Chapter 1
Back to the Future:
Tracing the Roots and Learning Affordances of Social Software

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ABSTRACT

This chapter provides a developmental perspective on Web 2.0 and social software by tracing the historical, theoretical, and technological events of the last century that led to the emergence—or re-emergence, rather—of these powerful and transformative tools in a big way. The specific goals of the chapter are firstly, to describe the evolution of social software and related pedagogical constructs from pre- and early Internet networked learning environments to current Web 2.0 applications, and secondly, to discuss the theoretical underpinnings of social learning environments and the pedagogical implications and affordances of social software in e-learning contexts. The chapter ends with a social software use framework that can be used to facilitate the application of customized and personalized e-learning experiences in higher education.

INTRODUCTION

Is social software merely a continuation of a broad class of older computer-mediated communication (CMC) and collaboration tools, or does it represent a significant transformation of social interaction capabilities? In this chapter, we trace the evolution of social software tools, beginning with their use to augment computational and communication capabilities and foster collaboration and social interaction, and progressing to their Web 2.0-enabled information aggregation capabilities. Throughout this chronological depiction, we emphasize the socio-pedagogic affordances and implications of social software. We conclude the chapter with a social software use continuum to guide the design of e-learning experiences in academic contexts.

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BACKGROUND

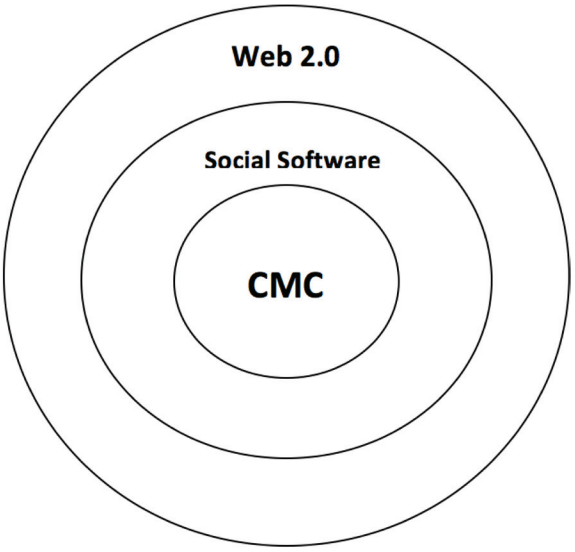
Before the name or construct of Web 2.0 became popular, the terms "social software" and "social computing" were being used interchangeably to describe the advent of a new wave of tools that support social interaction and collaboration in education. Therefore, we perceive social software as a subset of Web 2.0 and a continuation of older CMC and collaboration tools such as instant messaging (IM), newsgroups, groupware, and virtual communities (Kesim & Agaoglu, 2007; Alexander, 2006; Rheingold, 2003). Subsequently, we consider Web 2.0 as a more current and encompassing term that includes a broad range of web technologies, services, and tools, and refers to a renewed pattern of web technology adoption and innovation in the business sector (O'Reilly, 2007). Despite the chronological delineation between Web 2.0 and social software, the latter term has become more commonplace in academia and is the one preferred by EDUCAUSE (http://www.educause.edu/). Figure 1 illustrates our view of the relationship between Web 2.0, social software, and CMC.

The proliferation of the Web 2.0 "pattern" of technology-enabled social collaboration involves both new tools and new social behaviors and practices (Alexander, 2006; Cormier, 2008; Carroll, 2008). However, the roles of technology and sociology in the development of these online tools are often confused, and the actual novelty of Web 2.0 may be less than some proclaim. It is helpful, therefore, to distinguish between the social and technical sides of Web 2.0.

Social Side of Web 2.0

Web 2.0 was defined in an April 20, 2007 Burton Group report as "an ambiguous concept—a conglomeration of folksonomies and syndication, wikis and mashups, social networks and reputation, ubiquitous content, and perhaps even kitchen sinks" (Lindstrom, 2007, p. 6). The Burton Group report also suggests that "The value of Web 2.0 can be summarized in 2 words—participative and collaborative—served with a supersized helping of ubiquitous content" (p. 6). In a more recent (February 2008) Project 10X report, Davis (2008) characterizes Web 2.0 as the "Social Web" and describes it as the second stage of Internet growth that is all about "connecting people" and "putting the 'i' in user interface, and the 'we' into Webs of social participation" (p. 3). These definitions and attributes emphasize the social side of Web 2.0, as does O'Reilly's (2005) depiction of the four key attributes of Web 2.0 applications: collective intelligence, data on an epic scale, architecture of participation, and user-generated content.

Figure 1. Web 2.0, social software, and CMC



The social side of Web 2.0 was also emphasized in the 2007 *Horizon report* (New Media Consortium, 2007), which highlighted the concepts of *user-created content* and *social networking* as new trends that will have a significant impact on college and university campus learning environments. Educational researchers and practitioners have further delineated some of the social affordances of Web 2.0 applications as: establishing group identity and personal reputations, building social

contexts of knowledge, enabling personalization, and erecting recommendation and folk knowledge systems (Butterfield, 2003; Sessums, 2006).

Technical Side of Web 2.0

It is widely agreed that dramatic improvements in our information technology (IT) infrastructure have led to the emergence of Web 2.0 (see Jones, 2008). The exponential increases in personal computer power, high-speed broadband connectivity, and cheap, efficient, small-sized electronics, combined with the convergence of voice, data, and video into a single system, are enabling expansive computing environments that can synchronize online social interaction more effectively with offline activity. This cascade of IT developments and other business factors have led analysts to proclaim the advent of a new platform or generation of the Web (i.e., Web 2.0). IT researchers emphasize key technical factors or mechanisms of Web 2.0 that harvest, mine, scrape, filter, or aggregate user content and other information, and may include broader patterns of technology such as rich Internet applications, AJAX (asynchronous JavaScript and XML), Flash, Web services, and mashups.

Although the technical developments have certainly paved the way for or enabled the social side of Web 2.0, we believe that it is more meaningful as educators to take a Darwinian approach to the pedagogical affordances of technology, in order to better understand the linkage between the technical and social sides of Web 2.0 and to establish that this linkage has been continuous, gradual, and developmental in nature. As Madden and Fox (2006) conclude in their report for the Pew Internet and American Life Project, the heart of the Internet has always been its facility for social connectivity (see also Berners-Lee, 2000), and the actions or affordances that Web 2.0 technologies make possible to this end are in fact "nothing new" (p. 5) when compared to the social sites of the 1990s. In the next section, we engage in a "back to the future" analysis by tracing the roots and evolution of social software from pre-Internet to post-Web 1.0, revealing the technological and pedagogical trajectory that led to the emergence of current Web 2.0 and social software tools, systems, and applications.

EVOLUTION OF SOCIAL SOFTWARE

To answer the question of whether social software is simply a continuation of older CMC and collaboration tools as opposed to representing a significant transformation of our social interaction capabilities, we trace the technological and pedagogical evolution of social software across the history of the Internet, which we break into four periods: (1) pre-Internet (before 1969), (2) Internet (1969 to 1992), (3) Web 1.0 (1992 to 2000), and (4) Web 2.0 (after 2000). Within each period, we provide examples of social software tools, technologies, and networked learning environments that preceded and anticipated the social side of Web 2.0 (see Table 1). While other authors (e.g., Allen, 2004) have examined the evolution of social software with a focus on technical terminology, our goal is to underscore the influence of social constructivist principles as a developmental blueprint leading to current social software learning environments (SSLEs).

Pre-Internet Period: Before 1969

The history of social computing started with a declarative act of what Campbell (2007) calls the "digital imagination" and is portrayed by Press (1993) as "an information processing machine was needed to augment intellect" (p. 1). Long before the arrival of digital computers and the Internet, Paul Otlet, whom Wright referred to as the "forgotten forefather," envisioned in 1934 a "mechanical database stored on millions of 3x5 index cards" in the form of "a moving desk shaped like a wheel, powered by a network of hinged spokes

Table 1. Social software evolution timeline

Period	Social computing context	Examples
Pre-Internet (pre-1969)	Thinking machines Integrated domain Proto-learning networks Hypertext Computer-based conferencing	• Memex • oNLineSystem (NLS) • Galactic Network • Xanadu
Internet (1969 to 1992)	Computer-mediated communication Networked supported collaboration Personal computing environments Groupware	• ARPANET • Usenet • Virtual Communities (The WELL) • MUDs/MOOs • EIES • CSCW
Web 1.0 (1992 to 2000)	World Wide Web Groupware-based social interaction Open source movement Communities of practice	• CSILE • CSCL • Knowledge webs
Web 2.0 (post-2000)	Social software platforms Collective intelligence Network effect User-generated content Architecture of participation	• Wikipedia • Virtual worlds (Second Life) • Experience and resource-sharing tools • Folksonomies • Social bookmarking • RSS/XML

beneath a series of moving surfaces" (Wright, 2003, "The Web that wasn't," para. 1) that would allow scholars to search, read, write, and annotate documents. Next, Vannevar Bush envisioned the creation of "thinking machines" that mimic brain function and could be put to use to augment human cognition. Bush's (1945) article, "As we may think," contains his vision of The Memex, which he conceived as a mechanical information browser with the ability to capture trails or trains of thought that simulate brain associations and retrace them via machine. The Memex stands as one of the earliest conceptions of a hypertext system. Ted Nelson brought the concept of a hypertext system to fruition in 1963 in his Xanadu project, which anticipated the architecture of a deep hypertext document system that eventually resulted in the World Wide Web (WWW).

Throughout the 1960s and 70s, Engelbart, working at Xerox PARC, expanded on the visionary work of Bush and others and demonstrated his concept of an "integrated domain;" that is, how a networked computer system incorporating videoconferencing and other communication tools called the oNLineSystem (NLS) could augment collaborative capabilities and not just individual mental functions. In the 1960s, Licklider envisioned a networked computing system called "Galactic Network" to connect people and augment their knowledge and learning ability (Alexander, 2006). What stands out in the pre-Internet period is a vision of how computing machines, hypertext systems, and computer networks could augment human intelligence and group collaboration. These researchers perceived the pedagogical affordances of technology and their visions became a precursor to the Internet period where network-enabled social interactions began in earnest.

Internet Period: 1969 to 1992

At the dawn of the Internet, the technological infrastructure and standards for interoperability to support computer-to-computer communication were still being developed. The original purpose of the U.S. Department of Defense's ARPANET

(Advanced Research Projects Agency Network), the first major implementation of the Internet, was to interconnect geographically dispersed and technically disparate computers at university research centers (Press, 1993). Throughout the 1970s the network expanded through small government-funded projects such as Usenet (a contraction for "User Network") and NSFNET (National Science Foundation Network), as well as through various bifurcations and mergers, to create the complex interconnection of computers that is now the Internet, which today hosts approximately 600 million nodes. The 1980s ushered in the personal computing revolution, the commercial Internet, and by the end of the decade, networked-supported CMC became the dominant trend for collaboration within educational research centers. The fundamental ideas and technologies that underlie the modern personal computing environment were, however, essentially developed by the mid-1970s (Press, 1993).

Additionally, during this period the sparking of the "digital imagination" occurred in the educational community, and it was expressed in various networked learning applications. As early as 1971, Ivan Illich, in his book, *Deschooling society*, advocated for network-styled "learning webs" (Illich, 1971, p. 76) that use database-driven systems to interconnect learners, experts, and educational content, anticipating the knowledge webs of the 1990s and the social networking applications of the 21st century. The 1970s saw the emergence of influential educational projects that explored the constructivist pedagogical affordances of networked learning systems. These included Computer-Supported Intentional Learning Environments (CSILE) and other multiuser applications such as multi-user dungeons (MUDs), MUDs, object-oriented (MOOs), and multi-user virtual environments (MUVEs). CSILE, developed in the 1980s by Scardamelia and Bereiter (see Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989; Scardamalia, Bereiter, & Lamon, 1994), grew out of CSCL (computer-supported collaborative learning) and was designed to support collaboration and knowledge management in K–12 educational settings. CSILE had a significant impact on current, Web 2.0 social software applications because it was considered to be the first networked system for knowledge-building communities.

One digital imaginer in particular, Turoff, advanced the state of networked learning ideas in this period. Turoff coined the term "computer-mediated communication" (CMC) and in 1973 developed the Delphi method, a way to generate consensus on decisions by cycles of voting (see Turoff, 2002). Turoff also played an important role in the development of many early government projects that were premised on CMC and the use of social computing for knowledge management and collaborative learning. But Turoff's major contribution to the history of social computing was the NSF-funded Electronic Information Exchange System (EIES), which featured a computerized conferencing system for research communities and functioned as a means for human groups to exercise "collective intelligence" (Rheingold, 1993, pp. 113–14). Turoff was also involved in several research projects based on social constructivist principles such as group decision support, computer-supported collaborative work (CSCW), groupware, and others, which used CMC tools and processes to enable social interaction and user participation activities like voting, rating, and ranking that can be viewed as precursors to current reputation systems and tagging functionality now present in modern Web 2.0-based social software applications. Turoff and his associates conducted numerous related research activities in CMC from 1976 to 1991 at the New Jersey Institute of Technology's Computerized Conferencing and Communications Center, (see history in Turoff & Hiltz, 1995). Computerized conferencing systems like the EIES and various groupware and CMC systems in the Internet period were natural outgrowths of Englebart's vision of an "integrated domain" and the NLS from the pre-Internet period. Meanwhile,

a telecommunications industry convergence was underway and people were beginning to imagine the possibilities of a fully digital domain so well connected to computerized devices that it could serve as a worldwide information platform.

Web 1.0 Period: 1992 to 2000

The personal computing context preceding the arrival of the WWW had essentially all the functional features we have today, although access to the Internet lacked an intuitive interface and speed to accelerate connectivity. But the Internet was about to get a facelift and a speed boost that would, without question, change the world forever. In 1989, at CERN, the European Organization for Nuclear Research, Tim Berners-Lee circulated a new hypertext document system to aid collaborative work; by 1992 the system was released to the public as the WWW. In 1993, the Mosaic web browser interface was developed by the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign, and it provided a convenient desktop graphical user interface that facilitated global communication and information exchange. Popular Internet systems like email, discussion boards, search engines (e.g., Archie), Gopher, as well as various university and commercial services, migrated their tools to this more user-friendly web space while new services like eBay and Amazon were created to take commercial advantage of the new medium. As CMC tools began to connect people around the globe, one can easily understand how Internet technologies became more social (Alexander, 2006). Rheingold (1993) was one of the first to tell the story of how people were flocking to the Internet for all kinds of social activities. He noted the irony of how what started as a military project had evolved into a "citizen's thinking tool," and predicted that many of the social learning experiments underway at the time would influence and shape future generations of CMC tools on the Internet.

Stahl (2007) describes eight CSCL project prototypes tested in the 1990s that progressively aimed to demonstrate how groupware-based social interaction could improve knowledge building. For example, WebGuide, a web-based prototype program for a K-12 audience, was used to investigate methods for capturing and identifying the overlapping ideas or "perspectives" from individuals and their groups. Stahl (2000) elaborated on the term "perspectives" as follows: "The idea of perspectives traces its lineage to hypertext ideas like 'trail blazing' (Bush, 1945), 'transclusion' (Nelson, 1981), and 'virtual copies' (Mittal et al., 1986)—techniques for defining and sharing alternative views on large hypermedia spaces" (p. 85). These terms and concepts correspond to current Web 2.0 ideas and functions like social bookmarking, social tagging, and folksonomies, and are rooted in social constructivist principles.

Another source of influence on the development of the Web comes from the open source software (OSS) movement. This movement, which generates free software code through communities of developers, has provided key alternatives to proprietary computer software programs beginning with Apache for web servers in the early 1970s. The OSS movement produced the Linux operating system in 1991, the Mozilla web browser in the late 1990s, as well as a range of other essential software whose development continues on to the present day. The open source community promulgated a culture of participation by putting the power to develop "disruptive technologies" in the hands of communities of interest with strong egalitarian ethos. Indeed, the success of the OSS movement is often attributed to its self-organizing community of practice (CoP) that harnesses the "collective intelligence" of software user-developers—a characteristic that makes it a prime example of social constructivist learning in action.

The bursting of the dot-com bubble (1996–2001) marks the end of this Web 1.0 period and a time of irrational exuberance of investment in

technology ventures. When the bubble burst and was overshadowed by the events of September 11, 2001, many came to the realization that the Web was not a "super platform" on which any kind of innovative business technology approaches would automatically succeed. However, a global super platform was being built out of the convergence of increasingly more powerful technological infrastructures, improved systems interoperability, the social connection incentives of businesses and interest groups, and a new generation of digital imaginers personified by the innovative web applications of young software developers.

Web 2.0 Period: 2000 to Present

No single technology can be said to mark the commencement of the Web 2.0 period; rather, Web 2.0 is better thought of as a meme or idea describing patterns of emerging technology. O'Reilly (2005) and his associates first observed a few of these patterns forming among the flood of new tools and services appearing on the Web. These tools and services seemed to be changing the rules for how people interact with and through technology, resulting in new constructs and perspectives such as wisdom of crowds, data on an epic scale, architecture of participation, and user-generated content, as described earlier in this chapter.

The new Web as a user-centric and socially connective technology platform has caused a proliferation of "must-have" Web applications that have quickly amassed large numbers of members and subsequently become acquired by large companies like Google and Yahoo!. Wikipedia, the community-written encyclopedia, was formally launched on January 15, 2001 (Wikipedia, 2007). In the same year, the iTunes digital media player application was introduced by Apple. iPods entered the market in 2003, demonstrating that the fall of Napster was not the death knell for high-tech companies, in fact, just the opposite was true. iCohere (http://www.icohere.com/) was established as a software and consulting firm focused on creating collaborative communities.

Additionally in this period, a core set of social networking tools and services have emerged such as Friendster founded in 2002; MySpace, launched in 1999; LinkedIn, launched in 2003; and Facebook, which started as a college network, also in 2003. These social networking tools have collectively changed the rules of social interaction because of their inherent flexibility, user friendliness, and wide availability. Another core set of social software tools that has emerged in this period is one that enables resource sharing and tagging, examples of which are the social bookmarking site delicious (formerly del.icio.us, launched 2003), the photo sharing site Flickr (2004 public release), and the video sharing site YouTube (launched 2005). This toolset, which also includes web logs (blogs) and wikis, has led to the emergence of new constructs such as "social bookmarking," "social tagging," and "folksonomies," underscoring the theory of affordances discussed later in this chapter. We briefly define these constructs below and their implications for e-learning.

Folksonomies are user-generated or "grassroots" taxonomies and hence are dynamic and socially or collaboratively constructed, in contrast to established, hierarchical taxonomies that are typically created by experts in a discipline or domain of study. For example, the food pyramid is a well-established taxonomy created by the U.S. Food and Drug Administration (FDA). Even though the food pyramid has been revised several times, this is done by experts in the field of health and nutrition and based on empirical research. Folksonomies, on the other hand, are subjective and classifications of "things" or artifacts (e.g., photos, documents, URLs) are relative to each user (Peterson, 2006), emerging as a result of "personal free tagging" (Vander Wal, 2005) or "social tagging" (Seldow, 2007).

Specifically, *tagging* involves the ability for any user of a resource-sharing technology to label

an object by entering one or more descriptors (tags) for that object in addition to its name, title, or other identifier. Other users can then label their objects using the same tags, or search for objects using these tags, creating a global collection of "things" that are linked or indexed by common metadata. This tagging process or phenomenon "uses the language of a community to form connections" and has been identified by Professor Chris Dede of Harvard's School of Education as "socio-semantic networking" (Seldow, 2007, p. 5). Folksonomic classification or "social tagging" can be a powerful teaching tool, especially if an instructor's pedagogical approach is more constructivist (e.g., implementing a CoP) than objectivist (i.e., primarily lecturing and testing).

Last but not least, we have begun to see explicit social constructivist learning tools released during the Web 2.0 period. Moodle, an open source course management system, was intentionally designed based on social constructivist principles and developed with the open source LAMP (Linux, Apache, MySQL, PHP) tool suite in 2001 by Dougiamas, an Australian programmer who still directs the growing Moodle community. Fle3 (Future Learning Environment 3) is another example of web application software based on CSCL pedagogy that was prototyped in Scandinavia in 1998–99 but was not released until 2002. MUVEs such as massively multiplayer online role-playing games (MMORPGs), Second Life, and OpenCroquet have emerged in this period as well; Dede (1996) predicted the effectiveness of MUVEs in supporting meaningful and distributed learning well before the Web 2.0 period.

Summary

This overview of social software history reveals how the technological changes in each period are developmental in nature, such that new tools that emerged in the Web 2.0 period are premised on the continuation of a tradition of CMC and collaboration tools rather than a radical transformation of social interaction capabilities as some are proclaiming. Tools for networked social interaction have naturally evolved through the periods described, beginning with a focus on "augmenting human thinking" and progressing to "computer-mediated communication," "group collaboration," and eventually, "collective intelligence," which can be perceived as the result of current Web 2.0-enabled information aggregation and social networking capabilities. Despite this evolutionary trend, Web 2.0 tools have changed the nature of social interaction resulting in a new pedagogical ecology that has implications for higher education and e-learning. We examine this pedagogical ecology next.

THEORETICAL AND PEDAGOGICAL UNDERPINNINGS OF SOCIAL SOFTWARE

Few would argue against the idea that social constructivism and distributed cognition offer a solid theoretical framework within which to ground the pedagogical affordances of social software. In fact, Web 2.0 and social software tools are enabling an unprecedented opportunity to enact the fundamental principles of social constructivism and distributed cognition, which entail *learning as a social process* (Duffy & Cunningham, 1996; Brown, Collins, & Duguid, 1989). Learning as a social process is based on the idea that "knowledge is always under construction (fluid, dynamic)" and acquired "through enculturation [into a CoP]" (Dabbagh & Bannan-Ritland, 2005, p. 9).

Cormier (2008) describes "knowledge … [as] a moving target" (p. 1) and proposes a "rhizomatic model of education" (p. 3) powered by the Internet in which "the community is the curriculum" (p. 3) and "not the path to understanding or accessing the curriculum" (p. 3). McLoughlin and Lee (2008) posit that while "the directive for the teacher to be a 'guide on the side' as opposed to a 'sage on the stage' has been with us for many years, Web

2.0 equips us with new ways in which to realize this goal while continuing to recognize the role of the teacher as an expert" (p. 5). We agree with these claims and believe that *learning as a social process* and telecommunications technology (the genesis of social software) are inextricably linked, and that overall, the linkage or interaction between learning theory and technology is systematically redefining and transforming our learning spaces, perspectives, and interactions. So how did this compatible bonding of pedagogy and technology come about, and what are its implications for learning in general and e-learning in particular?

Pedagogical Ecology

Jaffee (2003) uses the construct "pedagogical ecology" to characterize the linkage between pedagogy and technology, positing that pedagogical ecology emphasizes the non-neutrality of the learning space, and subsequently, the consideration of the expectations and potentials that each learning medium brings forth to the teaching and learning process. Supporters of this view (e.g., Kozma, 1994; Frielick, 2004) argue that each learning medium, setting, or context, has a unique set of characteristics, and that understanding the pedagogical affordances of these characteristics is essential to understanding their ecological influence on teaching and learning. For example, Frielick (2004) suggests that "the teaching/learning setting (the classroom, the lecture theatre, the e-learning environment, the department, and even the institution itself) can be viewed as a system that is characterized by mental events" (p. 330). Frielick adds that this system can be described as an ecosystemic process that transforms, influences, and shapes the quality of learning outcomes. We concur with Frielick and argue that Gibson's theory of affordances provides a viable thesis with which to view the reciprocal and transformative interaction between pedagogy and technology (Dabbagh, 2004).

Gibson (1979) espoused an ecological (environmental/contextual) approach to psychology and argued that learning is based on action and perception (information pickup) rather than memory and retrieval (information processing). Gibson proposes that objects and artifacts (e.g., technologies) have certain affordances (possibilities for action) that lead organisms (e.g., people) to act based on their perceptions of these affordances. Later in this book, the authors of Chapter 5 argue that Gibson's theory of affordances has been misconstrued in educational technology settings or interpreted to take into consideration *only* the objective properties of the tools or the functionalities supplied by the tools' developers. However, we believe that instructional designers and faculty need to be aware of the concrete or intended affordances of these tools in order to harness their pedagogical potential and design appropriate learning activities. So the question for faculty and instructional designers becomes, "What is it about this technology that makes users [students] want to interact with it in this way?" and "What perceiving abilities does it provide or enable?" and "How can we leverage or harness this technology in educational contexts?"

Patterns of technology use across the decades have shaped our teaching and learning experiences, and consequently, our learning theories and models. This is where "the relativistic nature" of the ecological view (see Chapter 5) comes into play. For example, broadcast technologies that focus primarily on transmitting information, which were the norm in traditional distance learning environments, resulted in pedagogical models and constructs that can be characterized as primarily behaviorist or prescriptive in nature, Examples of such models and constructs include programmed instruction (PI), computer-assisted instruction (CAI), stimulus–response–reinforcement (SRR), and Gagne's events of instruction (Saettler, 1990; Dabbagh, 2002; Dabbagh & Bannan-Ritland, 2005), among others. Figure 2

illustrates the pedagogical ecology of traditional distance learning environments.

As telecommunications and network technology evolved following the birth of the Internet and the WWW, new affordances for use emerged leading to new pedagogical trends in distance learning. For example, learning spaces and interactions became unbounded and distributed so that learning could happen anytime, anywhere, using a variety of media; the "physical" distance between the learner and the instructor or the learner and other learners became blurred or relatively unimportant; learning resources proliferated, prompting a reconsideration of what constitutes an acceptable academic source; and the concept of learning in groups, or collaborative learning, flourished. As a result, new pedagogical models began emerging such as distributed learning, open/flexible learning, learning communities and CoPs (Dabbagh & Bannan-Ritland, 2005). Figure 3 illustrates the pedagogical ecology of distributed or networked learning environments.

Internet and web-based technologies premised new learning interactions (affordances) that were not thought possible before, such as the coupling of experts from all around the world with novices, the accessibility of global resources, the ability to publish instantly to an international audience, the opportunity to take virtual field trips, the opportunity to communicate with a wider range of people, and the ability to share and compare information, negotiate meaning, and co-construct knowledge. These activities emphasize learning as a function of interactions with others and with the shared tools of the community, supporting and epitomizing the principle of *learning as a social process* described earlier (Brown et al., 1989; Brown & Adler, 2008).

A Three-Component Model

Figure 2 and Figure 3 suggest a recursive and transformative interaction between three components of a learning environment that work collectively to shape our learning spaces, perspectives and interactions. These components are: (1) learning technologies; (2) instructional strategies or learning activities; and (3) pedagogical models or constructs (Dabbagh & Bannan-Ritland, 2005). Figure 4 illustrates the recursive and transformative interaction between these three components, which is ecosystemic (Frielick, 2004). The arrows in Figure 4 depict a cyclical and iterative relationship between the three components of the model, in which patterns of technology use shape our learning interactions (enacted through

Figure 2. Pedagogical ecology of traditional distance learning environments

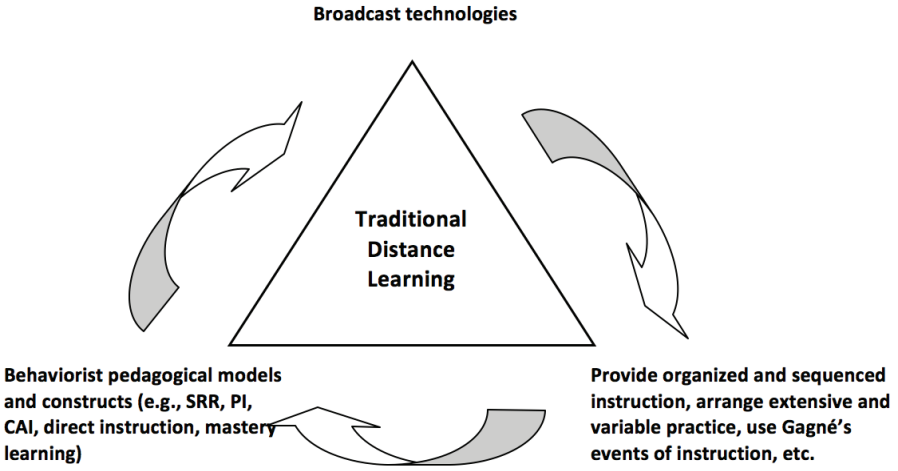
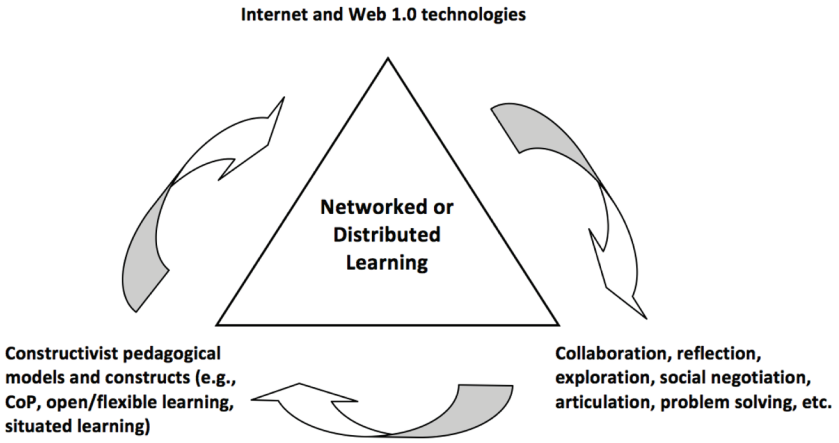


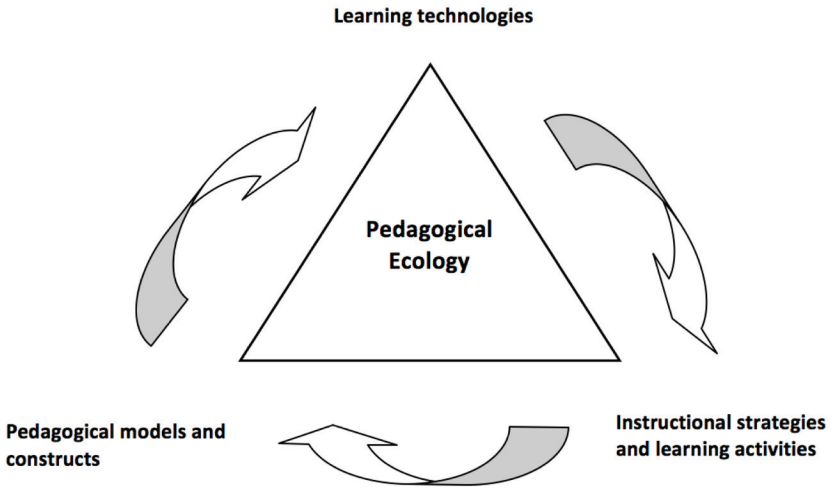
Figure 3. Pedagogical ecology of networked distance learning environments



instructional strategies and learning activities) and our sociocultural practices, which in turn shape our pedagogical models and constructs leading to the emergence or re-emergence of new learning technologies. The three-component model embodies the non-neutrality of the learning space and emphasizes the pedagogical affordances of learning technologies, or pedagogical ecology, as discussed earlier.

More specifically, the three-component model suggests that as new technologies continue to emerge, bringing forth new learning affordances, pedagogical practices and social structures are transformed. So what are the perceived affordances of Web 2.0-enabled social software? How is social software transforming our learning spaces and interactions? Figure 5 implies that SSLEs best capture the pedagogical ecology of social software tools. SSLEs are affording new learning activities such as blogging, podcasting, social bookmarking, and socio-semantic networking, enabling pedagogical models that are globalizing education (e.g., open education, borderless education, transnational education) (Dabbagh & Benson, 2007)

Figure 4. Pedagogical ecology of technology-mediated learning environments in general



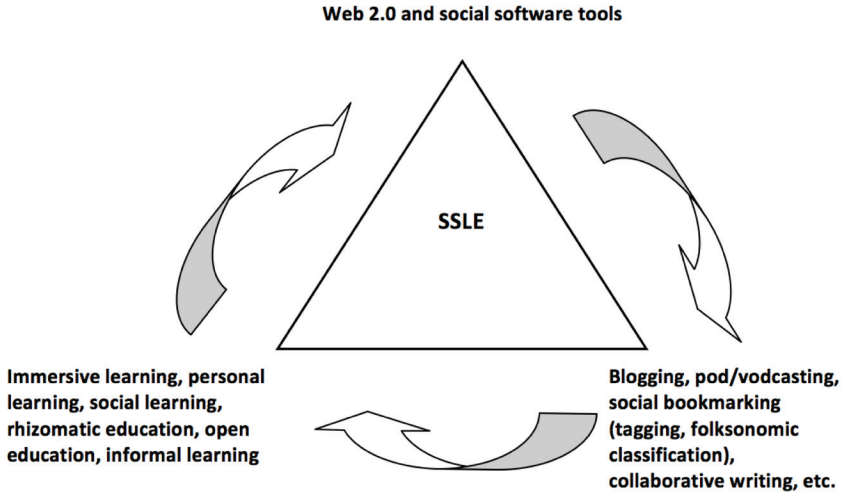
in addition to personalizing, contextualizing, and socializing education (e.g., personal learning environments [PLEs—see Chapter 5], immersive learning, informal learning, rhizomatic education) (Sclater, 2008; Cormier, 2008; Frielick, 2004).

IMPLICATIONS FOR SOCIAL SOFTWARE USE IN E-LEARNING

While the three-component model provides a theoretical and conceptual grounding within which to situate SSLEs, higher education faculty would benefit from a more applied representation or classification of social software use to help them integrate social software tools into their e-learning practice. However, attempting the development of such a classification is often difficult due to the multifunctional and emergent nature of the tools. For example, a wiki can be used in multiple ways, including but not limited to collaborative editing, group discussion, content repository, and even course delivery, making it a very flexible e-learning tool (Watson & Harper, 2008; EDUCAUSE Learning Initiative, 2005). Additionally, Skype has evolved from a tool for placing free, online VoIP calls, to a full-featured computer conferencing application; Facebook now has widgets for adding course spaces and interfacing with traditional learning management systems (LMSs) such as Blackboard. Despite the emergent nature of social software, there have been several attempts at classifying both Web 2.0-based and pre-Web 2.0 social software tools to aid their use in educational and non-educational contexts.

We begin with Laurillard (1993), who classified educational media based on a principled teaching strategy defining the learning process as a dialogue between teacher and student that embodies the following characteristics: discursive, adaptive, interactive, and reflective. Gunawardena, Lowe, and Anderson (1997) developed a model for examining the social construction of knowledge in computer conferencing environments. The model has five developmental stages beginning with the sharing and comparing of information (Stage 1), progressing to the co-construction of knowledge through social negotiation (Stage 3), and leading to the agreement and application of newly constructed meaning (Stage 5). Gunawardena et al. argue that this model is necessary for the generation of new knowledge in collaborative learning contexts. Salmon (2004) also developed a five-stage model that depicts how CMC tools can be

Figure 5. Pedagogical ecology of social software learning environments (SSLEs)



used to generate varying levels of interactivity to support social interaction and knowledge creation. The stages include: (1) access and motivation; (2) online socialization; (3) information exchange; (4) knowledge construction; and (5) development. Salmon's model enables participants to gain both technical and e-moderating skills. Web 2.0 classifications include Obasanjo's (2004) five broad classes of social software that enable groups to communicate, share experiences, discover friends, manage relationships, and play games, as well as O'Reilly's (2007) four-level hierarchy of Web 2.0 applications that captures how these tools increasingly leverage user contributions to embrace and empower the broader network.

The classification that we developed is similar to the above models in that it is based on the learning affordances of the tools however it differs in that it is specifically grounded in the pedagogical ecology of SSLEs as depicted in Figure 5. Hence it is fluid, dynamic, and transformative (i.e., less static). Moreover, it is more applied in that it is user and use oriented and thus based on a continuum (rather than hierarchy) of social software use in which the user can activate the features of the tool to enable the degree of interaction and sharing desired and/or required for learning.

We perceive social software tools as providing three levels of social software use in e-learning contexts, which are described in turn below.

Level 1: Personal Information Management

At the lowest level of social interactivity are people who use social software tools to manage personal information only (both online or offline). They do not activate any of the social sharing or networking features the tools provide, and do not have an observable presence on the "grid," so to speak. Users may "pull in" other people's content, but the goal is to create a private learning environment rather than sharing self-generated content with others. Usage at this level involves passive use of systems preferences and features. The focus is on managing private information for personal productivity or e-learning tasks such as online bookmarks, to-do lists, multimedia libraries or archives, and personal journals/writing.

Level 2: Basic Interaction or Sharing

This level embraces users' capacity for communication, social interaction, and collaboration via social software. Most social software tools provide a public and globally-accessible interface and a variety of built-in features that enable social interaction through various strategies such as expressing individual identity, gaining awareness of the presence of others, engaging in conversations, establishing relationships, forming groups and reputations, and sharing experiences and resources publicly (Butterfield, 2003; Sessums, 2006). At this level, customization prevails and users manually configure the look, feel, and function of their tools. Collectively, this behavior helps foster a nascent culture of knowledge sharing and can spawn relatively small common interest networks and groups.

This level is also about using social software to foster learning by increasing or improving users' capabilities for aggregating and incorporating various types of digital resources into the e-learning experience. Examples of such resources include open educational content, traditional learning objects, micro-content like tags, short message service (SMS) messages, or collaboration objects from various online learning systems and social activities. Folksonomic activity is a prime example for this level. Folksonomies or grassroots taxonomies, described earlier in this chapter, are an emergent property that results from the aggregation of social (public) tagging activity. Another example of Level-2 activity involves RSS-based syndication services. RSS (Really Simple Syndication) can open up the collaboration space to wider public audiences by notifying subscribers what others are doing and by redistributing

content from individual or group collections. RSS expands the functionality and broadens the user base of learning object repositories such as Multimedia Educational Resource for Learning and Online Teaching (MERLOT at http://www.merlot.org/). The RSS redistribution capability makes it easier to bring learning objects or open educational resources into (and out of) course tools via RSS feeds. Moreover, third-party web meta-information aggregation services like Technorati, Digg, and Rollyo provide differing strategies to enhance the overall process of redistributing, re-publishing, and remixing educational content and social information. User-friendly customization capabilities thatprovide the impetus for individual members to engage in social interaction also drive the aggregative activities that can lead to the formation of novel systemic behavior as the scale of interaction intensifies (Wiley & Edwards, 2002).

Level 3: Social Networking

The social networking level represents the highest degree of social interaction. We see this level as somewhat resembling O'Reilly's (2007) concept of "Web 2.0-ness," which stems from the application or tool being usable solely online on the global Internet, where it can leverage the power of network dynamics. The mechanism that directs this process is known as the network effect: when enough people begin using a particular social software tool, or interacting (sharing and aggregating) in an online community, the value of the network increases for everyone involved, and a multiplier dynamic can set in that escalates the benefits of the service for all (Weinberger, 2002; O'Reilly, 2007). Social software mediates the learning process at this level by filtering it through the collective intellect, which in turn reshapes meaning for social software tool users.

While the three levels apply to all types of social software tools, Table 2 illustrates how this continuum of usage applies to a core set of educational social software tools such as blogs, wikis, media sharing applications (e.g., Flickr, YouTube), RSS readers, and social bookmarking utilities (e.g., delicious). We end the chapter with a simple example of how the social software use continuum can be applied in an e-learning context involving wikis.

LEVELS OF SOCIAL SOFTWARE USE APPLIED TO WIKIS

Wikis epitomize the social constructivist idea that knowledge derives from social interactions, since it is a social software tool that makes it easy for multiple users to create and edit web pages collaboratively. A wiki provides a shared interactional space or platform for fostering collaborative knowledge construction. This collaborative space mediates the online interaction of users through what Perkins (1992) calls a "rich" (as opposed to "minimalist") learning environment (p. 48)—with tools for offloading memory demands, managing tasks, accessing information, and building modular content structures. Wikis allow their owners to manage public access. Additionally, the interface is designed to permit the public or registered users to easily edit content. In this way, wikis are inherently designed to support all the levels of the social software use continuum.

For example, at Level 1, a wiki could be used as a private or personal online workspace in a manner similar to how one works offline with word processing software. In an e-learning scenario, an instructor can recommend that students who do not have a word processor, or who are busy travelers and need to access all their learning content online (mobile learners), use one of the free, commercially hosted wiki tools such as Wikispaces (http://www.wikispaces.com/). This way, students can self-manage their documents online, and they do not necessarily have to share their work. Level 2 usage takes advantage of wiki features that activate the possibilities for creating a collaborative workspace. Such features include

Table 2. Continuum of social software use

Tools	Level 1: Private Information Management	→	Level 2: Basic Interaction or Sharing	→	Level 3: Social Networking
Common tool features for each level	• Setup for private use/personalization • Disable search engine indexing		• Enable public view • Setup personal profile • Configure tool for resource sharing		• Configure to pull in other people's knowledge or content via comments, RSS feeds, etc. • Enable information "push" via subscription, follow, watchlist, notifications, etc. • Build tool-based communities/ groups/ collections • Employ promotional activities • Setup multimodal, two-way communication pathways
Blog	• Use as private online journal		• Create multimedia blog posts • Enable blogroll		• Dynamic access to related/recommended content (e.g., TrackBack) • Enable comments, TrackBack, RSS feeds • Add blog to RSS aggregation services (e.g., Technorati)
Wiki	• Use as private content management space		• Password protected collaborative editing and commenting		• Public collaborative editing and commenting • Enable users view history/recent changes
RSS reader (Bloglines)	• Private news/media feed archive		• Enable personal archive sharing		• Access social filtering features to network with like-minded tool users or discover content via recommendations
Social bookmarking (delicious)	• Private bookmark archive		• Personal and collective tagging		• Create/join user networks to access other people's links • Use group tags; subscribe to tags
Social media (Flickr, YouTube)	• Set up private media archive or channel (consume only)		• Create/add media content and apply Creative Commons licenses		• Create/join public user groups or channels
Start pages (iGoogle, PageFlakes)	• Private multimedia information management web pages built on widgets		• Enable subscriptions		• Invite/enable group or open editing of content
Social networking sites (MySpace, Facebook)	• Privacy controls available but public access the default		• Add contacts, friends, etc.		• Enable a range of conversation/ chat, comment, discussion management services (e.g., wall graffiti)

inviting new members, adding comments, and enabling RSS feeds for each content page. Instructors of e-learning courses can encourage students to form independent groups using wikis to work on collaborative projects. Students can compile project content in a public area, edit documents collaboratively, and invite the instructor, experts, and/or peers to comment on or annotate their content. Instructors can also manage multiple group projects via RSS at this level, making it easy to provide feedback and monitor learner progress. Also, at Level 2, the collaborative space established naturally progresses to a higher level of experience sharing and content aggregation due to the accumulation of users' digital resources and use of wiki features such as RSS feeds and widgets. An e-learning instructor can use a central wiki for several classes, enabling a learning community that builds reusable knowledge on an area of study. With their familiar web page structure,

wikis are one of the most versatile social software tools for assembling and maintaining content of various types.

Finally, at Level 3, wiki use would involve large numbers of learners who contribute content, provide feedback on existing content, or act as site "gardeners" to weed out and correct inaccurate content, although there are some who may participate solely as consumers—thereby contributing to the popularity of the site and the network effect. Wikipedia is the prime example of the power of Level 3 social networking use that e-learning could aspire to accomplish. Of course, this is not easy to achieve, and the size of the network, in addition to institutional restrictions, poses limits for academic class applications.

CONCLUSION

Social software is the realization on a *web-based platform* of the fundamental principles of social constructivism. As we have argued in this chapter, the pedagogical ecology of social software harnesses the principles of social constructivism in an unprecedented fashion. Social software tools are enabling the design of SSLEs that are stretching the scope and deepening the interconnectedness of learning activities leading to the "globalization" of e-learning and the "flattening" of our world as Thomas Friedman (2007) purports. Knowledge in SSLEs is perceived as belonging to, and distributed in, communities of practice or "environments of participation" in which the learner practices the patterns of inquiry and learning, and the use of shared resources is part of the preparation for membership in a particular community (Firdyiwek, 1999). This is an exciting time for e-learning. Instructors and faculty in higher education contexts can leverage social software use to design SSLEs that truly foster or instantiate communities of learners. Higher education institutions should seriously consider the impact of SSLEs and adapt to the fact that Web 2.0 levels the playing field between the wisdom of the crowds and traditional authority.

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KEY TERMS AND DEFINITIONS

Affordances: Grounded in Gibson's (1979) theory of affordances. Implies possibilities or potentials for action and alerts us to how an object can be interacted with, or how an object can be specifically designed to enable a particular action.

Distributed Learning: A pedagogical model or construct that refers to learning anytime, anywhere, using a variety of media.

Folksonomies: Subjective classifications of "things" or "artifacts" (e.g., photos, documents, URLs) that emerge as a result of users entering

descriptors of such artifacts. Often used interchangeably with "tagging," "social tagging," and "socio-semantic tagging."

Networked Learning: Formal or informal learning that is made possible by computing devices that are connected to one another over computer networks.

Pedagogical Ecology: Characterizes the linkage between pedagogy and technology and emphasizes the non-neutrality of the learning space and the expectations and potentials that each learning medium brings forth to the teaching and learning process.

Social Constructivism: Refers to a set of epistemological principles that privilege sociocultural factors over individual psychological ones in the construction of reality and the learning process.

Social Networking: Refers to a type of online tool used to establish and maintain connection with friends and acquaintances (e.g., Facebook, LinkedIn, MySpace). This term is also used in the chapter to refer to a general process of online social interaction, and more specifically, to the third level of social software use that leverages the power of large-scale network dynamics.

Social Software: Describes the advent of a new wave of tools that support social interaction and collaboration in education. The term appears to be more commonplace than "Web 2.0" in educational discourse and literature. It is described in the chapter as a as a subset of Web 2.0 and a continuation of older computer-mediated communication (CMC) and collaboration tools.

SSLE: Social Software Learning Environment. Describes the pedagogical ecology of social software tools that instantiate learning activities and social interactions such as blogging, podcasting, social bookmarking, and socio-semantic networking. SSLEs produce new pedagogical affordances and models and their use on a large scale can transform pedagogical practices and social structures.

Web 2.0: A popular term used to describe a broad range of web technologies, services, and tools. Also used to define a renewed pattern of web technology adoption and innovation in the business sector.