ways according to specific research objectives. The concept of degree centrality (which

indicates the extent of a node connection) identifies the most connected actors. The concept of betweenness centrality (which captures the intermediary nature of a particular node's connection) is used to identify and characterize the intermediary positions of actors in the network. Besides the main concepts referred above, other concepts related to these ones are also used, but less often. All these concepts are mathematically defined, but it is beyond the scope of this paper to provide detailed algebraic specifications, which are available in several books (Scott, 2000; Wasserman & Faust, 2007).

THE LITERATURE REVIEW

General Aspects and a Synthesis of the Main Results

There is not a great number of articles that addresses specifically the problem of UIR using SNA techniques. There is a variety of perspectives that reflect specific and idiosyncratic concerns of the authors. Few papers follow the same guidelines or share identical perspectives. However, there are small groups of authors that build on past works or use identical databases, such as patent databases.

In terms of the main study object or main research preoccupation the studies can be classified in the following categories: 1) the study of the characteristics of personnel/institutional networks that are prominent in university-industry relations; these studies generally rely on the use of patents that are co-produced jointly by university and non-university members, and the patterns of collaboration are analysed; 2) the study of university-industry relations in the context of specific industrial settings or in the context of specific institutional conditions; these studies may rely also on patent databases but other types of data may be used, either primary data, obtained through questionnaires, or secondary data, obtained through diverse documental sources; 3) the contribution of the study of university-industry relations to the validation of theories; these studies also rely on a mix of patent, primary and secondary data.

In addition to these themes there are other themes that are addressed in these studies, either in a parallel way or as themes that frame the former or the research approach. The themes that could be common to the papers are, in broad terms, the three main themes above indicated but, within each one, the approach and main research concerns and targets are quite different. The literature will be analysed not through the lens of the broad themes, but through the details of the specific papers. This methodology will permit to extract from the papers the main academic debates and to highlight the respective contributions to knowledge. The next sections will perform that task. Table 1 synthesises the results.

The table indicates the main identified concepts on UIR that have been researched using SNA. It is possible to divide those concepts in four groups. The first one includes the two first concepts, which are related to intrinsic structural properties of the network. The second group includes the two following concepts, which are related to institutional and knowledge characteristics of the network. The third group includes the next three concepts, which are related to specific patterns found in networks. The fourth group includes the last two concepts of the table, which are related to the validation of existing theories. The last concept is related to the search for new methodological approaches, mainly related to the use of new data sets. The main results and the literature for each concept will be described and explored in the following sections.

Table 1. University-industry relations and social network analysis: main debates and conceptual propositions arising from the literature review

Main Concepts	References (Authors, Year)	Conceptual Propositions Proposed by the Literature
Strong and weak ties, structural holes	(Gilsing & Duysters, 2008; Rost, 2011; van der Valk, Chappin, & Gijsbers, 2011; Villanueva-Felez, Molas-Gallart, & Escriba-Esteve, 2013)	• Balanced social structures (strong ties with some weak ties) seem to be more innovative. • Differential outcomes on the nature of knowledge contingent on the specific balance of the structure of social capital.
"Small worlds" networks	(Balconi, Breschi, & Lissoni, 2004; Guan & Zhao, 2013; Protogerou, Caloghirou, & Siokas, 2013; van der Valk et al., 2011)	Networks with high clustering and short average geodesic paths are more conducive to inventive or innovative activity.
Open-science and proprietary technology	(Balconi et al., 2004; Jason Owen-Smith & Powell, 2004)	• The institutional attributes of open science and proprietary technology influences network structure. • Open science networks are more connected and dense than proprietary networks that are more fragmented and disperse.
Knowledge base and environment as relational factors	(Gilsing & Duysters, 2008; Krätke & Brandt, 2008; Leydesdorff, 2004; J. Owen-Smith, Riccaboni, Pammolli, & Powell, 2002; Plum & Hassink, 2011)	Different knowledge bases affect network structural properties, the position of individual entities in the network and their capacity to access knowledge
Patterns of university-industry relations	(Gilsing & Duysters, 2008; Krätke & Brandt, 2008; Leydesdorff, 2004)	• Patterns are influenced by regional industrial structures. • Biotechnology has a specific pattern of university-industry interaction.
Public research organizations as central actors in innovation networks	(Breschi & Catalini, 2010; De Stefano & Zaccarin, 2013; Lissoni, 2010; Minguillo & Thelwall, 2012; Protogerou et al., 2013)	• Academic authors-inventors assume more brokerage positions. • Public research organization are at the centre of innovation programmes.
Influence of commercial orientation on fundamental science production	(Balconi & Laboranti, 2006)	Academics more connected to industry are more productive in scientific terms.
Industrial districts	(Capo-Vicedo, Molina-Morales, & Capo, 2013; Morrison, 2008)	• Public research organization as main intermediaries of knowledge flows to the district. • Weak knowledge exchanges but strong information exchanges inside the district actors.
Triple-helix theory	(Heimeriks, Hörlesberger, & Van Den Besselaar, 2003; Khan & Park, 2013)	• Triple helix assumptions on institutional role intersections are supported. • Multiple communication channels with differential roles in the Triple Helix relation.
Methodological contributions	(Heimeriks et al., 2003; Kim, 2012; Minguillo & Thelwall, 2012)	Asides from patents indicators, other indicators and data unmask fundamental structural or relational properties.

Strong and Weak Ties, and Structural Holes

The influence of the nature of the relation on the performance of the network is a debated issue. The concepts of strong and weak ties were introduced by Granovetter (1973). Strong ties represents strong and regular interactions between the actors (nodes) of the network and weak ties represent sporadic and temporary interactions.

Coleman (1988) claimed that cohesive groups and strong ties were effective ways to coordinate an exchange of knowledge flows, while Burt (1992) argued that strong ties resulted in redundant information and that innovation required new knowledge inflows and perspectives coming from weak ties. Unfulfilled connections between groups with internal strong ties are said to be structural holes, which can be filled by specific actors, with strong intermediary positions. Villanueva-Felez et al. (2013) apply these concepts to assess in which way the structure of researchers' social capital affects academic performance. The authors distinguish between academics that are completely embedded in a network that has no weak ties (establishing links with members of his or her own department, without ties with government, industrial, or other societal actors), academics which are in a network that is formed predominantly by weak ties, and academics that are in an integrated network that contains both strong and weak ties. The results show that the academics in the network with no weak ties are the less productive. On a study of a network of inventors and on the assessment of the impact of patents (based on forward citations) and integration of knowledge (based on backward citations), Rost (2011) concludes that inventors with balanced social capital (strong ties but also some weak ties) come up with the most innovative solutions, or integrate the most knowledge or have the highest impact on future knowledge. He concludes that Coleman's and Burt's perspectives are complementary and that in the presence of strong ties, weak network structures (structural holes or peripheral position) leverage the strength of strong ties in the creation of innovation. Similar arguments are advanced in a visual network analysis of two government sponsored programmes that aimed to foster innovation through public-private partnerships (van der Valk et al., 2011) and also by other studies of university-industry relations or industry networks (Ahuja, 2000; Gilsing & Duysters, 2008).

"Small Worlds" Networks

The open science characteristics of scientific communities translate, in social network terms, into the so-called networks with "small worlds" characteristics (Albert & Barabási, 2002). The small world properties, in the context of scientific networks in a specific discipline, are defined by the existence of a large component connecting almost all nodes and within the large component, all nodes (scientists) are close to each other (Albert & Barabási, 2002; Newman, 2001). These characteristics of academic networks are not found in networks of non-academic inventors, except in since-based fields. The influence of small world properties on innovativeness is addressed in studies of industry networks (Verspagen & Duysters, 2004) and in university-industry networks (Guan & Zhao, 2013), and generally considered to be positive, although there are disagreements concerning this positive influence (Fleming, King Iii, & Juda, 2007).

Open Science and Proprietary Technology

The analyses of patent databases provides the basis for the exploration of another important concept, which is debated in multiple forms and in its multiple consequences in studies of university-industry relations, which is the distinction between the characteristics of open science and proprietary technology (Cowan & Jonard, 2003; Merton, 1957). The debate can be inserted in a larger debate concerning the influence of diverse institutional conditions on processes of relations between organizational entities. Balconi et al. (2004) conduct a study of Italian academic and industrial inventors whereby, departing from assumptions on the behaviour or characteristics of "open science" networks and "proprietary networks", expect to find differences between the networks of academic and non-academic inventor. In

fact, the study found that networks of industrial inventors are much more fragmented than networks of academic inventors, except in the chemistry field (defined in a broad sense, i.e. including biotechnology). The chemistry sector, science-based field, was different because it was influenced by the institutional weight of scientific inputs in commercial technology.

Knowledge Based and Environmental Conditions as Relational Factors

Other articles support the importance of environmental factors in shaping specific properties of networks. A study of the Boston biotechnology sector (Jason Owen-Smith & Powell, 2004) found that the information flows between the actors of the network, which included firms and public research organizations, depended not only on network participation and geographic proximity, but also on the institutional characteristics of the network. In public-dominated networks firm performance depended only on net participation, unlike in networks dominated by private entities, where innovative performance depended on position factors, i.e., their closeness to central actors (although this characteristic was weak in terms of statistical significance).

An important determinant of cooperation between university and industry, and an important factor in terms of innovative performance, seems to be related to the position of the firm in the network. That position may be related to geography (Balconi & Laboranti, 2006) or that position may be related to the knowledge base that the firm possesses and that may confer the firm the possibility to connect with more or less central actors of the network. A study of an industrial network in Germany (Cantner & Graf, 2006) argues that a prerequisite for future cooperation is not based on past cooperation but rather on a shared knowledge base. It puts in question ideas that argue that persistent cooperation, based on trust, is necessarily the basis for collaboration. In a study of two industrial networks (biotechnology and multimedia) in a period that was characterised by the transition of an existing dominant design and a shift away from rules, norms, routines or activities, Gilsing and Duysters (2008) argue that environmental conditions related to different knowledge bases, and the validation and selection mechanisms inherent to each of the two fields, explain the relational and structural properties of the two networks. For instance, the connection of public research organizations is centrally present in the biotechnology field but absent in the multimedia field (Gilsing & Duysters, 2008).

Differences in the knowledge base show up as an important factor in the determination of collaboration structures in another study involving biotechnology firms in a regional context (Plum & Hassink, 2011). It points to differences related to internal competencies of the firms regarding differential capabilities in terms of the nature of the knowledge required to develop the differential products of each firm, in which the knowledge of the market also has a role.

Although in a quite different perspective, a study of the differences between the structures of two networks emphasises the importance of environment in shaping the properties of the network (Capellari & De Stefano, 2014). Patents that are owned by the university (which is the assignee) or invented by the university (the university is not the assignee but at least one of the inventors is a tenured academic), are analysed separately, showing differences in terms of size of components, number and size of subgroups and the brokerage position of inventors. The institutional factors are mediated by two universities that have different policies related to patenting ownership.

Patterns of University-Industry Relations

Databases on scientific literature have been extensively used to analyse the patterns of collaboration between scientists. Patent databases are also being explored to analyse the patterns of collaboration between academia and industry.

An exploratory analysis of the simultaneous embeddedness of researchers in scientific and technological networks (Breschi & Catalini, 2010), which compares networks of authors, inventors and authors-inventors, and the overlap between them, argues that author-inventors play a crucial role in connecting the two other networks (only authors and only inventors) and occupy important positions in each community. The role of academics as fundamental intermediaries between public and private research is explored in a study (Lissoni, 2010) that founds that academic inventors tend to be more central actors in broker and gatekeeping positions, although strong brokerage positions are very few and held by scientist with many patents and publications. De Stefano and Zaccarin (2013) reach similar conclusions regarding the larger relational activity of academic authors-inventors vis-a-vis industrial authors-inventors.

Two important differences were also apparent in Balconi et al. (2004): academic inventors were more connected than non-academic inventors, and had a more central position. The central position of academics, or of the university, is a characteristic that often shows up in analysis of networks where public research organisations are involved (Balconi & Laboranti, 2006; Breschi & Catalini, 2010; Jason Owen-Smith & Powell, 2004; Protogerou et al., 2013).

The knowledge base of patents is researched to see how much innovation is really based on science (Leydesdorff, 2004). This question is important because theories about university-industry relations are historically influenced by the biotechnology sector. The biotechnology is a science-based sector whose inventive activities tend to be performed in close collaboration with public research organizations and whose output is patented through co-authorships or co-assignments between academic and industrial inventors. The access and the analysis of patents databases have become easier and many studies have thus relied on these data to infer general conclusions to other fields of science, that are not so formalized in terms of literature relations. The study analysis two sets of patents, extracted from the USPTO, one based on patents that have a university as a co-assignee, and another that has a Dutch address as an assignee. The structure of the co-words networks linking patents and their citations to other patents and scientific literature is analysed. The analysis is entirely based on the visualization of sociograms, while nodes are (co)words). The two networks are quite different. In the set of university patents (which represents university-industry relations) the fields of biotechnology and molecular biology dominate the set and the knowledge base of the patents, and the visualising shows a neat organization around the intellectual organization of the disciplines. In the set of Dutch patents (representing the knowledge base of the international economy) the visualization shows a recognizable representation of the Dutch industrial structure with a dominance of electro-technical and chemical applications and large multinational corporations. Although biomedical application integrates the patents they are not central to the whole set. These results strongly suggest that inferences of university-industry relations based on literature and patent analyses are heavily conditioned by the specificity of the biotechnology sector.

Public Research Organizations as Central Actors in Innovation Networks

The central position of public research organizations shows up in descriptive analyses of networks that involve heterogeneous actors. Both a study of the network structure of science parks (Minguillo &

Thelwall, 2012), using web links as indicators of connections, and a study of the collaborative networks established during the seven Framework Programme on Research and Technological Development of European Commission, show the central position of public research organizations. In the study of science parks, governmental agencies also play an important role, and in the case of the Framework Programmes, although firms are present in larger numbers, they are not the central actors.

Influence of Commercial Orientation on Fundamental Science

The impact on fundamental research of an orientation to patenting and commercialization has been researched trough the relationship between patenting activity and publication record of university researchers, and in general the results point to a positive correlation between patenting and publication activity (Czarnitzki, Glänzel, & Hussinger, 2009). This theme is revived with a social network approach (Balconi & Laboranti, 2006) and the results support the positive relationship between publication record and patenting activity. The author argues, in line with other similar arguments (Rosenberg & Nelson, 1994), that industry feeds on academic research but that academic research also needs inputs from high technology industries in order to find direction to its research. So, academics that are close and collaborate with industry producing patents are also the ones that are more productive in purely scientific terms.

Industrial Districts

There is a strand of research of university-industry relations using social network analysis methods that adopt a deductive approach and try to validate some relatively entrenched conceptual implications of some theories.

One of the researched theories looks at the implications of the industrial district approach. Morrison (2008), in her study of the furniture sector in Italy, argues that the community of informal ties appears to be rather small and that 'know how' sharing is also rather limited, contrary to assumptions from industrial district theorists that based their ideas on the development of these concentrated regions on intense knowledge exchange between the actors. It, however, supports the argument that public research organizations, more than large firms, play a central role and as intermediaries in the knowledge flows for innovation that occur in the industrial district, and that knowledge for innovation does not arise only from the close interactions of the firms of the district, an idea that is also supported by a study of a Spanish textile industrial district (Capo-Vicedo et al., 2013).

Triple-Helix Theory

The implications of the triple-helix approach are also examined. Using webometric indicators and semantic analysis of the contents of the webpages Kim (2012) found that university and industry websites were similar, thus suggesting there is an intersection or interchangeability of the roles and function of the two types of organizations, as suggested by the triple-helix theory (Etzkowitz & Leydesdorff, 1998). Diverse channels of communication and relations between the diverse institutional actors (co-authorship, participation in projects, information diffusion) is also explored in Heimeriks et al. (2003) which argues that each communication channel or media has different functional purposes in maintaining in the maintenance of the links of the triple-helix relation.

Methodological Contributions

Finally, there is a search for alternative methodological approaches and indicators in the studies of networks of university-industry relations. Some authors propose the use of webometric approaches (Kim, 2012; Minguillo & Thelwall, 2012) and other authors propose the use of simultaneous indicators of relational characteristics, such as citations, project participation, questionnaires or other data (Almodovar & Teixeira, 2014; Furukawa, Shirakawa, & Okuwada, 2011; Heimeriks et al., 2003), arguing that analysis based on a single indicator underestimate the level and may not capture all of the complexities of the collaboration patterns.

FUTURE RESEARCH DIRECTIONS

Some possible research paths are open. Eventually, the use of more complex and elaborated concepts of network analysis could improve the analysis of data, it may have the potential to reach different or stronger evidence and conclusions, and it may be an aspect that must be improved. The diversity and plurality of university-industry relations has not been properly addressed in the literature, which tends to use patents as indicators of collaboration. New sources of data must be explored. Environmental and institutional influences of diverse sorts are clearly very important factors that condition and determine university-industry relations, and research is open to greater exploratory efforts. There is a considerable potential to test theoretical and conceptual propositions which are assumed but have scarce empirical support.

CONCLUSION

The use of social network analysis in the study of university-industry relations was reviewed in this study. There are not many studies that combine the two perspectives and the ones that exist follow different research objectives and concerns and different methodological proposals. It seems evident that this particular knowledge quest is in a highly exploratory phase. Nevertheless, the contributions to knowledge have been varied and important, ranging from purely descriptive studies and methodological explorations to deductive testing of established theories.

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KEY TERMS AND DEFINITIONS

Betweenness Centrality: A social network analysis measure that indicates how much a node is in the middle of the connections between other nodes.

Degree Centrality: A social network analysis measure that indicates the number of other nodes to which the node is connected.

Density: A social network analysis measure that describes the level of linkages between nodes in a network. The more nodes are connected to each other, the denser the network is.

Innovation Process: Is a complex social and technical process that transforms ideas and technologies into new or improved products or services.

Open Science: Open science is generally, but not exclusively, performed in university settings and is characterized by the wide non-commercial dissemination of research results and scientific knowledge.

Proprietary Technology: Is characterized by the appropriation by private entities of specific claims on technology, generally, but not exclusively, through the legal mechanism of patenting.

Social Network Analysis: A methodological approach that employs quantitative techniques to analyse social structures.

Strong and Weak Ties: A strong tie represents a person with whom there is a regular interaction, and a weak tie represents a person with whom there are sporadic or punctual contacts.

Structural Holes: The connection potential between elements or groups of elements that are not connected.

University-Industry Relations: A set of connections between people in university and people in industry. There are many forms of relations, including informal ones (the flow of graduates to industry, mobility of researchers, public meetings, professional networks) and formal ones (research contracts, licensing, joint labs).

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Chapter 45
Social Networking and Knowledge Sharing in Organizations

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ABSTRACT

Knowledge sharing in organizational context is facilitated by communicative process affected by varied social dynamics. It can be a difficult process in case of distributed organizations as employees may not be aware of the right source of getting advice and expertise. In such a scenario, social networking tools provide the required functionality for such sharing and lead to better social ties among knowledge providers and seekers across the organization. The chapter brings out some factors that affect knowledge-sharing behavior in the context of organizations using social networking tools as a communicative media.

INTRODUCTION

Employees working in an organization have both explicit and tacit knowledge. Explicit knowledge is easier to document and share than tacit knowledge which stems from practical and experiential understanding. Solutions to contemporary business problems can be achieved by utilizing the available expertise spanning across different functional areas of an organization (Wenger & Snyder, 2000). Staying connected helps in advancing the understanding about various functional domains and helps in generating a multi-perspective outlook for tackling any issue. One such way of staying connected can be achieved by using social networking tools within the organizational boundaries. Yammer, Salesforce Chatter, Microsoft Sharepoint online are a few examples of collaborative and social tools used in enterprises. Enterprise wide social networking can help in connecting people from different backgrounds and domains making it easier to transfer knowledge to wider audiences (Riemer & Scifleet, 2012). The present chapter draws from extant literature to highlight the usefulness of social networking for knowledge sharing purposes along with discussing the relevant factors and adoption issues.

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BACKGROUND

In its simplest form, social networking can be described as the use of internet technology to create and share user generated content by a web of people connected with each other online. Sophia van Zyl (2009) defines social networking as "applications or websites that support the maintenance of personal relationships, the discovery of potential relationships and should aid in the conversion of potential ties into weak and strong ties, by utilizing emergent Web 2.0 technologies." Social networking allows people to make connections, join groups of their interest, contribute information and discuss issues of relevance. All this is accomplished through various modes such as online communities, blogs, discussion forums and other online collaborative tools.

Enterprise Social Media

An emerging trend in the use of online collaborative tools in organizational context is Enterprise Social Media (ESM). Leonardi et al. (2013) define enterprise social media (ESM) as "web-based platforms that allow workers to communicate messages with specific coworkers or broadcast messages to everyone in the organization; explicitly indicate or implicitly reveal particular coworkers as communication partners; post, edit, sort text and files linked to themselves or others; view the messages, connections, text, and files communicated, posted, edited and sorted by anyone else in the organization at any time of their choosing." ESM is an effective platform for connecting people across functional domains and making visible the information shared with a wider audience. Similar to popular social platforms like Facebook and LinkedIn, ESM platforms may vary in the functionality offered and features supported but primarily they serve similar inherent purpose of bringing people together facilitating information flow and knowledge conversations, crowd source solutions across multiple domains, share relevant expertise and foster collaboration(Riemer & Scifleet, 2012).

SOCIAL NETWORKING AND KNOWLEDGE SHARING

Nature of Knowledge

Every organization wants its employees to share their knowledge with their co-workers as it will eventually benefit the organization in terms of improved performance. Knowledge exists in explicit and tacit forms. While explicit knowledge is easier to communicate and acquire, tacit knowledge is acquired by way of practice and encompasses skills and experiences held by people. It is difficult to document and explicate tacit knowledge as it is embedded in action and involves commitment (Nonaka, 1994). Such knowledge is helpful when there is a specific problem to be solved. The knowledge seeker approaches the potential knowledge provider with the problem and a solution can be reached by consensus after considering the circumstantial issues and making appropriate judgments. Creative solutions can be achieved by mutual knowledge sharing leading to enhanced creative performance when employees search information, share and co-create more information by way of interactions and discussions thereby adding to existing knowledge base of discussants (Sigala & Chalkati, 2015).

Interactions Over Social Media Platforms

Social media platforms can be instrumental in facilitating the above said interactions where it can occur in the form of immediate unplanned instances or in events of specific information needs (Subramaniam & Nandhakumar, 2013). Tracking the activity of individual users can give a fair idea about their interest areas and relevant domain expertise (Kane, 2015). It leads to an overall understanding about the tacit knowledge resources possessed by various employees, a phenomenon termed as "ambient awareness" (Leonardi & Meyer, 2015).

Social networking tools enable collective completion of task with virtually co-present actors (Subramaniam & Nandhakumar, 2013). Problems can be viewed from different perspectives and social networking tools can be instrumental in crowdsourcing solutions by integrating cross functional expertise (Mäntymäki & Riemer, 2014). Thus, collective intelligence enabled by inputs from various sources across organization has significant potential of improving work performance leading to survival and growth in contemporary competitive environment. Although technology is adopted with intentions of functional improvement and advancement of organizational performance, its actual usage is imperative to understand its effects on organizational variables. Some of the factors that have an influence over knowledge sharing are listed below.

Social Ties

Social networking tools may help in fostering and maintaining connections that can be used to facilitate such discussions subsequently leading to consensual viewpoint on the issue. Strong social ties enhance the knowledge sharing behavior among employees (Chow & Chan, 2008). Dyadic knowledge exchange is enhanced in case of the virtual communities supported by social networking as it increases the possibility of frequent communication and increased flow of information among the dyads (Pan et al., 2015). Hence, better mechanism can be in place to increase the social interaction in both online and offline modes (Chen & Hung, 2010) along with shared goals (Chow & Chan, 2008) to foster better understanding among the group.

Shared Goals

Shared goals have an indirect effect on knowledge sharing intention among coworkers. Also, a sense of being a part of the group instills a responsibility towards knowledge contribution in the group (Chang & Chuang, 2011). An environment of equality among individuals can also help in facilitating knowledge sharing (Yu et al., 2010). Working towards a collective goal can help to generate knowledge contributions from all members of a particular community.

Social Trust

Social trust influences knowledge sharing intentions (Chow & Chan, 2008; Din & Haron, 2012). Intensive interactions and mutual trust leads to more reliable knowledge sharing (Chang & Chuang, 2011). Strong interpersonal trust helps in reposing faith among knowledge seeker and provider thereby easing the transfer. However, fostering trust online is not always possible and the same can be accomplished by way of bringing people together in offline situations too (Chen & Hung, 2010).

Reciprocity

People want to share their knowledge as they feel that they need to reciprocate the help they received earlier (Yu et al, 2010; Chen & Hung, 2010). Thus, a knowledge contribution initiated by one member can lead to a chain of reciprocal responses adding to the cumulative knowledge base of its members.

Self-Efficacy

Individual self-efficacy will lead to higher contribution towards knowledge sharing activities (Hsu et al., 2007). Relative advantage of the knowledge sharing exercise, the belief in one's own abilities (Hsu et. al., 2007) and mutual understanding among the knowledge partners helps in facilitating the sharing process (Chen & Hung, 2010).

Relational Context

Mechanisms to support and foster knowledge sharing vary according to relational context (Boer et al., 2011). The congruency between the relational assumptions of knowledge contributors has an effect on the sharing behavior. Similarity in assumptions about knowledge and the respective knowledge communities facilitates knowledge transfer.

Sharing Culture

The overall culture of the organization plays an important role in knowledge sharing activity. Highly open members view such platforms as the opportunity to discuss ideas, have opinions and debate issues along with coming up with potential solutions to problems with the help of mutual knowledge contributions (Yu et al, 2010). Social networking can be even more effective in an environment conducive for utilizing it to its best potential. Cultural norms affect the employee mindset and subsequently their need to seek collective expertise (Patroni et al., 2015). Employees may explore an area in greater depth due to both competitive and collaborative intent which eventually expedites their learning (Patroni et al., 2015).

Motivation

People are motivated by extrinsic and intrinsic rewards in respect of sharing their expertise or domain knowledge. Sharing knowledge over social platforms leads to an increase in the reputation of the knowledge provider which serves as an incentive and further increases both the quality and the quantity of the content shared (Hung et al., 2011). Apart from this, intrinsic factors like altruism also affect the knowledge sharing behavior positively (Ma & Chan, 2014).

Similarity

Lingual similarity can enable better exchange and understanding which leads to subsequent effective exchange of information (Chang & Chuang, 2011). Similarity of status and location of an individual in the hierarchy may also have an effect on the knowledge sharing behavior. As the individual experience

increases, members tend to share more with the people of similar expertise than with similar status (Hwang et al., 2015).

Context

Social networking acting as a medium of knowledge exchange eventually effects employee performance. However, the effect on performance differs according to task context (Kuegler et al., 2015). Performance varies in inter-team and intra-team conditions. Inter-team task context requires the contribution of novel ideas and new information suitable for innovative performance in contrast to intra-team usage where routine task specific information is required (Kuegler et al., 2015).

Excess Information

Too much information on social networking platform can even create clutter and make things worse as it may become difficult to find the relevant information. Different conversation threads may be difficult to follow. There can be attention conflict which may undermine the purpose of generating an overall awareness about knowledge conversations in the organization (Leonardi, 2015).

ADOPTION ISSUES

Any new technology should be viewed from multiple perspectives before introducing it in the organization. Thus, actors at organizational, individual and technological level are considered for successful adoption and post-adoption usage of social networking tools. Organizational support in terms of user awareness and training is required for increasing the self-efficacy of users. Moreover, motivational support in terms of recognition and reputation feedback (Hung et al., 2011) can lead to more positive contribution by users. Purpose of social networking tools in organization, participants, and adequate risk analysis along with policy mechanisms should be considered before taking any decision to adopt such a system (Turban et al., 2011). Individual acceptability can be increased by ensuring the ease of their functional operation. Individual tendencies like self construal and interdependence (Liu & Rau, 2014) should be considered in adoption decisions. Also, individual usage is increased to as much as 25% when peers are using a given social media technology (McKinsey, 2015). Relative ease of use will render the tools accessible thereby increasing the possibilities of their continued usage. Existing usage of social networking tools in popular context can be examined to design tools that allow for added functionality as per organizational requirements. 35% of companies from a data set of 1500 were reported to adopt ESM platforms following the adoption by competitors (McKinsey, 2015). Irrespective of the reasons of adoption, it is the prerogative of company to decide about the extent of identity to be revealed. More identity leads to accountability while anonymity may help to raise genuine concerns and provide way for unique solutions (Kane, 2015).

FUTURE RESEARCH DIRECTIONS

Although social networking is a widely researched area, there are many aspects that can be taken up for future research in the context of its usage in organizations. Social networking is having an impact on the way people connect and share with each other. However, there can be instances of misunderstandings due to poorly represented information which can be explored in respect of collaborative work. In addition, there is a need to explore these tools in light of design constraints. Often these tools are third party applications and may not be fully in sync with organizational or group requirements. Having a user oriented perspective in this regard can advance the design research in finding better ways to adapt them to organizational peculiarities which may be quite distinct from general and popular designs. Working in groups fosters collaborative thinking but excessive interaction over social networks may be a source of proliferating groupthink among employee which needs to be researched further. People tend to avoid any controversial and political issues in organizational communication. Hence, sharing in case of sensitive or political information is also another potential area worth exploration which may lead to interesting results.

CONCLUSION

Contemporary organizations are primarily knowledge driven. Knowledge is a co-created phenomenon. Organizations are employing various tools to provide employees with the right knowledge at the right time. Social networking tools have been used in variety of ways to make this knowledge exchange easier and accessible to employees. The article was an attempt to highlight some factors that have an influence over the knowledge sharing behavior of employees in an organization. However, there is still a need to consider various structural and design issues so as to fully harness the functionality of networking platforms. Along with structural improvements, successful implementation and usage of these platforms requires a conducive culture with organizational support. These are just means that can be utilized to the best of their potential by employing them in the right conditions.

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KEY TERMS AND DEFINITIONS

Altruism: Intention or action showing self-less concern for others potentially benefitting the receiver.

Self-Efficacy: The belief in one's ability to accomplish a task successfully. It affects the way an individual approaches the task.

Social Ties: The connections with fellow individuals in one's communication network. Information moves in different ways across various social ties in a social network.

Tacit Knowledge: The knowledge which is acquired by experience and practice, often difficult to explicate.

Virtual Communities: A group of individuals communicating over a social network to accomplish a shared goal.

Web 2.0: Web characterized by interactive and collaborative user generated content. The information generated is more dynamic in nature.

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Chapter 46
Understanding the Potentials of Social Media in Collaborative Learning

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ABSTRACT

Social media is used daily on many occasions to form communities. More than just being a place for connecting people to larger communities, social media has become a platform technology to enable creating and sharing knowledge. Social media is a potential technology to improve collaborative learning practices. Thus, players in education field should investigate and understand the beneficial use of social media. This chapter illustrates the potential benefits of using social media in collaborative learning. Collaborative learning with social media technology is analyzed with extensive examples from the research studies. These examples are carefully reviewed by providing a critical analysis of the benefits and drawbacks of the social media on learning.

INTRODUCTION

Social media is a potential technology to support collaborative learning practices. This chapter illustrates the potential benefits of using social media in collaborative learning. To explain the potentials of social media, the first part of the chapter discusses the nature of the social media technologies and web 2.0. The second part illustrates the idea and importance of collaborative learning to address the changing demands of the 21st century. After introducing the fundamental concepts and ideas related to social media in first two parts, final section discusses the potentials of social media in collaborative learning following with a discussion section and a summary in the conclusion section.

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BACKGROUND

Web 2.0 and related developments enabled the growth of social media concept. Web 2.0 provides both technical and philosophical bases that empower the underlying properties of social media. Web 2.0 created a new opportunity for the end users to feel related to the other users and/or institutions who are the creator, co-creator or shareholder of the content. The latest development in the Web 2.0 technology offered a platform that allows internet users to create and share many audio-visual knowledge artifacts (Yengin, 2014 a). Especially, the user owned content creation and sharing qualities makes Web 2.0 empowered social media services as a potential platform for collaborative learning, in which the working together and co-creation of knowledge is essential.

The idea of using social media for learning is widely discussed in the literature (see following sections). Since there is a literature already discussing the social media in learning in general, this chapter aims for turning our attention to a more specific discussion on the potentials social media brings for collaborative learning activities. Hence, to analyze the issue with a comprehensive understanding, this chapter discuss the underlying mechanisms of Web 2.0 that empower the social media concept, definitions of social media with examples and list of social media services, dynamics and importance of collaborative learning in modern education and connections between collaborative learning and social media.

SOCIAL MEDIA

Before starting to talk about social media, it should be defined with a clear distinction from the interchangeably used terms such as "social networking". Social networking is defined in Meriem-Webster dictionary as "forms of electronic communication (as websites for social networking and microblogging) through which users creates online communities to share information, ideas, personal messages, and other content (as videos)". The same dictionary defines the social media as "a creation and maintenance of personal and business relationships especially online".

Several authors defined "social networking" as a venue for users to share their activities and interests with others in a particular community (Fenton, 2012). Social networking allows users to have an online profile in a bounded system to connect with other users to communicate and collaborate (Boyd & Ellison, 2007).

Different authors defined "social media" as a way of creative expression (Gauntlett, & Thomsen, 2013; Zagalo & Branco, 2015), exchanging user-generated content (Kaplan & Haenlein, 2010), spreading and sharing meaningful and valuable content (Jenkins, Ford, & Green, 2013) in a culture of collaboration and connectivity (Dijck, 2013) using web technologies such as web 2.0 (Power 2007 ;Tuten 2008 & Brown 2009).

Although dictionaries and different authors make an attempt to define the "social networking" and "social media" to show that these are not exactly same terms, people often use the term of "social networking" and "social media" interchangeably (Cohn, n.d.). This confusion could be a result of the lack of clear cut between social media and social networking concepts. To approach this issue of providing a clear and definite deception of "social networking" and "social media", this part will provide literature about the common and different properties of these terms and provide a short and practical definition.

The basic commonalities of "social networking" and "social media" are that they both rely on the internet as a communication channel. Another common property between two is allowing people to interact in social ways. The online social interaction or online sociality is defined as "collective action, communication, building communities, connecting and networking, creative content making, collaborative knowledge building, sharing, playing etc." by Fuchs (2013).

Comparing social media and social networking terms, the main difference is that social media allows publication of knowledge. The two main distinctive characteristics of social media are enabling the participation and power of publishing (Hanna, Rohm & Crittenden, 2011). While social media is related to user-generated publishing and distribution of the content knowledge, social networking creates the necessary basis and a technical framework for the social media to live on.

Interestingly, a social networking service may change its characteristics within time and transform to a social media platform. For example, a study (Kwak et al., 2010) showed that hat users' way of using social networking tool may re-define it as a social media platform. In their study, researchers crawled 41.7 million user profiles, 1.47 billion social relations, 4, 262 trending topics, and 106 million tweets to analyze the topological characteristics of Twitter, which is an online social networking service allowing users to follow and being followed on published content (Kwak et al., 2010). According to the results of this study, Twitter had become a social media platform even though it had started as a social networking service.

As seen with the examples, sometimes the precise categorization of the technologies and services as social media or social networking platforms may be impractical since the terms are used changeable by many people and the services may transform to a different nature in time. For practical reasons of avoiding confusions, the definitions would be that the "social media" as the services that allow users to generate and share content online and the "social networking" as the services that allow to managing the relationships in online social communities.

In addition to the definitions, seeing the examples of social media services may be more helpful for readers to better understand the social media services. Using website traffic data from different sources, eBizMBA Rank website (2016) published the following list in Table 1, showing the most popular 15 social media and social networking services as of Feb 2016.

These social media services can be categorized in two formats: "users' profiles based" and "content-based services" (Kamila & Bhattacharjee, 2014). User profile based services focus on content and connections around the profile of a member of the service (e.g. personal info, hobbies, likes-dislikes, interest etc.) and the content-based services emphasis on the content development and publishing, while still providing pages of public profiles and connections.

For example, the first 3 in Table 1 are the users' profiles based social networking services emphasizing connecting with users (both in professional and non-professional manner) who are usually like-minded in order to share content and ideas for creating new knowledge using the power of the crowds in a networked community. Pinterest and Instagram may be categorized as the content-based networking services in which the produced user' contents are stored in an archive or a repository like services and stored in a social network (Andersen, 2007).

Table 1. The most popular social media and social networking services as of Feb 2016

Service	Estimated Unique Monthly Visitors
Facebook	1,100,000,000
Twitter	310,000,000
LinkedIn	255,000,000
Pinterest	250,000,000
Google Plus+	120,000,000
Tumblr	110,000,000
Instagram	100,000,000
VK	80,000,000
Flickr	65,000,000
Vine	42,000,000
Meetup	40,000,000
Tagged	38,000,000
Ask.fm	37,000,000
MeetMe	15,500,000
ClassMates	15,000,000

SOCIAL MEDIA AND WEB 2.0

Currently, social media technologies depend on Web 2.0 technology. In order to understand the social media, it is important to take a look at the term of Web 2.0 technologies and its distinctive properties. Web 2.0 allows making connections through individuals, creating collaborative communities, publishing of user-generated content, integration of multiple source of knowledge and communication, using mash-up strategies to integrate many contents and harnessing collective intelligence in a decentralized manner using web services and cloud computing (o'Reilly 2007 ; Rouse & Haughn, n.d.).

Before Web 2.0, Web 1.0 offered a limited way of connection between individual users. In order to create a community, the website author, who is the only sole owner of the content, had to create a circle of connections (Fuchs et.al. 2010). Also, the publishing in Web 1.0 required a set of skills in website building and programming. Web 2.0 removed such barriers for the end users and empowered them to connect each other and become the owner of the content (Gylfason, 2010). For instance, users can co-create Web 2.0 content as a story by performing distributed comments and discussions in addition to editing and manipulating the text and pictures in the story (Alexander & Levine, 2008). In such a scenario, a reader or a follower of the story can contribute to the story development and become a co-author. Participating the content creation in collective interactions rather than just the consuming the information, users build collective intelligence in communities (O'reilly, T., 2007).

Shortly, the changing role and interactions between web users in production and distribution of information brings new possibilities in the intellectual growth of the societies. These possibilities provided by Web 2.0 and employed in social media platforms open new ways for activities in collaborative learning.

COLLABORATIVE LEARNING

The first idea of collaborative learning term was developed in the 1950s and 60s by a group of secondary school teachers (Bruffee, 1984). It is a type of learning experience in which learners work and be in a learning process together (Whipple, 1987). In the research literature, collaborative learning is described as cooperative activities in the educational context (e.g. reviewing course book together or sharing assignments etc.), as joint problem solving in learning processes and/or as a development of a lifelong learning process evolving in many years in communities such as in professional work field (Dillenbourg, 1999). Collaborative learning improves the relationships intensity between learners, create dynamic communicational flow, reduce duplication, lower the risks and increase reward satisfaction once the students achieve their learning goal (Keas & Mandell, 2009).

Supporting collaborative learning is important to prepare learners for the future business world. Today's economy demands the creation of new ideas and products in collaborative ways (Bonnet, 2016). The latest changing global environment forces us to move on knowledge economies (Quinn, 1992; Acs, de Groot, & Nijkamp 2013; Jorgenson& Vu, 2016), which are economic models that growth is dependent on the knowledge to generate values. Knowledge economies need the establishment of decentralized business structures and frameworks (Madanipour, 2013) to allow the creation of economic value by employing knowledge in goods and services (Crevoisier, 2016).

This new way of doing business requires us to adopt the idea that "the creation and broadcasting of the knowledge is shifting from centralized points – where the knowledge is accumulated in entities that are controlled by certain stakeholders (e.g. teachers, books, agencies) to more distributed points – where the knowledge is created and distributed by the well-connected users in the networks" (Yengin, 2014). In order to successfully respond the changing dynamics of the new economy, institutions controlling the policies of the education systems should create new learning strategies that allow addressing the requirements and demands of this new economy. To adopt the requirements of the new economic systems in which social media plays an important role (Choi, Huang, Palmer, & Horowitz 2014), education may need to make a shift from the factory model of learning environments toward a collaborative learning environment in a social networked setting (Quintana et al., 2016; Baumeister 2005; Gibson 2006).

POTENTIALS OF SOCIAL MEDIA IN COLLABORATIVE LEARNING

Recent studies already discussed the rise (Zawacki-Richter et al., 2015) and importance (Ford, Bowden, & Beard 2011; Popescu 2014) of social media in facilitating the collaborative learning activities. Rather than focusing again on the increased used and the importance, this part focuses on functional potentials of social media collaborative learning to give the reader wider perspectives on the possibilities with social media in collaborative learning.

Before starting presenting the potentials of social media, it should be kept in mind that the social media is not an ultimate solution to all collaborative learning activities. First of all, social media cannot be considered as the exact replacement of face to face communication which has many benefits and superiorities over the digital communication channels (Hiltz & Turoff, 1993; Daly, 1993). Rather, social media should be considered as a supplement or an expanded way of computer-mediated communication (Watson & Hill, 2015) that allows remote communication, documentation and recording of communication, creating channels to allow generation of more ideas and have greater equality of participation

(Bordia, 1997). Similarly, social media is not an exact replacement of face to face social and collaborative learning activities in the classroom, especially for friendship building for social well-being. Several authors discussed that there is no relationship between friendship quality based on social media use and well-being of students (Wang et al., 2014); but negative social well-being was positively associated with levels of uses of media (Pea et al. 2012). These authors and studies add weight to the argument that teachers and students should not use the social media as an entire replacement of traditional collaborative learning activities in the classroom, but use the social media as a supplementary communication method.

Although social media is not an exact replacement of face to face teaching, it brings new opportunities and changes for education in institution level and pedagogic level. In institution level, it is a fact that using social media for collaborative learning activities require several transformations in policies. Social media is highly influencing the educational institutions to change their traditional way of doing business in order to keep their competitive power and to strengthen their services providing cost effective and personalized learning activities, compared to the traditional learning environments (Dabbagh & Reo, 2010). To implement collaborative learning activities with social media, schools should change their processes to address issues such as "meeting specific the learning objectives, time constraints, complexity of classroom management, constraint on Internet access, limited social media tools in schools, teachers' limited understanding of using social media and limited guidance" (Bull et al., 2008).

In the pedagogic level, social media also introduces new approaches to the collaborative learning. Several studies showed that social media services provide new appealing and engaging learning activities since it allows applications for self-motivated, autonomous and personalized activities. In other words, the allowance of self-motivated, autonomous and personalized learning is the why the social media would be a good supplementary method for collaborative learning. For example, authors (Junco, Heiberger & Loken, 2011) investigating the impact of social media use on 125 students' learning and engagement showed that using social media tool (Twitter) for the different academic activities and co-curricular discussions may highly engage both students and faculty to collaborate actively to the learning process. In addition to engaging activities, authors also reported that social media has effects on students' positive feelings to collaborative activities (Hung & Yuen 2010) and social media is engaging with self-motivated and autonomous collaborative activities in and out of the classroom (McGloughlin & Lee, 2010). Also, several authors discussed that the basic elements of social media support creation of personal learning settings which lead to self-regulated learning experiences which are essential in collaborative learning (Dabbagh, & Kitsantas, 2012; Dabbagh & Kitsantas, 2013).

In addition to potentials described above, another answer for why social media is beneficial would be that the social media's role in positive community building for collaborative learning. For example, in social level, social media creates a cycle in which students collaborate on learning task to build knowledge and create new ideas while socializing and communicating. Community engagement creates opportunities for students to participate in events and collective activities. In such social media enabled collaborative learning communities, students may construct a digital identity (Dalton & Crosby, 2013) and develop social skills (Bauman and Rivers, 2015), form online friendship (Koutamanis et al., 2013), build rapport (Cain et al., 2013) and show responsible communication patterns to satisfy their psychosocial needs (Manago, Taylor, & Greenfield, 2012).

Ultimately, establishing good relationships and friendship are important factors in collaborative learning activities. Thus, using social media for altering the communication for friendship and the roles in a learning community becomes an important effect of social media. For example, social media addresses

this by providing communications platforms for understanding and being aware of own and others' emotions, which also influence collaborative learning performances (Chanel et al., 2016).

Having argued why social media engage students' positively in learning, this part focuses on answering of for what kind of activities and when social media should be used. Actually, research showed that students use social media as guided collaborative learning activities include socializing purposes (meet other students), asking questions during self-studies, exchanging documents and making literature reviews and preparing for exams (Zawacki-Richter et al., 2015). In another earlier study, authors reported that students use social media for doing daily multi-tasking, developing friendships in a networked way, building knowledge and learn collaboratively in a decentralized way (Ulbrich, Jahnke & Martensson 2011).

Although social media provides positive potentials and opportunities as discussed above, introducing social media to the class without the teacher facilitations will not bring out these potentials. The role of the teachers' becomes a critical success factor. Students shouldn't let to use social media for learning purposes without any guidance and pedagogical strategy employed by teachers. A study (Selwyn, 2009) conducted to investigate 909 students' education-related use of social media, illustrated that students interactions are not related to academic tasks when there was no guidance and pedagogic strategy. To put it another way, using social media in learning should be guided by the teachers. Once it is a guided activity, it opens many positive ways to collaborative learning as explained above paragraphs.

As teachers' roles become critical, teachers' pedagogic styles and use of social media should be also discussed to benefit from the social media. For example, similar to the students' usage, a survey conducted with thousands of participants (Stansbury, 2011) showed that teachers use social media mainly for networking with colleagues, using real world examples in learning, collaborative learning activities, communication, creating assessments, accessing the parents, announcements, community outreach and professional development. Another study (Moran,Seaman & Tinti-Kane, 2011) investigating the faculties attitudes toward the using social media reported that although faculty sees the social media with some value in teaching activates, they complain about the time required to engage in social media activities, and they have concerns about privacy and integrity issues.

To conclude the investigation on the potential of social media in collaborative learning and to comprehend the full potentials, finally, the risk and challenges should be presented. First of all, it should be noted that not every student are readily capable of operating on social media platforms safely. According to recent studies, such students can be exposed to some risk of peer pressure (Milner, 2015), cyberbullying, clique-forming sex abuses (O'Keeffe & Clarke-Pearson, 2011) and privacy issues (Barnes, 2006) while they use social media services. Similarly, a recent report indicated that the privacy of faculty and students is the one of the biggest concern and blockages in adopting social media in the classroom, especially widely used commercial social media tools (Seaman,& Tinti-Kane, 2013).

Several authors also discussed the difficulties that teachers face when identifying the authenticity of the students' thoughts and ideas when they use social media. For example, plagiarism is one of the concerns (Hayes & Introna, 2005; Evering & Moorman, 2012). Keen (2007) argues that using basic cutting and pasting makes young generation believe that the idea and thought belong to them, which also allows the creation of "'younger generation of intellectual kleptomaniacs". On the other hand, the digital culture brings a new way of learning in which borrowing, sharing or promoting others' content may be welcomed in some learning fields, if there is an awareness of the risks (Iliescu 2008;). Moreover, guidelines to use social media in learning highly encourages sharing of knowledge with resource citing (Rennie & Morrison, 2013).

Finally, the digital culture difference between students and the adults also may be an issue for using social media in collaborative learning. Teachers and parents who are not savvy in social media culture may not be able to understand the students' lives which are heavily embedded in the social media culture (Boyd, 2009). Parents and teachers' lack of knowledge and unfamiliarity of social media use may create a huge disconnection between generations in order to construct social communities to tackle the life and society in general (Yardi, & Bruckman, 2011).

DISCUSSIONS

To adopt social media practices and make transitions, institutions should understand and conceptualize social media as a platform for the community (Hanna, Rohm & Crittenden, 2011). In the education sector, this platform should support the students' access as well as integration with the current systems. Furthermore, educational institutions should provide infrastructure to implement social media technologies and synthesize them into the existing school learning management system. For instance, social media and other online services of educational institutions should support students' mobile devices and various operating systems (Zawacki-Richter et al., 2015). Also, web 2.0 based social media services that that enable collaborative learning should be embedded into the web-based learning systems.

In order to avoid privacy and reputation issues, educators may be role models of responsible social media usage. They need to avoid conflicts of interest, harming public image of their institutions and creating false impressions that their personal comments are official. Educational institutions need to address the challenges of privacy, plagiarism and other ethical issues by creating policies. There may be also a need for presenting teacher training programs to instruct on the meaningful use of social media technologies in collaborative learning. Also, these institutions should provide guidance for students in using social media and self-regulated learning activities both in formal and informal learning environments.

FUTURE RESEARCH DIRECTIONS

Social media provides different ways of engaging students in collaborative activities. The research on the effects of the risks and benefits of social media in collaborative learning should be extended in order to be able to safely employ the concept with its full potentials while avoiding the risks. In this chapter, a general review of the social media benefits and risks has been provided. However, with a carefully designed study and/or series of studies, it would be possible to have a more specific analysis of social media effects on learning. For example, considering the range of the social media applications with many attributes that may cause multiple effects on different elements of the learning, it may be hard to identify the exact effects of each attribute of social media without controlling isolated effects in experimental studies. As a future research, several controlled studies investigating the effects of social media by isolating the number of variables should be carried. Once such controlled studies are conducted, it would be also easier to compare the social media's specific effects with other technologies' effects.

In addition, future research on social media may be extended with the studies that investigate social media effects on the development of skills that are important for matching the 21-century learning requirements such as collaboration, communication, creativity, critical thinking, problem-solving etc. The future research on the effects of social media also should not be limited only to the positive effects; it should also cover the negative effects such as the likely effects of social media on possibly downgraded writing, face to face communication and attention-focusing skills.

Although there is a need for further research on pedagogic aspects, the social media phenomenon can't be ignored as the previous research literature signals the potentials. Thus, the role of social media in addressing the global changes in the 21 century shouldn't be ignored and there should be more investigations to understand the different forms of social media as well as potential risks and benefits for education to be able to adapt these changes by conducting future research studies.

CONCLUSION

In this chapter, the potential benefits of using social media in collaborative learning have been documented and discussed with examples from the recent research studies. The first part of the chapter investigated the essentials of the social media technologies by reviewing the terminology of social media and social networking with examples of recent social media services, connections to the Web 2.0 and the concept and importance of collaborative learning. The second part of the chapter provided a review of benefits, risks and challenges of using social media which illustrated the potentials of these technologies in a collaborative learning. Finally, the discussion part provided a set of suggestions on using social media in collaborative learning.

In conclusion, social media provides a potential platform for collaborative learning. Social media tools open a way of addressing the changing demands of 21 century. Benefiting from the enabling functions of social media that are running on the frameworks of web 2.0, students can actively engage in the lesson content building, they become self-regulated learners owning the content rights and the responsibility of their learning as well as becoming socially connected to a learning community while forming a relationship with their learning partners. Teachers, establishing new pedagogic methods to integrate the social media tools into the classroom and curriculum may also be a part and the facilitator of such learning communities. While providing positive potential, teachers and students should be also aware of the risks and challenges of the social media such as peer pressure, cyberbullying, clique-forming, sex abuses, privacy, plagiarism and other security issues.

Finally, adaptation of social media in daily school practices may bring some extra challenges and adaptation obstacles such as meeting specific the learning objectives, time constraints, complexity of classroom management, constraint on Internet access, limited social media tools in schools, teachers' limited understanding of using social media, limited guidance and finding standard measurement and assessment of collaborative learning with social media tools.

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KEY TERMS AND DEFINITIONS

21st Century Learning: Cognitive skills required to address the demands and challenges of the 21st century (e.g. creativity and Innovation -inventive thinking, cross-cultural understanding -global awareness and cross-cultural skills, critical thinking, effective communication, collaborating, the flexible & self-directed learning, skills related to being information and communication technology literate).

Collaborative Learning: The type of learning experiences or learning strategies that allow learners to create knowledge and meaning in a form of social construct.

Knowledge Economy: Economic models that based on the growth dependent on the knowledge to generate values.

Social Media: The services that allow users to generate and share content online.

Social Networking: The services that allow to managing the relationships in online social communities.

Web 1.0: This is the first stage of the internet that only allows the static content publication with no option for direct modification and/or creation of content by other users.

Web 2.0: The platform technology that allows making connections through users and user communities to enable users to publish and share user generated.

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Chapter 47
Using Social Media to Increase the Recruitment of Clinical Research Participants

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ABSTRACT

Research has shown that clinical research continues to have difficulty recruiting participants. This problem is expected to increase as the number of clinical trials increases and as there continues to be more focus on complex diseases and treatments. Researchers have typically relied on traditional recruitment methods to recruit participants, which revolve around the physicians and their support staff having the primary role to locate and recruit these participants. However, with individuals using online platforms such as social media to retrieve information, this creates an opportunity for research site personnel to use it as a way to relay information on clinical trial opportunities. Studies that have used social media as a way to recruit participants are discussed. Furthermore, pros and cons of social media for recruitment, along with recommendations that future researchers should consider when deciding whether to implement this type of strategy in their clinical trials will be shared. In general, clinical trial recruitment strategies need to shift to an approach that is not only more targeted, but also has a larger reach. By evaluating the success of studies that have used social recruitment strategies so far, it is evident that future researchers can also achieve recruitment success through social media. Moreover, social media could be a promising new avenue for clinical trial recruitment that allows for a more positive experience for both investigative site personnel and potential participants.

INTRODUCTION

Clinical trials are research designed to evaluate ways to prevent, detect, or treat diseases and conditions (National Institutes of Health, 2015). Despite their importance, it has become increasingly challenging to enroll participants in clinical trials. According to Mahon, Roberts, Furlong, Uhlenbrauck, and Bull (2015), a high number of clinical trials fail to recruit the necessary number of participants. Multiple

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studies have been conducted to estimate how many fail, and although they vary in the exact number, researchers recognize and agree that insufficient recruitment is a significant problem that continues to exist in clinical trials. As the number of clinical trials increases (Inventiv Health, 2013), as there is an increased focus on research that involves more complex diseases and specialized medicines, and as researchers work to develop treatments that are better targeted to patients (Akhtar, Israel, & D'Abundo, 2015), the problem of insufficient recruitment will continue to grow unless changes are made to the recruitment process.

In general, researchers rely on traditional recruitment methods to enroll participants. Traditional recruitment methods revolve around the physicians and their support staff having the primary role to locate and recruit these participants. This could include them personally recruiting patients, searching their patient databases, or through printed materials such as flyers and newspapers (Tanner, Kim, Friedman, Foster, & Bergeron, 2015). Although these ways can lead to the recruitment of some participants, they prove to be limited to a small patient population and are not aligned with changing times. In recent years, medical information is becoming more available to patients on the internet. Similarly, according to the Pew Research Center (2014), 87% of adults use the internet. In fact, many patients are now using the internet as the first source to retrieve health-related information such as on physicians, diagnoses, and therapies (Omurtag, Jimenez, Ratts, Odem, & Cooper, 2012). Furthermore, individuals are becoming more informed when it comes to health-related issues and are taking a bigger role in their healthcare decisions. In fact, when experiencing symptoms, many individuals are first searching the internet before deciding to see a physician (Shere, Zhao, & Koren, 2014). Despite this, recruitment strategies have not adapted with these changes. "What most in the industry have not yet adjusted to is the fact that patients and caregivers have changed how and where they seek and find information – especially healthcare information" (Inventiv Health, 2013, p. 6). With individuals using online platforms to retrieve information, this creates an opportunity for research site personnel to use it as a way to relay information on clinical trial opportunities.

More specifically, social media is an online platform where discussions and engagement can take place between individuals, online communities, and research staff (Shere et al., 2014). It is a platform that can be used to discuss or disseminate information on clinical trials. Grajales lll, Sheps, Ho, Novak-Lauscher, and Eysenbach (2014) found that social media is being used to increase and maintain communications across the different stakeholders, which could include communications between research site personnel and potential participants. Therefore, using social media could be an avenue for investigative site personnel to use to disseminate information on clinical trials to potential participants.

This chapter will review clinical research studies that have successfully utilized social media strategies in recruitment, along with the conclusions and recommendations that future researchers should consider when deciding whether to implement this type of strategy in their clinical trial recruitment.

BACKGROUND

Clinical trials are designed with the objective to enroll a specific number of participants who are to receive a specified treatment such as a drug, procedure, or behavioral program (Akhtar et al., 2015). However, trials frequently discontinue, even in late stage Phase III trials, due to failure to accrue (Schroen et al., 2010). The failure to recruit the necessary number of participants can have an effect on the overall success of the study (Embi et al., 2005). Insufficient recruitment could lead to delays in the approval

of necessary medications and higher costs due to the extended recruitment period. In addition, the inability for a study to enroll the target sample size can lead to an insufficient statistical power (Carlisle, Kimmelman, Ramsay, & MacKinnon, 2015). This can prohibit the ability to answer the study's research questions or lead to conclusions which are not accurate. Further, the inability to enroll the necessary number of participants can have an effect on all stakeholders including the investigate site personnel led by principal investigators who carry out the clinical trials, and the individuals with diseases or conditions.

Social Media

Social media use is expected to continue to increase. As of 2015, the Pew Research Center found that approximately 65% of American adults use social networking sites, an increase from 7% as of 2005 (Perrin, 2015). Social media are "web-based tools that are used for computer-mediated communication" (Grajales lll et al., 2014, para. 5). There are different types of social media platforms including blogs, microblogs such as Twitter, social media sites such as Facebook, and thematic networking sites such as forums that center on a particular disease or condition. The applications are diverse in their traditional primary functions – for example, LinkedIn for professional networking, Facebook for social networking, YouTube for media sharing, and blogs and Twitter for content production (Dizon et al., 2012).

The traditional uses of many of these platforms are evolving into more of knowledge-based platforms. These types of social media applications are now platforms to share new information and encourage the exchange of ideas (Dizon et al., 2012). Therefore, they can be used to communicate in a variety of ways including the sharing and discussion of clinical trial recruitment opportunities. In fact, strategies that inform and educate on the diseases and conditions being studied have shown to lead to the improvement in recruitment (Dizon et al., 2012). Therefore, the benefits for providing this type of information are two-fold – educating the population of interest about the disease or condition and increasing their interest in the research opportunity. Patel, Doku, and Tennakoon (2003) described it as a process of providing information to the potential participants and then creating an interest for the study.

Social media applications and tools are widely accessible and are usually of no to low cost (Dizon et al., 2012). In consequence, they can be advantageous to use versus traditional methods, which are limited to a small patient pool and can be costly at times. Another advantage is the ability to target specific populations. Social media networks such as Facebook can be used to target specific individuals based on their user profiles and have the flexibility to be changed in real-time if necessary (Frandsen, Walters, & Ferguson, 2014). Therefore, there is the opportunity to monitor and adapt to responses in real-time and maximize the ability to recruit potential participants.

Changing Recruitment Practices

In order to keep up with current trends, it is important to change or enhance clinical trial recruitment practices. Traditional recruitment methods, which entail the physician along with their investigative site personnel as the primary roles to locate potential participants can no longer be the primary method as they are limited to a small group of participants. For example, the literature has shown that traditional recruitment methods exclude minorities populations and women, and thus, they are significantly underrepresented in clinical trials. However, utilizing social media as an avenue to recruit participants for clinical research also presents an opportunity to increase the enrollment of these populations. According to Jens Michael Krogstad from Pew Research Center (2015), although there are some differences in

the preference of social media sites, Latinos, Blacks, and Whites use social media platforms about the same. Further, research has also shown that women are more likely than men to use social networking sites (Perrin, 2015) and studies using social media in recruitment have been able to successfully them (Fenner et al., 2012; Tweet, Gulati, Aase, & Hayes, 2011; Shere et al., 2014). Finally, traditional recruitment methods also exclude other groups such as those who do not have a primary physician and those in rural areas (Tanner et al., 2015), which is not a problem with social media. Therefore, recruitment through social media can resolve some of the issues that are raised with traditional recruitment methods.

There are advantages to using social media to recruit participants to clinical research and trials. However, the number of clinical trials using social media platforms for recruitment is limited. The next section of this chapter will review some studies that have utilized social media to recruit participants.

Integrating Social Media in Recruitment

One study that implemented social media in the recruitment of a clinical trial focused on women who were either early in their pregnancy or trying to conceive. In this study, the researchers used traditional recruitment methods in the first phase of the study and added in social media as a supplementary recruitment source in the second phase of the study (Shere et al., 2014). The traditional recruitment methods consisted of targeting those women who called a telephone counselling program, using notice board postings, and sharing the brochures during clinic appointments. Potential participants were also identified through patient chart review. After 4 years of using these recruitment methods, the recruitment strategy was re-evaluated and it was decided to not only expand advertising to other healthcare establishments, but to also use social media. In the six months when social media recruitment methods were used, the researchers were able to recruit 12 times more women. The researchers used a variety of social media methods including Craigslist, Facebook, Twitter, and pregnancy discussion forums and message boards such as *Baby and the bump* and *Baby on the way* to post ads on the study. Individuals who were interested to participate in the study were asked to contact the study coordinator. After discussion of the study details with a healthcare professional involved in the study, the potential participants were invited to the hospital to go over the informed consent and to continue with the study. The researchers found that despite expanding the use of traditional methods in the second phase, social media contributed to a large portion of the recruitment. In fact, 78% of the recruitment was achieved through social media methods. The authors concluded that although traditional recruitment methods were used in both phases of the study, the introduction of the social media strategies led to a surge in the recruitment. Online social media platforms have the ability to access individuals who are actively looking for information about a specific topic, which would lead them to research opportunities, whereas traditional recruitment methods are generally passive recruitment strategies. This goes back to the point made earlier in the chapter that individuals are using the internet as a primary platform to seek information. It is also important to note that the researchers strategically not only used social media platforms which have a wide following and ability to target a large number of people, but they also specifically targeted sections of the social media where a large number of women and families are typically found. The researchers also thought that the social media created awareness to the study that may have led to some recruitment from the traditional methods.

Another clinical trial that used social media for recruitment was a health intervention trial involving young adult smokers. The researchers used a Facebook ad campaign to target and recruit young adults to the smoking cessation study (Ramo, Rodriguez, Chavez, Sommer, & Prochaska, 2014). Thirty-six

ads, which included a combination of different ads including sponsored stories and picture/text ads, ran over a 7-week period. The campaign was successful and showed that Facebook is an efficient and affordable method to enroll young adults, especially as the researchers were able to target specific study populations via this method. Due to the success in the targeted approach, the researchers advise that it is possible to target a specific population by location, demographics, and keywords in Facebook. In addition, simplicity seemed to be important in relaying the main study message. Given the limited space available, complex images and too detailed messaging is advised against as it can lead to confusion and the possibility of the main message being missed. Also, newsfeed ads were found to be more successful than the other ad types in regards to the number of people it reached, the number of times it was clicked on, and its' cost. Moreover, the researchers found that Facebook is an effective way to reach a very large sample of young adults across the United States in a short amount of time. However, it is also important to point out that using Facebook may limit the generalizability of the sample population. In this study, the sample population was predominantly non-Hispanic Caucasian urban-residing men compared to what is reported in the literature. Therefore, it is suggested that future researchers use other social media platforms, which although might be used less overall, will have a stronger appeal to specific populations. For example, research has shown that that Twitter has a higher appeal among younger adults, urban dwellers, and non-whites (Duggan & Smith, 2013).

Another smoking cessation clinical trial also attempted to explore the advantages of online social media for recruitment. The researchers explored the feasibility of social media recruitment in a clinical trial evaluating the effectiveness of a behavioral support program on smoking cessation (Frandsen et al., 2014). This study used a combination of both traditional and social media methods for recruitment. The traditional recruitment methods consisted of flyers around two university campuses and ads in newspapers. The social media recruitment method consisted of multiple Facebook advertisements that included different wording and logo combinations. When an individual would click on the advertisement, it would direct them to another website where they would receive brief information on the study and a link to enter in their contact details so they could be contacted to be screened for the study. The researchers closely monitored the advertisements, activating and removing them based on the number of clicks and the capacity at the investigative sites. Similar to the previous studies, the researchers targeted a specific population – adults living within a certain distance from the sites. The researchers were able to enroll 51.9% of the participants through the Facebook advertisements. Although the participants who were recruited via social media were seven years younger than those who were recruited through the traditional methods, there were no other differences in the characteristics between them. It is also important to note that in this study, the cost of online advertising was found to be more than the traditional method of advertising the study in the newspaper. In fact, the online advertising cost two times more per participant versus the traditional recruitment methods. However, Frandsen et al. (2014) note that this is an estimate and various factors can affect the cost and determining the exact amount. For example, a higher percentage of contacts from the social media avenue ended up enrolling in the study, perhaps because they had more detailed information on the study prior to screening, not only lowering the cost of sharing information but also expediting the process up to enrollment. Based on the results of the study, the researchers recommend using online social media to advertise as a supplement to traditional recruitment strategies.

Another case study that will be presented is a research study conducted by researchers at Mayo Clinic who utilized social media for the recruitment of their study. A member of a social networking site approached the researchers to perform research on her condition, spontaneous coronary artery dissection

(Tweet et al., 2011). The researchers who recognized the value of increasing their knowledge of this condition designed a pilot study. The researchers used Inspire, a social networking site for women with heart disease, to recruit women who self-identified with spontaneous coronary artery dissection. The study is different from the others presented as it both recruited and collected data from the participants purely online. The researchers were able to recruit the target sample size of 12 after just one week of receiving IRB approval. Given the already established use of Inspire for sharing information on heart disease, resources, and opportunities, the researchers were able to utilize this strong aspect of the platform to recruit the participants and collect their medical records and imaging data. The pilot study illustrated the advantage of using a disease-specific social networking community online to recruit for their study. Their study also demonstrated that social networking can enable research participant engagement and lead to recruitment. Furthermore, although recruiting potential participants with rare diseases and conditions can be challenging, the study demonstrated that it might not be difficult when using a social networking platform.

The last study that will be discussed is an online preventative intervention study. The Mood Memos study was a randomized controlled trial with the objective to evaluate if promotional messages could improve self-help behaviors for depression (Morgan, Jorm, & Mackinnon, 2013). Participants were to receive emails over six weeks, which encouraged the use of effective self-help strategies. A variety of online-based sources were used to recruit participants over 14 months, which included Google advertising, Facebook, forums, links from websites, online community noticeboards, and email groups or lists. The researchers tested Facebook but found it to be less cost-effective than advertising on Google so did not continue with it. Also, other researchers have found, Facebook is a useful platform for targeting populations with specific demographics. However, as this study was not targeting specific demographic populations, the researchers did not find Facebook to be a viable resource. Surprisingly, this study also did not find online depression forums to be good recruitment source. The researchers did a search through Google and Bing and followed links from other sites to identify appropriate forums. Permission was received from less than half of the 58 forums that were approached. While smaller forums did give permission to post, it was found that it was a time-consuming process to post and moderate responses. Moreover, recruitment via this method was found to be limited as many of the individuals did not meet the eligibility criteria. Although the study was able to demonstrate that it is possible to recruit a large sample size purely through online sources, there was difficulty recruiting through them; however, the most effective method was found to be Google.

The next section will discuss some of the key pros and cons from the studies discussed and provide some guidance on what future researchers and investigative site personnel should consider when deciding whether to use social media as a recruitment method.

FUTURE RESEARCH DIRECTIONS

As the studies presented in this chapter have found, there are both pros and cons to using social media in the recruitment of clinical trials. One of most commonly reported benefits of using social media in recruitment is the ability to have a wider reach and to be able to use a targeted approach to find the right participants. Traditional recruitment methods are considered to be mostly a mass advertising approach while social media has the ability to target specific demographics and populations. As clinical research becomes more focused, it will become even more important to find the right patients. Another posi-

tive aspect of social media, specifically when focusing on established online community networks and forums, is the ability to share information and research opportunities with individuals who are already well-connected and involved with the sharing of information around a specific disease or condition. These individuals are more likely to be interested to learn and potentially participate in research opportunities.

On the other hand, as Morgan et al. (2013) pointed out, there are also some difficulties in using social media. Unlike traditional recruitment methods, in order to be the most effective, social media recruitment methods require continuous monitoring and effort, especially since they are in "real-time." Shere et al. (2014) recommended closely monitoring response rates and revising methods based on responses. In fact, the dynamic nature of social media compels researchers to continuously monitor ads and postings to determine if changes are needed based on the responses received. This will help ensure that the recruitment strategies that are implemented are the most appropriate at any given time. In addition, there have been conflicting findings in the literature about the cost of using social media for recruitment compared to traditional methods. Frandsen et al. (2014) estimated the cost of using social media to be more compared to traditional recruitment. However, they also note that this can vary study by study depending on various factors. Finally, it is also important for researchers to be cautious about the potential security and confidentiality issues that could occur with social media. Just like with most information that is online, there are some concerns that are introduced when social media is used for participant recruitment. Bull et al. (2011) discussed a study that used Facebook in trial on preventative HIV education. They found that confidentiality and data security concerns may be raised when using social media in research.

Future research studies should consider utilizing social media for recruitment in order to have the most efficient process. While no formal guidelines have been set forth by health authority agencies on how future research studies should use social media for recruitment, there have been some recommendations set forth by researchers on how to successfully use this avenue as a recruitment strategy. Shere et al. (2014) first recommended understanding the target population in order to be able to determine which platforms would be the most appropriate for them. In doing so, the researchers are not just using an approach that is geared to the general population, but instead are taking into account the characteristics of the targeted population and utilizing an approach that would be best geared towards them. In turn, this will help ensure that the recruitment strategies are best tailored for the targeted population. Another way to maximize the recruitment process would be to use a variety of recruitment methods in order to maximize the reach of potential participants and to be the most time- and cost-effective. Shere et al. (2014) recommended using a combination of passive, broad-spectrum and targeted, active recruitment techniques while Inventiv Health (2013) specifically proposed using a combination of social media methods and traditional methods. Both of these ways could help increase the efficiency and probability of successful recruitment. Further, similar to the suggestion by Ramo et al. (2014), Inventiv Health (2013) also noted that information and advertisements on social media should contain terms that are understood by the population and to ensure simplicity through empathy and clarity. Through simplicity, there is a greater probability that the social media user will understand the message that is being conveyed. Moreover, through all of these approaches, future research can maximize on the benefits of social media in recruitment.

CONCLUSION

Traditional recruitment methods are no longer viewed as the most effective way to recruit participants to clinical trials. The ability to access healthcare information on the internet has paved the way for patients to become more involved in their healthcare decision-making. In turn this means that investigative site personnel should consider providing information on diseases and conditions as these patients can then become potential participants. Further, by using social media platforms to share health-related information and clinical research opportunities, there is an ability to reach potential participants who might not have been reached through traditional recruitment methods. Social media allows investigative site personnel to reach a larger patient population and a more diverse patient pool, including those populations who have continuously been underrepresented in clinical trials such as minorities and women. Although there is still a need for investigative site personnel to have a formal set of guidelines to follow when using social media recruitment practices, there are some studies and recommendations that shed light on how to achieve success through this type of recruitment strategy.

Recruitment strategies need to shift to an approach that is not only more targeted, but also has a larger reach. By evaluating the success of studies that have used social recruitment strategies so far, it is evident that future researchers can also achieve recruitment success through social media. Social media could be a promising new avenue for clinical trial recruitment that allows for a more positive experience for both investigative site personnel and potential participants.

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KEY TERMS AND DEFINITIONS

Clinical Research: Research that directly involves humans or that utilizes materials from humans (such as blood or tissue).

Clinical Trials: A type of clinical research where individuals are assigned to intervention(s) to evaluate the outcomes.

Investigative Site Personnel: Teams of healthcare professionals who are led by principal investigators and are responsible for carrying out the protocol.

Participant Recruitment: Finding and enrolling the best-qualified patients in a clinical trial in order to answer research question.

Principal Investigator: A primary researcher who is responsible for conducting a clinical research study or trial as per the protocol.

Social Media: Web-based tools that allow for various types of communication or information sharing.

Social Networking: Websites or applications allowing individuals to interact with other users such as those with similar interests.

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Chapter 48
Why It Is Difficult to Disengage From Facebook

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ABSTRACT

The huge popularity of social network sites like Facebook gave rise to numerous studies exploring the prerequisites and consequences of FB use. This chapter does not deviate from this direction. It offers a theoretic attempt to analyze the reasons of attachment to FB but through another perspective: the disengagement phenomenon. The theoretical framework is based on the attachment theory and the actor network theory. Assuming that FB allows the satisfaction of the innate attachment need and that there is a social and technical interaction between users and the FB structure, the present analysis investigates the relations between user attachment style and FB use and between FB user and the FB platform (hardware and software). The aim here is not to reject (or not) some formulated hypothesis, but to develop a theoretical frame from the existing theories. The argument is that human/human and human/non-human attachment could explain why users find it very difficult to disengage even though they are willing to do so and suffering from being invaded by FB.

INTRODUCTION

In many countries, social life has become heavily reliant on the use of Social Network Sites (SNS). The leader of SNS is Facebook (FB) with more than one billion monthly active users (Patterson, 2015). Founded on 2004 mainly by Mark Zuckerberg, FB was exclusively destined to the Harvard University. Later, FB began to expand to reach the entire world. The biggest demographic using the site is the 18-29 age range. The graduated adults from college are the leaders and women seem to use it more than men (Patterson, 2015).

The deeper intrusion of FB in the society and in the professional context has removed concern not to enhance connection but to break it. Many connected people begin expressing their willingness to be disengaged. They suffer from being invaded by technologies and steered to adapt their FB experience to an economic object (Van Dijck, 2013). Even though, they could not detach and continue to integrate

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FB into their daily lives they feel bored or busy. So, the power is already handed on those who could disconnect (Jauréguiberry, 2014). Thus, the main question that we try to give some responses to is: why it is so difficult to disengage from FB and alter its use?

We should note here that disconnection/disengagement is not the opposite of connection. It is obviously coupled with it and could not be understood without its existence. It involves the choose-nots category by distinction with the have-nots and the want-nots, who consciously choose to not engage with FB partially or totally (Jaurréguiberry, 2014). We consider disengagement as an approach of re-appropriation of FB use; a way of changing one's practices and a situation where the relation to and with FB is at risk (Karppi, 2014). When users will be faced by the choice to be separated from FB or individuals, attachment will be highlighted. Based on the attachment theory and the Actor Network Theory (ANT), we try to underline the nature and the quality of the attachment within FB network social structure. We then attempt to study the human/human attachment and the human/non-human attachment in order to border the disengagement phenomenon. Hence, the aim here is not to reject (or not) some formulated hypothesis but to develop a theoretical frame from the existing theories.

This analysis could help users as well managers and technology designers to understand how attachments to FB could impact people emotion and behavior. It answers to the serious preoccupation of the professional context about the permanent connection of their employees to FB and information technologies in general. This analysis could also help companies willing to implement disengagement measures to apprehend this choice from a relational perspective in order to get the implication of all users.

BACKGROUND

Preliminary Debate

While many studies emphasize the good effects of FB on users and its propensity to satisfy the need to belong and the need for positive self-presentation (Nadkarni & Hofman, 2012), some others draw its negative side such as the social media fatigue (Laumer et al., 2013) and the risk of dependence and addictions (Xu & Tan, 2012).

The question of whether the consequences of FB use are positive or negative is still debatable. However, it seems to influence / be influenced by the degree of user's engagement involved in/by/with FB (Karppi, 2014). If the disengagement phenomenon is related to the increase of connection (Sheldon et al., 2011), we should, at the beginning ask why people are so attached to the use of FB?

Amichai-Hamburger (2002) and Hart et al. (2015) assert that personality is a major factor in Internet use and in determining people's engagement causes and consequences with social media (here FB). Nadkarni and Hofman (2012) sustain that a high level of extraversion, neuroticism, narcissism, and low levels of self-esteem and self-worth are associated with high FB use. In two surveys of nearly 600 people aged 18 to 83, Hart et al. (2015) conclude that people who are more engaged with FB are higher in attachment anxiety and extraversion. However, they find that extraversion, neuroticism, and self-esteem were not as consistently related to user FB engagement.

Then, as FB is a virtual social network through which users create and entertain relations with each other, the attachment theory seems to be one of the leading theories for studying interpersonal relationships (Rom & Alfasi, 2014). Using FB seems to be influenced by how people successfully build rela-

tionships with their primary caregivers during their childhood period (Andangsari et al., 2013) which is successfully transmitted to adulthood (Hazan & Shaver, 1987).

Furthermore, we cannot treat the attachment of FB user only from the user perspective and so, from the study of human/ human relation. User practices should also be examined through the network conditions that empower them and through all things which can possess the user as much as he/she possesses them (Fenwick & Edwards, 2010). In fact, all the components offered by FB (messages, photos…) allow users to create/destruct links, intensify/decrease ties and choose to interact with near/distant friends.

These complex associations, formed by human and non-humans entities, make the ANT (Latour, 1999) useful when studying FB user attachment. The identification of actors and their associations enables the understanding of their expectancies and objects and the appreciation of their role in the technology construction, adjustment and appropriation.

The Human/Human Attachment via FB Platform

Being connected with others is considered by the self-determination theory as one of the basic psychological human need. Nowadays, users compete to register the high score of FB friends/ likes/sharing regardless of their type of use to show their great socialization and famous. As the use of Internet, FB might be of particular utility for who are physically distant or who avoid face-to-face contact as they find difficulties to interact with others (Nadkarni & Hofman, 2012). It can so connect the absence (spatially) with the presence (Giddens, 2013), lower barriers to communication, enhance the control of time and space of interaction (Mckenna & Bargh, 2000), which provide a sense of security and belonging, the main elements of attachment.

The theory of attachment describes and explains the attachment styles of adult to close personal relationship (Hazan & Shaver, 1987). Within FB network, users are not simple individuals related to each other. They are relational individuals having, at the same time, different facets and identities, which shape their representation (Dalsgaard, 2008) not only about themselves and the others but also about interpersonal loss, rejection, or abandonment. Founded on Bowlby's work on children's attachment to their primary caregiver, Hazan and Shaver (1987) distinguish between two dimensions (based on the internal working model) of attachment: secure and insecure. The latter is formed by three patterns (anxious, avoidant and disorganized).

Several studies have examined the relation between the attachment styles and SNS behaviors.

Despite the fact that some researchers have reported the absence of difference in SNS use (FB and Twitter) by attachment styles (Hansen, 2008), others have stated a significantly dependence between use of FB and insecure attachment style (Hart et al., 2015; Oldmeadow et al., 2013; Rom & Alfasi, 2014). In fact, while the secure attachment people tend to be more comfortable with intimacy and independence when interacting with others (both on/off line), the insecure attachment people (the disorganized and anxious attachment styles) are significantly predictive of using SNS to avoid a more personal face-to-face discussion (Nitzburg & Farber, 2013). However, the disorganized attached people are likely to not feel intimate on these platforms and so they may express less demand for care on the SNS sites than the anxiously attached people. On the other hand, the avoidant attachment users show the opposite behavior of anxiously and disorganized attached people in using FB. They are reluctant to use FB. This could be due to their self-sufficiency and their lower involvement in building personal relationships over SNS (Hart et al., 2015; Oldmeadow et al., 2013)

So, anxiously attached people seem to be the most engaged on FB (Andangsari et al., 2013). The anxiety aspect of attachment refers here to the degree of concern above others' evaluation and approval. This type of individuals appears to be sensitive to positive feedback (likes, comments…) which affects their feeling about themselves and intensifies their frequency of posting and updating status (Hart et al., 2015). Since they perceive others as available for their requests and problems, they are prone to greater importance to manage their self-presentation in order to get their attention because they anticipate and fear rejection (Hart et al., 2015; Oldmeadow et al., 2013).

However, and as noted by Rom and Alfasi (2014), by being active on FB use, anxiously attached people seem to perpetuate the same characteristics of social inhibition shown in the real word. If it is so, it may be possible then to understand why they cannot disengage. Disengagement would be assimilated to separation. When the anxiously attached persons are faced even to short separations, they could be profoundly disturbed and sometimes, this situation can lead them to panic states (Karen, 1994). So, they resist to this separation and could be so clingy that they may suffocate other by their claim of attention.

Indeed, if becoming more detached (but not less connected) during a period caused increased use of FB (Sheldon et al., 2011), it is likely to suggest, as argued by Bauman (2010), that users are becoming governed by the strong desire to be attached with others. If it is so, could we advance that insecurity, dependence on the emotions and acts of others and the obsessive behaviors to call on attention from the network and to not miss any information will be the cost supported by society?

"Numerous studies indicate that almost half of the human species can be classified as insecurely attached or insecure with respect to attachment" (Ein-Dor et al., 2010, p.123). Insecure attachment is not a pathology in itself (although it can be a major risk factor of disorder) and it is often the result of insecure parental figure (O'Brien et al., 2012). This figure is unable to give to her child the comfort and the security that she has not. Thus, a vicious circle will be created and the insecure attachment style would be perpetuated.

Yet some children spend eight hours per day with technology which is more than the quadruple of the number of hours recommended by the American Academy of Pediatrics. How will this digital generation grow, live and what attachment style will it have? If anxiously attached people perceive FB as the community to which they belong (Rom & Alfasi, 2014) and which provides them with security, so, these online relations will be the external sources that regulate their affection. This attention provided will thus be a reinforcement and reward to continue using FB (learning theory of attachment). Overall, the disengagement practices will be then more difficult.

The Human/Non-Human Attachment: FB Platform in Loop

Users wrongly believe that FB has only some specific known and pre conceived functions to realize (Latour, 1999). In fact, FB has a clear and simple functioning. Its features enable users to form, sustain or interrupt relations easier and without cost. That is why the degree of ease of use perceived by users is found to be deterministic for using FB (Nasri & Charfeddine, 2012). This conceptualization of technology (here FB) as an exterior thing to humans, draws from the acceptance models such as the TAM (Technological Acceptance Model) or the UTAUT (Unified Theory of Acceptance and Use of Technology). Regarding these models, humans decide to use the technology through their perceptions, evaluations and attitudes. Other external factors such as gender, culture or experience are also supposed to influence the relationship between humans and technology. However, technology is not just a material apparatus constructed by humans' actor to satisfy their interest in a particular context and on which they have power.

It is also a product of their action. From this point of view, there is a dynamic interaction between actor, content and context which emphasizes the definition of technology by the ANT as a social construct.

By using FB, the actors are connected to their platforms…and this latter connects them (Latour, 2000) in such a way that they become united with FB (Karppi, 2014): they cohabit, co-evolve, co-act and have a mutual dependence (Brangier & Hammes-Adelé, 2011). So, the inherent dichotomy between object/subject and the technological determinism are thus rejected and replaced by an equal ontological footing with one another (Graham, 2005) and a high level of technosymbiosis (Brangier & Hammes-Adelé, 2011). Thus, when studying the relationship between the user and FB, the question is not the ability of the user as independent subject to manage or to accept/reject the technology as object, but the nature and the quality of the link that exists between them. Hence, the aim is to determine whether their attachment is bad or good, how it can condition the user's action (Latour, 2000). Overall, how user "enacts" with FB.

Based on the cognitive dissonance, Festinger (1957) argues that, when doing an action, the actor tends to avoid any feeling of discomfort by changing his/her way of actions. For example, the disliked object when associated with the liked person/content becomes less disliked. Applying this principle of congruity, even if users dislike their use of smartphone or computer screen and aim to disengage, their attachment to what is shown, heard or read through this referential interface prohibits them to do so. The face-to-face is increasingly replaced by this active interface which becomes users' eyes, hearing and even by which they smell and touch things.

This role is also played by the FB software. In fact, FB communicates with users and replaces their physical absence by sending a heard and seen signal to inform about interaction. It also acts like an extension of the human memory when reminding them of the birthday of their friends or of their participation in events. Moreover, when users logs on to FB for the first time, an affective bond seems to be constructed in such a way that when they attempt to quit FB, an emotional request will be appeared showing the potential loss of not only the online relations but the offline also (Karppi, 2014). Users' response will be then distracted and they will be worried about the implications of this request. These links, described by Licklider (1960) as a symbiosis, show a direct relationship and a mutual dependence between FB and users and underlines that FB is not just an object but a partner.

Nevertheless, this is the visible category of the iceberg. There are hidden facets that mask the users' "interactive loneliness" (Lipovetsky, 2006) and their "accepted isolation" (Guillaud, 2011). The molecular forces, which work behind the visible side, invite users, unconsciously, to interact (Sampson, 2012), to navigate only where friends or friends of friends had navigated (Guillaud, 2011) and to remain into a personalized "filter bubbles" (Pariser, 2011) in which pertinent information predicted by the EdgeRank algorithm from user's profile will be selected (Taffel, 2015). This algorithm masks the messages that are incongruent with the background or the political orientation of a given user, hides the status less liked by him/her and even deletes FB's accounts of revolutionary activists (as it was done in Tunisia when Ben Ali was President) (Lindenberg, 2011). So, it allows a preferential attachment in such a way that "the rich get richer and the good get better". Consequently, the information received by users is not objective nor it is completely randomized; and the social link that they, mistakenly, believe to maintain is selected and not independent. This way of FB commodification and algorithmic agencies could be described as being "anti-social" (Taffel, 2015), unethical and lack transparency (Pariser, 2011). Furthermore, FB transforms the users' profile, shares, like (even the past forgotten ones), friends and their amount of time spent connected on the platform into an economic opportunities by delivering information to the relevant commercial sites which personalize ads and shape user relation and behavior. Indeed, FB forces sometimes the users to accept the violation of certain laws which were conceived to protect their private

sphere before allowing starting a service. In some, FB structure orients the action to a preferential way and tries to guard this "merchandise" by manipulating emotion, behavior and past memories.

Overall, through the FB technical platforms, affective relations and strong ties with users are created. By the selection of who they should contact, view and share, FB gives the unaware users what they want to read, reinforces their self-presentation and meets their needs. This relation will make the disengagement difficult and a painful choice.

When FB is inaccessible (voluntary or mandatory), users could express distress/anxiety/awkward as if they will be separated or anticipated separation from an attachment figure. This negative feeling seems to be also expressed with the mobile phone, an interface that can allow FB connection (Lee and Katz, 2014).

Hence, if the hardware has contaminated all physical space, the software has passively affected the users' participation by analyzing their habits and their desire (Karppi, 2014). So, Software influences individual or collective behavior as do subjective norms and social influence. Based on this analogy, users seem to conform to the influence of FB platform as to the pressure of "normal" society to continue to be connected. To disengage will be thus regarded as abnormal behavior and will show an uncared feeling of others loss.

FUTURE RESEARCH DIRECTIONS

This investigation has FB as unit of focus. So, generalizing this analysis into other SNS is limited although some facets could be shared (Hargittai, 2008). Additionally, other variables could influence relations regarding FB use. While some studies indicated the relation between gender differences and parental education in FB use (Hargittai, 2008) and the attachment styles, others, have stated the influence of age on frequency of SNS use (Nitzburg & Farber, 2013) as well as differences across cultures (Nadhkarni & Hofmann, 2012). Moreover, Stieger and al. (2013) show that people who disengage from FB are especially those who are more worried about privacy, have an average age of 31 (those who still using Facebook has 24 years old), are men, have fewer friends and they are (slightly) more hooked on the web. Future studies could take into account these variables and test their relations with the human/human and human/non-human attachment. They could also initiate some FB disengagement practices in a voluntary or mandatory context and evaluate their relation with user attachment styles as well as the "translation" process with regard to the technology mediator. Besides, considering the impact of culture, it is possible to test the influence of people who are orally oriented (i.e: Arab and African countries) on the FB disengagement.

CONCLUSION

The aim of this analysis is not to determine whether users are independents from or slaves of FB, but rather, how attachment shapes the FB and the users, could enable or disable users' actions and could enhance/constraint their rational/irrational behavior. Surely FB platform allows people to keep in touch with others and makes new relationships more easily accessible. However, the nature and quality of attachment that it maintains seem to transform the relation human/human and human/non-human, which requires more investigations and raises more awareness.

Our analysis shows that the attachment could be a major predictor of FB use. In fact, anxiously attached users are more inclined to find difficulty to disengage since they receive the attention and reassurance required from the online community. Besides, FB platform keeps users in touch thanks to its features but also its affective interaction. However, these relations are not equal. There is an exchange asymmetry about information at the expanse of users and a manipulation of their cognition, emotion and behavior. Since 1964, Ellul argued that moral considerations between technique and its use cannot exist in the new social order. Even though, the users, unworried, continue to be attached.

Through disengagement, it would be possible to show the hidden facets of FB platforms and to select what attachment should be preserved and what should be removed or remodeled. Based on the rational choice theories, human actors have the ability to distinguish between the costs and the benefits of their action guided by their personal interest. Then, more awareness about the misuse of personal data by FB for commercial goals should enhance the degree of care and limit the degree of openness of single users.

It is delusional to believe that it will be a full disengagement (Jauréguiberry, 2014). But, some emergent disengagement practices could be applied (use of technical filters, rational click on like function…) which can be helpful in optimizing users/platform' relationships and changing the rules of the FB game.

By reference to the learning theory, resistance to disengage results mainly from the user's operant learning experience. If so, the nature of attachment could be relearned and the FB use re-appropriated.

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KEY TERMS AND DEFINITIONS

Actor Network Theory (ANT): It is an approach that treats an object as a social construct and assumes that it can act as the human in a network.

Anxiously Attached Person: It refers to the degree of concern exhibited by a person over others' evaluation and approval. It is manifested by an excessive need for attention and reassurance.

Attachment Theory: It presents different styles of attachment that have been built in the childhood period and transmitted to the adulthood. These styles can explain some aspects of the attachment to Facebook and the consequences of disengagement perceived as a separation from caregiver's figure.

Disengagement: It is a way of changing one's practices of connection and an approach of re- appropriation of technology/FB use.

Facebook: It is a SNS which allows a variety of free ways of communication for multiple users and use but with an asymmetry exchange of information and a manipulation of users' cognition, emotion and behavior.

Human and Non-Human Attachment: It is a relationship between human and material generated from the ANT. These two actors are considered to have an equal status until they enter into association within the network.

Social Network Sites (SNS): They are sites that provide possibility to interact with others but which may impact the interpersonal relationships, the human well-being and behavior.

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Section 6
Sports and Entertainment

Chapter 49
Mining Sport Activities

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ABSTRACT

For many people, sport is one of the stress-relieving activities. People being involved with sport wish to achieve attractive shape, healthy lifestyle, lose weight, and so on. However, there are also people who deal with sport because of competition goals. In order to fulfill their competition goals, they need to train properly. Even for professionals, it is very hard to perform a serious training. On the other hand, recent expansion of smart sport watches and even smart phones allow athletes to train smarter. During the months and years, they produce dozens of activity files. These files offer thousands of opportunities for data mining approaches, where athletes gained a deep insight into their training data. Data mining approaches are able to extract habits of athletes, help to prevent over-training syndrome and injuries, clustering similar activities together, and much more. In this chapter, the authors show opportunities for data mining, enumerate recent applications, and outline future potential for research and applications in the real world.

INTRODUCTION

For many people todays, sport is one of the stress relieving activities. People usually get involved in sport to achieve attractive shape, healthy lifestyle and better feeling. However, some people get involved in sport to compete professionally. Competitions were recently reserved for the professionals only. Few years ago, the professional community became more open to amateur athletes whose main objective is not competing. Nowadays, these can join to professional sports communities (Rauter, & Doupona Topič, 2011). Especially in massive sports events (running marathons, triathlons, cycling competitions), organizers give the opportunity to amateurs for competing with professionals in the same competition.

Amateurs need to train properly in order to fulfill their competition goals. Performing hard training is difficult not only for amateurs, but even for professionals. Athletes usually train at different stages and places to improve the effectiveness of training – gym, fitness, swimming pool, road, macadam, etc.

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Another obstacle that usually makes planning sports training sessions difficult for amateurs are properly balancing the two typical training phases, i.e., resting and eating that accompany each end of the training session. Consequently, athletes need to hire personal sports trainers in order to continuously improve their performance. Unfortunately, this hiring becomes very expensive after some time for amateur athletes.

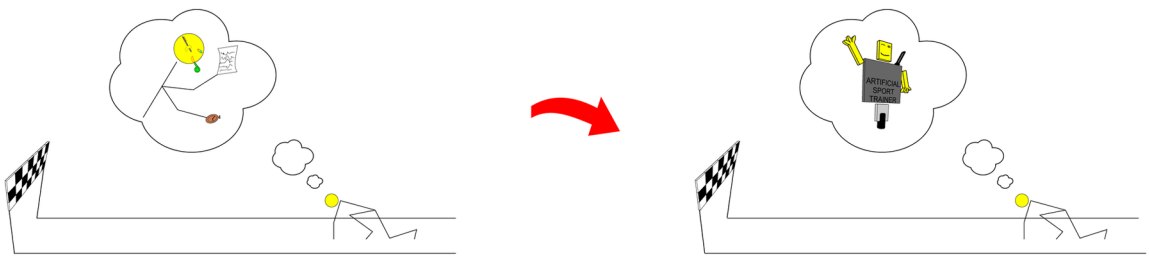
Recent expansion of smart sports watches and smart phones allow athletes to carry out the sports training sessions smarter. Usage of mobile devices (Baca, Dabnichki, Heller, & Kornfeind, 2009, Baca, Kornfeind, Preuschl, Bichler, Tampier, & Novatchkov, 2010) typically causes production of the dozens of activity datasets containing data about athlete's position, speed, hearth rate and power rating over the sports training sessions. Analyzing these activity datasets enable an athlete to gain the deeper insight into every training session. Furthermore, a computer program using the latest data mining methods is even able to extract athlete's habits during sports training. Moreover, it may notify the athlete for possible over-training syndrome to prevent injury, advice nutrition using prediction and in the end, generate various sports training plans by clustering similar activities together.

Consequently, there is a lot of possibilities how to use these data for a further analysis and apply them for improving the athlete's performances. In a nutshell, these activity datasets offer an infrastructure for developing the artificial sports trainer (AST) as proposed by (Fister, Ljubič, Suganthan, Perc, & Fister 2015) that will be capable to help athletes during all sports training phases. Unfortunately, the most of athletes (especially amateurs) are not familiar with sports training theory and thus every assistance in any phase of sports training is welcome. As a matter of fact, the proposed AST computer framework based on Computational Intelligence (CI) algorithms that is open and therefore suitable for incorporating the new features easily.

The primary objective of the AST is to generate the sports training sessions of similar quality as a real trainer. At the moment, the AST serves as a framework in which a various features covering different phases of sports training are incorporated especially in individual sports disciplines, where a lot of sports activities have been tracked using the wearable mobile devices. It definitely will present a bright star in planning, performing, controlling and evaluating phases of the sports training also in team sports disciplines in the future.

In this chapter, we focus on opportunities of data mining in sports. In line with this, the association rule mining method is proposed that was applied up to the present for solving two problems, i.e., discovering hidden habits of athletes in sports training and detecting the over-training syndrome. The results of both applications showed a true potential of these methods for data mining the sports activities. However, both applications can be incorporated in the AST framework as the features in the future.

Figure 1. Illustration of training plan generation in the past and future



Organization of this chapter is as follows. The next section is devoted to highlight background and fundamental information. In line with this, sports trackers and data mining paradigm are discussed. Then, the principles of data mining the sports activities are clarified. After that, the current applications in mining the sports activities are discussed shortly. The article concludes with a discussion and future research directions.

BACKGROUND

Sports Trackers

In order to track athlete's sports activities in the past, running athletes had worn very simple watches (later renamed to simple sports watches). These watches allowed to monitor only time and were therefore used for analyzing the duration of workouts and interval trainings. One of the pioneers of sports watches, the finish manufacturer Polar, released first sports watch enabled measuring and monitoring the heart rate in 80's. Heart rate monitors allowed heart rate measurements in a real-time, thus allowing athletes to adjust performance in training/race. Hearth rate was also stored into sports watch's memory suitable for the later analysis. Consequently, all measured data helped athletes to perform better training and competition by achieving much better results. At the beginning of the last century, the huge expansion of cycling sensors for measuring a speed and cadence in real-time emerged. The manifestation of those sensors improved also cyclist's performance. Today, modern sports bike is equipped with so called power meter. Power meter offers real-time power monitoring, and nowadays presents the state-of-the-art technology in cycling.

Another revolution was born with an emergence of mobile and pervasive computing. The mobile devices have been renamed to sports trackers when a massive production of smart phones and appropriate software applications has started. Sports tracker is basically an application running on the smart phone in order to track a sports training session (Fister, Fister, Fister, & Fong, 2013). These mobile devices obtain information from a global positioning system (GPS). There is a lot of sports watches on the market equipped with GPS that behave almost the same as the sports trackers (e.g. Garmin Forerunner, etc.). Consequently, todays almost every type of sports training sessions can be monitored using the sports trackers (even swimming). Data about sports activities can be uploaded to the internet after a finishing the training sessions. Powerful software applications allow the online analysis of these training data, sharing sports activities with friends in a "social network" and rearranging virtual competitions between these. Much more functions are accessible to users, e.g. weight monitoring, commenting on social networks, pace prediction and personal records storing. Data tracked during the workout is actually written into the XML datasets. There are two special formats of sports training datasets:

- GPX (GPS Exchange Format) (Code snippet 1),
- TCX (Training Center XML) (Code snippet 2).

The first code snippet presents an example of the GPX dataset, while the second an example of the TCX dataset. Both formats are easily for parsing, i.e., extraction of parameters. In fact, there are many tools which allow researchers to extract features from datasets. How to deal with these data is outlined in the paper (Rauter, Fister, & Fister, 2015).

Code snippet 1. An example of GPX file

```
<trkpt lon="14.05636821873486" lat="46.03463463485241">
        <ele>714.4000244140625</ele>
        <time>2015-05-16T14:11:34.000Z</time>
        <extensions>
          <gpxtpx:TrackPointExtension>
            <gpxtpx:atemp>22.0</gpxtpx:atemp>
            <gpxtpx:hr>136</gpxtpx:hr>
          </gpxtpx:TrackPointExtension>
        </extensions>
      </trkpt>
      <trkpt lon="14.056426053866744" lat="46.03455643169582">
        <ele>714.7999877929688</ele>
        <time>2015-05-16T14:11:35.000Z</time>
        <extensions>
          <gpxtpx:TrackPointExtension>
            <gpxtpx:atemp>22.0</gpxtpx:atemp>
            <gpxtpx:hr>136</gpxtpx:hr>
          </gpxtpx:TrackPointExtension>
        </extensions>
</trkpt>
```

Data Mining

Data mining (Han, Kamber, & Pei, 2011) is a popular discipline of computer science dealing with information extracted from large databases. This means, data mining methods help us to discover knowledge hidden in data. These methods have been became more popular in the current era of big data. In line with this, various data mining applications were developed for application in business, finance, medicine, engineering and even sport domain. At the moment, the most frequently used methods in data mining encompasses:

- Classification,
- Clustering,
- Association rule mining and
- Regression.

Classification is a process of searching a model for describing data classes or concepts. The model is built using an analysis of learning dataset, where the results of classification are known. This learned model can be used for prediction of test dataset, where the classification results are unknown. Clustering enables an integration of similar data into the so called clusters and does not use any output variables (Jain & Dubes, 1988). Association rule mining searches for relations between attributes that stay normally hidden in databases. Regression differs from the classification in the number of output variables,

Code snippet 2. An example of TCX file

```
<Activity Sport="Biking">
      <Id>2014-09-13T12:53:15.000Z</Id>
      <Lap StartTime="2014-09-13T12:53:15.000Z">
        <TotalTimeSeconds>8156.731</TotalTimeSeconds>
        <DistanceMeters>24078.68</DistanceMeters>
        <MaximumSpeed>13.526000022888184</MaximumSpeed>
        <Calories>683</Calories>
        <AverageHeartRateBpm>
          <Value>132</Value>
        </AverageHeartRateBpm>
        <MaximumHeartRateBpm>
          <Value>152</Value>
        </MaximumHeartRateBpm>
        <Intensity>Active</Intensity>
        <TriggerMethod>Manual</TriggerMethod>
        <Track>
          <Trackpoint>
            <Time>2014-09-13T12:53:15.000Z</Time>
            <Position>
              <LatitudeDegrees>46.042062006890774</LatitudeDegrees>
              <LongitudeDegrees>14.055101796984673</LongitudeDegrees>
            </Position>
            <AltitudeMeters>769.0</AltitudeMeters>
            <DistanceMeters>0.0</DistanceMeters>
            <HeartRateBpm>
              <Value>80</Value>
            </HeartRateBpm>
            <Extensions>
              <TPX xmlns="http://www.garmin.com/xmlschemas/ActivityExtension/
v2">
                <Speed>0.0</Speed>
              </TPX>
            </Extensions>
          </Trackpoint>
```

because there is only one output variable. The most popular classification methods are: support vector machines (SVM) (Vapnik, 1998), decision trees (DT) (Quinlan, 1986) and artificial neural networks (ANN) (Gershenson, 2013). Interestingly, a high impact of nature-inspired algorithms tailored for data mining tasks (Fong, 2013; Fister, 2015) is increased.

MINING THE SPORTS ACTIVITIES

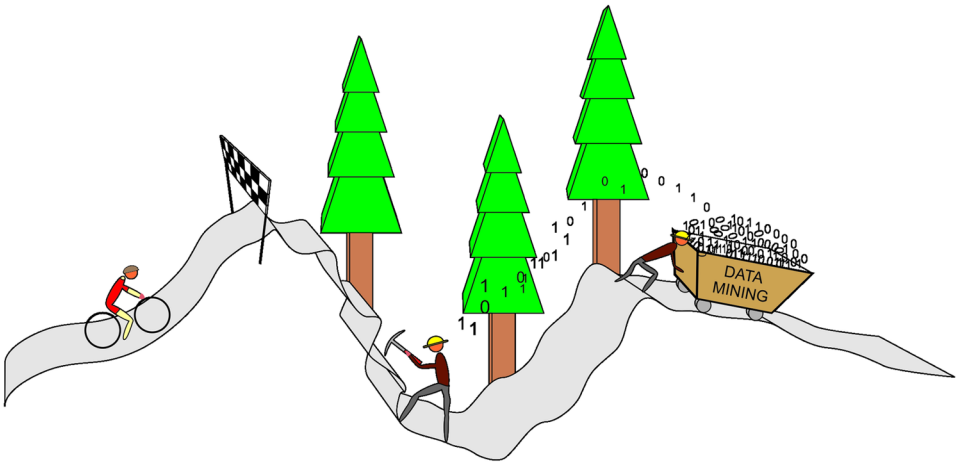
Mining the sports activities (Figure 2) offers athletes to get a deeper insight into their own characteristics, like a body capacity, physical conditions, mental abilities, etc. Usually, casual sports trainers measure a training load of an athlete indirectly by using some indicators of sports training intensity, like heart rate, lactate, VO2 max etc. An estimation of the athlete's progress and increasing the performance over the years bases directly on tracking this information.

Typically, athletes do not realize any insight in relations between indicators of sports training intensity that are saved into dataset as attributes. Knowing these relations (also associations) could have a great impact on an improvement of the athlete's performance. For example, the athlete performing the sports training session of medium duration, but high intensity will normally sleep badly that day. He will probably not regenerate till the next day. On the other hand, the same athlete will feel motivated and will have good eating habits after performing the long training session of low intensity.

Shall we find any special relations between attributes in large databases, and thus the athlete is guided to be motivated for sports training and consequently influences on his/her faster recovering? Of course. Using one of the data mining methods, named association rule mining, these hidden relations can be discovered. However, some of the association rules presents the positive relations that need to be promoted by the trainer, while another determining the negative relations should be prevented by trainer. For example, if an athlete has problems with eating and sleeping (consequently bad recovering) after the interval training session, he/she can still decrease the load or shorten the duration of the training session.

Mathematically, the association rules are expressed as an implication $X \rightarrow Y$, where X and Y are two subsets of items $I = \left\{i_1,\ldots,i_n\right\}$, and $X \cap Y = \varnothing$. In addition, a set of transaction named dataset $D = \left\{t_1,\ldots,t_m\right\}$ is defined, where each transaction has unique identification and contains a subset of items. Typically, each mined rule is estimated according to the set of transactions by two measures, as follows:

Figure 2. Mining sports activities



- Support, which is defined as proportion of transactions containing X and Y, and the total number of transactions in database, i.e.:

$$supp(X \Rightarrow Y) = \frac{n(X \cup Y)}{N}$$

- Confidence, which is defined as proportion of transaction that contains X also contains Y, i.e.:

$$conf(X \Rightarrow Y) = \frac{n\left(X \cup Y\right)}{n(X)}.$$

Thus, the support must be higher than the prescribed minimum support $S_{\min}$ and the confidence higher than the prescribed minimum confidence $C_{\min}$.

Let us notice that there is a lot of association rule mining methods. Anyway, the procedure of the proposed mining sports activities consists of the following four steps:

- Data collection, preparation and preprocessing,
- Selecting the proper association rule mining method,
- Applying the selected data mining method to extracted data and
- Presenting the results to athletes or trainers using visualization.

In the first step, data needs to be prepared. Obviously, sports training datasets are collected by athletes over many years. All these tracked data about past sports activities should be imported into databases. It is a good practice by athletes to add some additional information about present training session in a form of short questionnaire. Questionnaire describes some characteristics about athlete's feeling (e.g., eating and sleeping after training).

After the importing data about past training session, the proposed method for mining the sports activities is ready for preprocessing. The aim of the preprocessing is to extract attributes from data. These attributes are values extracted from the corresponding activity datasets (Rauter, Fister, & Fister, 2015) and questionnaires, as for example: total duration time, total distance, average speed, average and maximum heart rate and others. The structure of preprocessed features depends on the selected data mining method later. Extraction of these features are presented by various parsers that are described in paper (Rauter, Fister, & Fister, 2015).

In the second step, a decision needs to be received, where the expected results of the data mining should be determined. Consequently, a proper association rule mining method must be selected in the step. For example, if the athlete's behavior during or after training session is necessary, then the methods, like Apriori (Agrawal, & Srikant, 1994) or BatMiner (Fister, 2015), should be used. While the former is the traditional method, the later bases on the known swarm intelligence algorithm. According to the selected data mining method, the preprocessed data should be prepared.

The purpose of third step is to apply the selected data mining method to dataset, in other words, the selected data mining algorithm is being to run.

The final step is devoted to visualization of results to athletes or sports trainers. This step is very important due to successfully presentation of results obtained by the data mining method. Human are visual beings to whom the visual information say more than equivalent alphanumerical information. Therefore, the visualized, graphical information are more suitable for presentation of the results. One of the more popular possibility for graphical presentation are glyph-based diagrams (Ward, M. O. 2002).

CURRENT APPLICATIONS

Recent efforts in mining sports activities domain revealed two interesting applications for mining the sports activities:

- Finding hidden habits of athletes in training (Fister, 2015), and
- Detecting the over-training syndrome (Fister, Hrovat, Rauter, & Fister, 2014).

The purpose of the first application is to find some association rules in the sports training datasets obtained during athlete's training session. Usually, athletes are not aware about capacity of their body, influence of interval training on their sleeping, eating and other factors that influence on their performance. In order to help especially amateur athletes, the proposed mining the sports activities were developed. Results are presented athletes visually using glyphs (Figure 3, Figure 4). In the application, the association rule mining was implemented using the BatMiner.

The second application was devoted for detecting the over-training syndrome using association rule mining, where the Apriori was applied to real datasets created by mountain biker with mobile device. Experiments showed that this method is useful for detecting such kind of problems in sport. However, interpretation of results was still a bit weak in the application.

FUTURE RESEARCH DIRECTIONS

There is many opportunities and challenges for further research in this sports domain. Sports trackers are relatively young devices and therefore only a piece of their potentials were yet explored. On the other hand, athletes must be every year more and more fit in order to be prepared for competing on the higher level. Thus, many more parameters obtained from mobile devices during the sports sessions must

Figure 3. An example of association rule

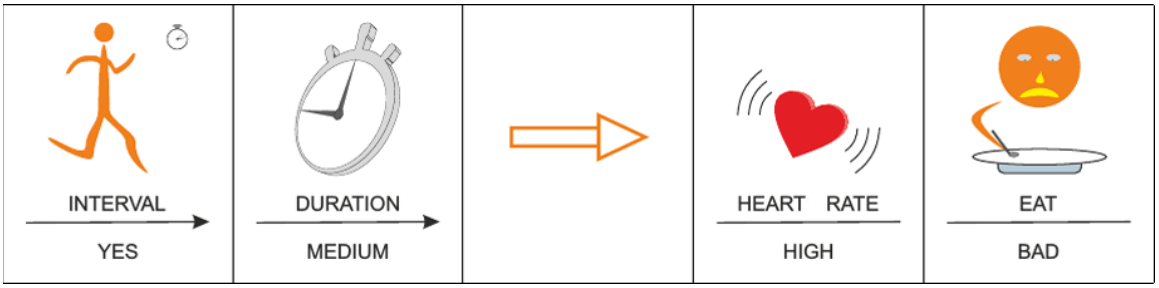
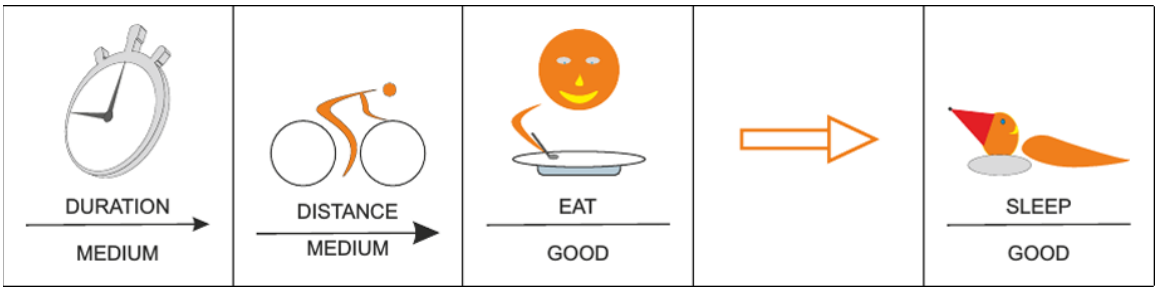


Figure 4. An example of association rule



be analyzed nowadays. Extracting athlete's advantages and weaknesses in dealing with various training types (intervals, long runs/rides) seems to be a promising way for further research besides other challenges that should be summarized as follows:

- **Finding the Proper Training Course:** The task of finding the proper training course is even more complex for sports trainers. Especially, setting up cycling course is very hard and demands many parameters by creation into account. These parameters are mostly connected with elevation, degrees of hills and even traffic conditions. In order to break this wall, data mining seems to be a promising method to find the best combination of training course.
- **Visualization:** Human beings prefer a graphic presentation against the alphanumeric presentation. In process of sports training and racing, athletes produce a lot of data that is normally presented in the alphanumeric form and usually means no special to athletes. However, a visualization of these strings enables also non-scientists a helpful view on results. One of the better solutions for visualization states on the glyph-based diagrams (Ward, 2002). Obviously, the visualization still offers many opportunities for research, e.g., visualization of segments of sports training, visualization of group of trainings, presentation of wall in performance and even virtual competitions among athletes.
- **Food Assistance:** What to eat at the proper moment is still a very peculiar question. Sports trainers and scientists had made many studies and simulations, and discovered that many factors influent on athlete's body and performance. Imagine the double ultra-triathlon (7.6 km swim, 360 km bike, 84.4km run), where an athlete's final success strongly depends on the proper food. Moreover, the proper eating is one of the most important factors in this kind of sports competition. In line with this, food prediction using data mining methods might help athletes in choosing the proper food for long-term competitions.
- **Analysis of Rivals:** Nowadays, many data about various competitions in different disciplines are available on the Internet. Therefore, many athletes dream about analysis the advantages and weaknesses of their rivals or competitors not only in individual sports disciplines but also in team sports. On the basis of the result history, there is a possibility to achieve opponents' weaknesses using the data mining methods.

CONCLUSION

In this chapter, we presented a short overview of interesting research topic that proposes data mining in sports. Features for improving the performances of athletes, get special insight of their habits and body capacities are described. Steps of mining the sports activities are systematically showed, as well as challenges and opportunities for the future research. As a matter of fact, all these features could be integrated into the AST framework and therefore more and more specific phases of the sports training could gradually be realized by AST. Thus, the potential of the AST would be growth until abilities of the real sports trainer could finally be achieved.

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KEY TERMS AND DEFINITIONS

Artificial Sport Trainer: Software that mimics behavior of human sport trainer in order to create a plan of sport training sessions.

Bat Miner: Algorithm for association rule mining based on bat algorithm.

Sport Tracker: Software for tracking sport activity in real-time.

Sport Training: A process built on scientific and pedagogical principles, which affects the performance of an athlete using planned and systematic training sessions.

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Chapter 50
Sport Exergames for Physical Education

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ABSTRACT

Sports active video games (exergames) are accessible forms of physical activity which might also be used in physical education (PE) curriculum. The purpose of this chapter is to review some of the relevant applications of sports exergames for inclusion in PE and to characterize one of these games (swimming) from different aspects of biomechanics, physiology, and psychology. The authors compared movement patterns, muscle activation, energy expenditure, enjoyment, usability, and game experience in participants with different performing levels (real-swimmers vs. non-swimmers, experienced vs. novice) and gender. Understanding these parameters may help in the development of more realistic sports exergames and meaningful gameplay and may give PE teachers a better idea of the inclusion of such games in their practice.

INTRODUCTION

Insufficient physical activity is one the main parameters for mortality, and obesity is a growing concern in post-industrial countries. A combination of physical exercise and healthy nutrition is essential for decreasing obesity. Active video games (exergames) are becoming popular as ways of motivating people to exercise more. However, it is not clear whether these serious games could also be used in physical education (PE) and serve as more than mere entertainment. In this chapter, we will examine existing academic literature based on the characteristics of sport exergames that are important in the domain of PE. We also provide a practical example of psycho-biophysical evaluation of a sport exergame to see how close and encouraging these games are, compared to the real sports.

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BACKGROUND

PE is considered to be a crucial part of primary school curriculum around the world which include both physical and educational contents (Lindberg, Seo, & Laine, 2016). Thanks to digital technologies, new learning environments provide opportunities for skill acquisition and socializing, and researchers are now examining the role, efficacy, and opportunities that these environments provide. On the other hand, several reasons including lack of time, lack of skills of PE instructors, and lack of support might reduce the quality and quantity of PE education (Lindberg, Seo, & Laine, 2016). Moreover, pedagogy has always tried to innovate teaching, and PE is also emerging regarding integrating technology into regular classes. One exciting area in which technology and education could merge is by using video games that include visual (and/or audio) stimulus. Video games can be applied to improve attention, executive functions, and reasoning (Neugnot-Cerioli, Gagner, & Beauchamp, 2015). They are also shown to increase several types of intelligence (e.g. visual-spatial and bodily-kinesthetic) while providing a playful-formative experience (del Moral-Pérez, Fernández-García, & Guzmán-Duque, 2015).

On the other hand, previous psychological research has linked aggression with video gaming (Anderson et al., 2010) and content analysis of video games was mainly concerned about violence and role of gender (Lee & Peng, 2006). As excessive use of technology, which also includes video gaming, is suggested to be a contributing factor in obesity, a new approach has been proposed to include active video games (exergames) that incorporate motion sensor technology and could be played using whole body movements. While gamification of regular exercise activities (e.g. GPS-based virtual reality zombie run) has been previously reported, active video games are not frequently used in the context of PE (Lindberg, Seo, & Laine, 2016), and insufficient evidence about efficacy of exergames exist within schools (Norris, Hamer, & Stamatakis, 2016). Previously, Ennis (2013) considered exergames in three categories of recreation (light to moderate intensity), public health (moderate to intensive physical activity - PA), and educational (to facilitate skills).

MAIN FOCUS OF THE ARTICLE

Motivation/Literacy to Play and Exercise

Several methods are used to increase players' motivation in sporting activities (Keegan, Harwood, Spray, & Lavallee, 2009) and game-based learning and storytelling are the primary ways to provide intrinsic motivation for learning (Laine, Nygren, Dirin, & Suk, 2016). Exergames provide a non-scary environment to develop components of mastering of fundamental movement skills (George, Rohr, & Byrne, 2016). For example, children might improve aiming and catching skills during virtual tennis without the fear of getting hit by the physical ball. In children with sensory dysfunction, exergames are used to increase their learning motivation and to make them more confident in facing various learning challenges (Chuang & Kuo, 2016). By embedding elements of nature, exergames can also provide a sense of connectedness and environmental concern, which might be important for exercising outdoor (Öhman, Öhman, & Sandell, 2016). Wittland, Brauner, and Ziefle (2015) also suggested that accepting serious games for physical fitness, is not dependent on gender, expertise, and gaming habits. However, when used with older adults, "guided hands-on" and "1-on-1" teaching methods might be used to increase their engagement when facing technology (Seides & Mitzner, 2015), because older adults need more

time to master the skills necessary to play active video games (Santamaría-Guzmán, Salicetti-Fonseca, & Moncada-Jiménez, 2015). Sun (2013) evaluated the effects of exergame in primary school students and showed that PA situational interest decreases over time, but exergame intensity increases. Therefore, strategies to balance the activities should be considered during the game design phase. Many models of have been created to explore game characteristics from designers and consumers' perspectives (cf. Mildner, Stamer, & Effelsberg, 2015). Gender, age, game type, players' characteristics and personalities are motivators for gameplay (cf. Jabbar & Felicia, 2015). For example, Shaw, Tourrel, Wunsche, & Lutteroth (2016) showed that considering personality and motivation of players in a virtual training exergame with two modes of competitive and cooperative gameplay might increase exercise, especially in competitive individuals.

Learning and Skill Acquisition

Digital games have become great tools in knowledge transfer due to fostering intrinsic motivation in players to acquire more knowledge (Mildner, Stamer, & Effelsberg, 2015). Some sports games may be used to simulate the real sports skills; for example, shooting exergames might have a positive skill transfer for increasing hitting scores (Eliöz, Vedat, Küçük, & Karakaş, 2016), and Vernadakis, Papastergiou, Zetou, & Antoniou (2015) showed that exergame-based interventions could improve object control skills in children. Moreover, players' interactions with the game and other players, affect their learning while sports exergaming (Meckbach, Gibbs, Almqvist, & Quennerstedt, 2014). Exergames might also increase PA while developing motor skills among overweight children and adolescents (do Carmo, Goncalves, Batalau, & Palmeira, 2013). Body tracking technologies have also been used as a live correcting tool for free weight exercises (Conner & Poor, 2016), and improved motor skills (balance) after exergaming was observed with higher scores in female players (Norris et al., 2016).

On the other hand, these games may not be as effective as traditional PE instructions for psychomotor development (Pedersen, Cooley, & Cruickshank, 2016). For example, virtual swimming in the air does not replicate the physical fidelity connected with moving water. A previous systematic review also showed that virtual reality applications have the ability to change behavior but have little gain in knowledge (Omaki et al., 2016). While cognitive functions are crucial for the functional autonomy, Monteiro-Junior et al. (2016) showed that a single bout of virtual reality training does not have any effect on cognitive function in older adults. Johnson, Ridgers, Hulteen, Mellecker, & Barnett (2015) also showed that short bouts of exergame playing may not influence perceived and actual ball control skill competence. Previous research also argues that when mastery is achieved, a gradual decrease in performance is expected (Adi-Japha, Karni, Parnes, Loewenschuss, & Vakil, 2016). Therefore, player balancing techniques should be used to provide an equilibrium between enjoyment and skill acquisition for players with different levels of expertise (Vicencio-Moreira, Mandryk, & Gutwin, 2015).

Competition vs. Cooperation

To gamify traditional sports, researchers and game designer are often challenged to provide a socially-enriching experience without bombarding players with game information (Choi, Oh, Edge, Kim, & Lee, 2016). Characteristics of different players should also be taken into account; for example, Staiano et al. (2012) concluded that in a group of adolescents, competitive players outperform cooperative participants on executive function test. Girls also play exergames mostly for social interaction and rather than

competition, and boys play games for intrinsic reasons (O'Loughlin et al., 2012). Online cooperative exergaming can also increase social relatedness in players compared to the time when they play against a computer character (Kooiman & Sheehan, 2015).

Opinion

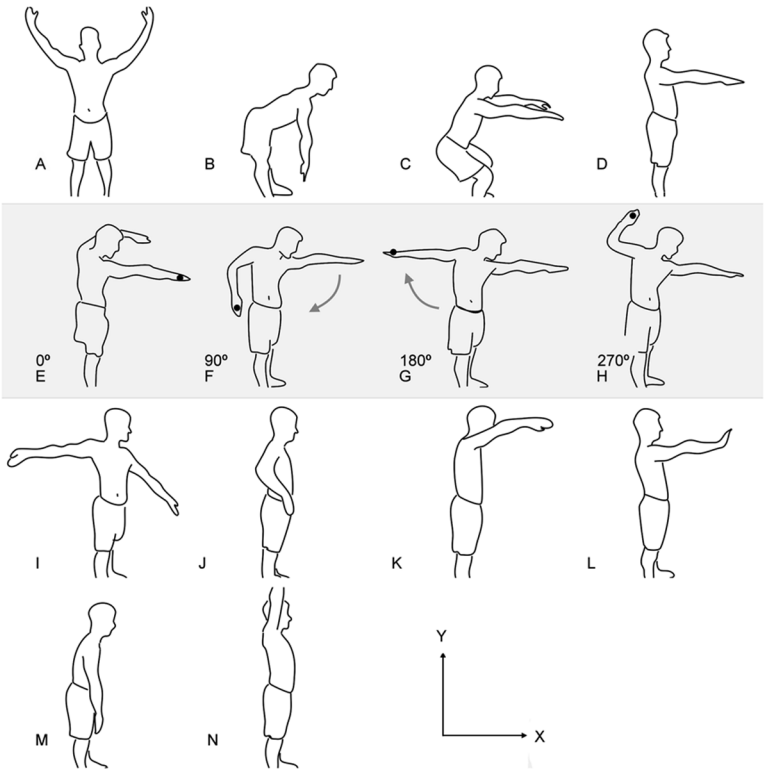
Previous research suggests that if PE instructors decide to use exergames in their teaching, they should justify why and how they want to apply them, and design strategies for the students to interact with exergames (Gibbs, Quennerstedt, & Larsson, 2016). For example, a meta-analytic review suggests that playing exergames can improve older adults' physical balance, balance confidence, functional mobility, executive function, and processing speed (Zhang & Kaufman, 2015), and coaches may use these ideas to design more effective exercise programs. Exergame inclusion in PE curriculum may also provide additional tools to meet PA standards and to motivate and engage the student in practice (Rudella & Butz, 2015). On the other hand, Hulteen, Johnson, Ridgers, Mellecker, & Barnett (2015) showed that while players had correct skill performance (during table tennis, tennis, and basketball), they also had proper movement during skill assessment, which shows that presence of evaluator may affect the way participants play. According to Kooiman, Sheehan, Wesolek, & Reategui (2016), exergames should not be seen as the primary tool in PE because there are several parameters that expand the activity beyond virtual environments. Using technology in education is mostly affected by teachers' attitudes towards using technology (Albirini, 2006). While Bransford et al. (1999) talked about the four different learning environments as learner-centered, knowledge-centered, assessment centered, and community centered, it is important to decide which area benefit learning new skills in exergames more.

Characterization

In this part of the book chapter, the authors mention studies that were included in the Ph.D. thesis of the first author about characterizing a sport exergame. In the first part, the authors compared movement patterns of forty-six college students, with different performance (novice vs. experienced, and real-swimmers vs. non-swimmers) and gender. Reflective markers were placed over the skin, and the 3D position of each marker was recorded using a motion capture system. Subject played different techniques (100 m each) of a swimming exergame designed for Microsoft Xbox and Kinect (Michael Phelps: Push the Limit, 505 Games, Milan, Italy). Subjects had to stand in front of Kinect and start their gameplays by "hyping" for the virtual crowd (Figure 1, Panel A). Then they had to slightly bend forward (mimicking start for the crawl, breaststroke, and butterfly; Figure 1, Panel B). For the backstroke technique, the start is shown in Figure 1, Panel C. Following the "Go!" command, they had to extend their back (Figure 1, Panel D) and swim according to the techniques (Figure 1, Panel E to H for crawl; Panel I for backstroke; Panel J for breaststroke, and panel K for butterfly). To start a new lap, they had to extend their arm forward (Figure 1, Panel L) and continue swimming. For terminating the race, they had to drop both arms (Figure 1, Panel M) and raise one arm immediately (Figure 1, Panel N).

The gameplay was divided into two phases of normal (with on-screen visual feedback to prevent players from playing too fast or too slow) and fast (playing without any feedback). Players' performances were ranked from 1st to 8th. The results showed that players who ranked better in the game (Figure 2), completed the game faster and with fewer arm cycles. By visually inspecting Figure 2, we can see that movement patterns of good performers were different that bad performers, who were mostly real-

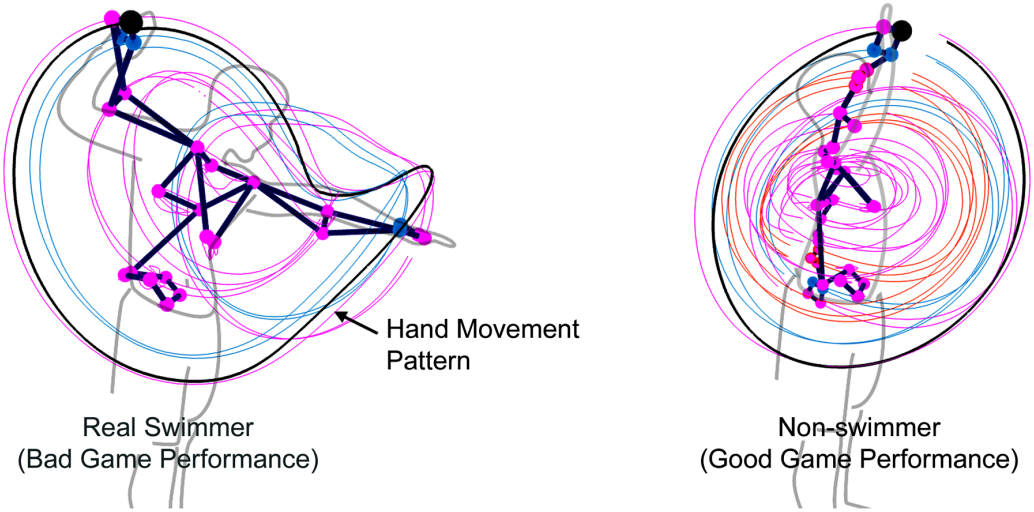
Figure 1. Body position during each phase of the game



swimmers, meaning that the game does not encourage players to swim correctly. Moreover, those who had prior experience with the game had fewer arm cycles and real-swimming experience and gender did not affect biomechanical parameters.

In the second study, the authors measured and compared aerobic and anaerobic energy systems contributions and the activity profiles of participants while sport exergaming. Players were equipped with a gas analyzer to measure oxygen consumption, and blood lactate was measured using a small amount of blood from their ear lobe after each technique and following the gameplay. From these two parameters, we were able to measure the total energy expenditure (EE) during the gameplay. Players' gameplays were also filmed to measure total playing time (TPT), effective playing time (EPT), resting time (RT) and effort to rest ratio (E:R) using video analysis. Our results showed that anaerobic lactic pathway accounted for around 9% of total EE and EE was not different between performing groups. This shows that although the level of EE is lower compared to real-swimming, both energy systems should be considered when analyzing sports exergames. Heart rate (HR) was also measured during the gameplay and differences were observed between real-swimmers and non-swimmers in the first technique. This confirms that real-swimmers tend to swim correctly and exert more at the beginning of the game, but as soon as they realized the mechanisms of the game, they tend to exert less. Players were active around 57% of total time, and E:R was approximately 1.3. Our results also show that although players dedicated more time playing than resting, the changes were not different between players. Experienced players had lower TPT, EPT, and E:R compared to their novice counterparts, suggesting that experienced players learn the strategies to play the game with lower exertion. This confirms the necessity of designing

Figure 2. Movement patterns during swimming exergame



games with lower resting times (loading of the game, navigating between the menus, etc.), dedicating more time to the actual gameplay.

In the third study, the authors measured muscle activation during sport gaming. Surface electromyography electrodes were placed over Biceps Brachii, Triceps Brachii, Latissimus Dorsi, Upper Trapezius, and Erector Spinae muscles. These muscles were chosen as they are frequently activated during swimming or were relevant because of the game itself. Maximum voluntary isometric contraction (MVIC) of each of the muscle was also measured to normalize the activation in percentages. Our results showed that muscle activation ranged from 5 to 95% MVIC, and differed between normal and fast swimming for all techniques. Muscular coordination was also investigated using biomechanics and observed that when participant plays faster, they complete different stages of the game faster, which results in higher stress some of the muscles more. Measuring muscle activation is important because it can show if players with greater experience, exert and engage less or not. While challenges in sedentary games are usually controlled by adjusting the complexity of mental tasks, employing in-game physical challenges can be unique characteristics of exergame design and muscle activation evaluation can provide guidelines to make sports exergames closer to real activities. Such evaluations can also address the Concerns regarding long-time computer/video game use, repetitive movements, and musculoskeletal disorders, such as neck and shoulder pain. Moreover, although sports exergames may not produce as much muscle activation as the real activity, such activities might still benefit participants to develop muscular endurance, especially when participation in real sport is not possible or practical due to disability, fear, or injury.

In the last study, the authors evaluated the game experience, usability, and enjoyment during sport exergaming to see if they affect future participation if PA and/or real sport. Enjoyment can both predict and be an outcome of PA participation and is one of the reasons why people play video games. System usability scale (SUS) is a measurement of learning, control, and understanding a game, and higher SUS grade means easier interaction between human, different games and menus, and various controllers and gaming platforms. User experience (UX) deals with consumers' dynamic perceptions and responses of products and systems and is an important factor for game design and positioning of the problems. For measuring enjoyment, a short version of physical activity enjoyment scale (PACES) questionnaire with

two additional questions was used to measure future intentions of participation in physical activity and real swimming. Game usability was measured by System Usability Scale and playability aspects using Game Experience Questionnaire. Our results showed that Female players with real swimming and exergame experience enjoyed the game more. Usability score was around 75 which is considered as good with high acceptability. PA intentions did not change within performing groups, but swimming intentions were increased for all players. A possible explanation might be that future PA intentions of those who frequently exercise, may not be affected by playing exergames. Another explanation might be that those who do not exercise regularly, may think that the health benefits attained through exergaming are enough, and there is no need for further PA participation. It might be possible that novelty and entertainment elements of swimming exergame, played a role in influencing players' attitudes towards real swimming intention.

FUTURE RESEARCH DIRECTIONS

In our research, most of the players had sports science background and were physically active. This might have influenced the way they were interacting with the game. The presence of the researchers themselves might have affected players' performance to play differently. It might be possible that novelty and entertainment elements of swimming exergame, played a role in influencing players' attitudes towards real swimming intention and therefore, longitudinal studies should be conducted to check the changes in intentions in the long run.

CONCLUSION

In general, our data suggest that better performance inside the game does not necessarily mean better performance in real swimming. The motion capture sensor is also not capable of capturing delicate movements of swimming, and it does not encourage players to swim correctly. Therefore, the game may not be used as a training tool for real swimming and may only be used as a motivational tool for teaching basic movements of swimming (e.g. coordination of the upper limbs). While we do not deny the possible role of video games in PE settings, we believe that there is still a long way to use sport exergames in the PE.

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KEY TERMS AND DEFINITIONS

Exergame: A combination of "exercise" and "game" is a term used for video games that are also a form of exercise.

Game-Based Learning: A type of game play that has defined learning outcomes.

Game User Research: It focuses on players' behavior via techniques such as playtesting, analytics, expert analysis, and others.

Skill Acquisition: A specific form of learning as the representation of information in memory concerning some environmental or cognitive event.

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