

Connectivism:

A Learning Theory for the Digital Age

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Update (April 5, 2005): I've added a website to explore this concept at www.connectivism.ca

Introduction

Behaviorism, cognitivism, and constructivism are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes, should be reflective of underlying social environments. Vaill emphasizes that "learning must be a way of being – an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events..." (1996, p.42).

Learners as little as forty years ago would complete the required schooling and enter a career that would often last a lifetime. Information development was slow. The life of knowledge was measured in decades. Today, these foundational principles have been altered. Knowledge is growing exponentially. In many fields the life of knowledge is now measured in months and years. Gonzalez (2004) describes the challenges of rapidly diminishing knowledge life:

"One of the most persuasive factors is the shrinking half-life of knowledge. The "half-life of knowledge" is the time span from when knowledge is gained to when it becomes obsolete. Half of what is known today was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). To combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction."

Some significant trends in learning:

- Many learners will move into a variety of different, possibly unrelated fields over the course of their lifetime.
- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of ways – through communities of practice, personal networks, and through completion of work-related tasks.
- Learning is a continual process, lasting for a lifetime. Learning and work related activities are no longer separate. In many situations, they are the same.
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking.
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning.
- Many of the processes previously handled by learning theories (especially in cognitive information processing) can now be off-loaded to, or supported by, technology.
- Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed).

Background

Driscoll (2000) defines learning as "a persisting change in human performance or performance potential...[which] must come about as a result of the learner's experience and interaction with the

world” (p.11). This definition encompasses many of the attributes commonly associated with behaviorism, cognitivism, and constructivism – namely, learning as a lasting changed state (emotional, mental, physiological (i.e. skills)) brought about as a result of experiences and interactions with content or other people.

Driscoll (2000, p14-17) explores some of the complexities of defining learning. Debate centers on:

- Valid sources of knowledge - Do we gain knowledge through experiences? Is it innate (present at birth)? Do we acquire it through thinking and reasoning?
- Content of knowledge – Is knowledge actually knowable? Is it directly knowable through human experience?
- The final consideration focuses on three epistemological traditions in relation to learning: Objectivism, Pragmatism, and Interpretivism
 - Objectivism (similar to behaviorism) states that reality is external and is objective, and knowledge is gained through experiences.
 - Pragmatism (similar to cognitivism) states that reality is interpreted, and knowledge is negotiated through experience and thinking.
 - Interpretivism (similar to constructivism) states that reality is internal, and knowledge is constructed.

All of these learning theories hold the notion that knowledge is an objective (or a state) that is attainable (if not already innate) through either reasoning or experiences. Behaviorism, cognitivism, and constructivism (built on the epistemological traditions) attempt to address how it is that a person learns.

Behaviorism states that learning is largely unknowable, that is, we can't possibly understand what goes on inside a person (the “black box theory”). Gredler (2001) expresses behaviorism as being comprised of several theories that make three assumptions about learning:

1. Observable behaviour is more important than understanding internal activities
2. Behaviour should be focused on simple elements: specific stimuli and responses
3. Learning is about behaviour change

Cognitivism often takes a computer information processing model. Learning is viewed as a process of inputs, managed in short term memory, and coded for long-term recall. Cindy Buell details this process: “In cognitive theories, knowledge is viewed as symbolic mental constructs in the learner's mind, and the learning process is the means by which these symbolic representations are committed to memory.”

Constructivism suggests that learners create knowledge as they attempt to understand their experiences (Driscoll, 2000, p. 376). Behaviorism and cognitivism view knowledge as external to the learner and the learning process as the act of internalizing knowledge. Constructivism assumes that learners are not empty vessels to be filled with knowledge. Instead, learners are actively attempting to create meaning. Learners often select and pursue their own learning. Constructivist principles acknowledge that real-life learning is messy and complex. Classrooms which emulate the “fuzziness” of this learning will be more effective in preparing learners for life-long learning.

Limitations of Behaviorism, Cognitivism, and Constructivism

A central tenet of most learning theories is that learning occurs inside a person. Even social constructivist views, which hold that learning is a socially enacted process, promotes the principality of the individual (and her/his physical presence – i.e. brain-based) in learning. These theories do not address learning that occurs outside of people (i.e. learning that is stored and manipulated by technology). They also fail to describe how learning happens within organizations

Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. When knowledge is subject to paucity, the process of assessing worthiness is assumed

to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. In today's environment, action is often needed without personal learning – that is, we need to act by drawing information outside of our primary knowledge. The ability to synthesize and recognize connections and patterns is a valuable skill.

Many important questions are raised when established learning theories are seen through technology. The natural attempt of theorists is to continue to revise and evolve theories as conditions change. At some point, however, the underlying conditions have altered so significantly, that further modification is no longer sensible. An entirely new approach is needed.

Some questions to explore in relation to learning theories and the impact of technology and new sciences (chaos and networks) on learning:

- How are learning theories impacted when knowledge is no longer acquired in the linear manner?
- What adjustments need to be made with learning theories when technology performs many of the cognitive operations previously performed by learners (information storage and retrieval).
- How can we continue to stay current in a rapidly evolving information ecology?
- How do learning theories address moments where performance is needed in the absence of complete understanding?
- What is the impact of networks and complexity theories on learning?
- What is the impact of chaos as a complex pattern recognition process on learning?
- With increased recognition of interconnections in differing fields of knowledge, how are systems and ecology theories perceived in light of learning tasks?

An Alternative Theory

Including technology and connection making as learning activities begins to move learning theories into a digital age. We can no longer personally experience and acquire learning that we need to act. We derive our competence from forming connections. Karen Stephenson states:

“Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge. ‘I store my knowledge in my friends’ is an axiom for collecting knowledge through collecting people (undated).”

Chaos is a new reality for knowledge workers. ScienceWeek (2004) quotes Nigel Calder's definition that chaos is “a cryptic form of order”. Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists – the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities.

Chaos, as a science, recognizes the connection of everything to everything. Gleick (1987) states: “In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect – the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York” (p. 8). This analogy highlights a real challenge: “sensitive dependence on initial conditions” profoundly impacts what we learn and how we act based on our learning. Decision making is indicative of this. If the underlying conditions used to make decisions change, the decision itself is no longer as correct as it was at the time it was made. The ability to recognize and adjust to pattern shifts is a key learning task.

Luis Mateus Rocha (1998) defines self-organization as the “spontaneous formation of well organized structures, patterns, or behaviors, from random initial conditions.” (p.3). Learning, as a self-organizing process requires that the system (personal or organizational learning systems) “be informationally open, that is, for it to be able to classify its own interaction with an environment, it must be able to change its structure...” (p.4). Wiley and Edwards acknowledge the importance of self-organization as

a learning process: “Jacobs argues that communities self-organize in a manner similar to social insects: instead of thousands of ants crossing each other’s pheromone trails and changing their behavior accordingly, thousands of humans pass each other on the sidewalk and change their behavior accordingly.”. Self-organization on a personal level is a micro-process of the larger self-organizing knowledge constructs created within corporate or institutional environments. The capacity to form connections between sources of information, and thereby create useful information patterns, is required to learn in our knowledge economy.

Networks, Small Worlds, Weak Ties

A network can simply be defined as connections between entities. Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, nodes, entities can be connected to create an integrated whole. Alterations within the network have ripple effects on the whole.

Albert-László Barabási states that “nodes always compete for connections because links represent survival in an interconnected world” (2002, p.106). This competition is largely dulled within a personal learning network, but the placing of value on certain nodes over others is a reality. Nodes that successfully acquire greater profile will be more successful at acquiring additional connections. In a learning sense, the likelihood that a concept of learning will be linked depends on how well it is currently linked. Nodes (can be fields, ideas, communities) that specialize and gain recognition for their expertise have greater chances of recognition, thus resulting in cross-pollination of learning communities.

Weak ties are links or bridges that allow short connections between information. Our small world networks are generally populated with people whose interests and knowledge are similar to ours. Finding a new job, as an example, often occurs through weak ties. This principle has great merit in the notion of serendipity, innovation, and creativity. Connections between disparate ideas and fields can create new innovations.

Connectivism

Connectivism is the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing.

Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical.

Principles of connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Connectivism also addresses the challenges that many corporations face in knowledge management activities. Knowledge that resides in a database needs to be connected with the right people in the right context in order to be classified as learning. Behaviorism, cognitivism, and constructivism do not attempt to address the challenges of organizational knowledge and transference.

Information flow within an organization is an important element in organizational effectiveness. In a knowledge economy, the flow of information is the equivalent of the oil pipe in an industrial economy. Creating, preserving, and utilizing information flow should be a key organizational activity. Knowledge flow can be likened to a river that meanders through the ecology of an organization. In certain areas, the river pools and in other areas it ebbs. The health of the learning ecology of the organization depends on effective nurturing of information flow.

Social network analysis is an additional element in understanding learning models in a digital era. Art Kleiner (2002) explores Karen Stephenson's "quantum theory of trust" which "explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it". Within social networks, hubs are well-connected people who are able to foster and maintain knowledge flow. Their interdependence results in effective knowledge flow, enabling the personal understanding of the state of activities organizationally.

The starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed.

Landauer and Dumais (1997) explore the phenomenon that "people have much more knowledge than appears to be present in the information to which they have been exposed". They provide a connectivist focus in stating "the simple notion that some domains of knowledge contain vast numbers of weak interrelations that, if properly exploited, can greatly amplify learning by a process of inference". The value of pattern recognition and connecting our own "small worlds of knowledge" are apparent in the exponential impact provided to our personal learning.

John Seely Brown presents an interesting notion that the internet leverages the small efforts of many with the large efforts of few. The central premise is that connections created with unusual nodes supports and intensifies existing large effort activities. Brown provides the example of a Maricopa County Community College system project that links senior citizens with elementary school students in a mentor program. The children "listen to these "grandparents" better than they do their own parents, the mentoring really helps the teachers...the small efforts of the many- the seniors – complement the large efforts of the few – the teachers." (2002). This amplification of learning, knowledge and understanding through the extension of a personal network is the epitome of connectivism.

Implications

The notion of connectivism has implications in all aspects of life. This paper largely focuses on its impact on learning, but the following aspects are also impacted:

- Management and leadership. The management and marshalling of resources to achieve desired outcomes is a significant challenge. Realizing that complete knowledge cannot exist in the mind of one person requires a different approach to creating an overview of the situation. Diverse teams of varying viewpoints are a critical structure for completely exploring ideas. Innovation is also an additional challenge. Most of the revolutionary ideas of today at one time existed as a fringe element. An organizations ability to foster, nurture, and synthesize the impacts of varying views of information is critical to knowledge economy survival. Speed of "idea to implementation" is also improved in a systems view of learning.
- Media, news, information. This trend is well under way. Mainstream media organizations are being challenged by the open, real-time, two-way information flow of blogging.
- Personal knowledge management in relation to organizational knowledge management
- Design of learning environments

Conclusion:

The pipe is more important than the content within the pipe. Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point of application. When knowledge, however, is needed, but not known, the ability to plug into sources to meet the requirements becomes a vital skill. As knowledge continues to grow and evolve, access to what is needed is more important than what the learner currently possesses.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era.

References

- Barabási, A. L., (2002) *Linked: The New Science of Networks*, Cambridge, MA, Perseus Publishing.
- Buell, C. (undated). *Cognitivism*. Retrieved December 10, 2004 from <http://web.cocc.edu/cbuell/theories/cognitivism.htm>.
- Brown, J. S., (2002). *Growing Up Digital: How the Web Changes Work, Education, and the Ways People Learn*. United States Distance Learning Association. Retrieved on December 10, 2004, from http://www.usdla.org/html/journal/FEBo2_Issue/article01.html
- Driscoll, M. (2000). *Psychology of Learning for Instruction*. Needham Heights, MA, Allyn & Bacon.
- Gleick, J., (1987). *Chaos: The Making of a New Science*. New York, NY, Penguin Books.
- Gonzalez, C., (2004). *The Role of Blended Learning in the World of Technology*. Retrieved December 10, 2004 from <http://www.unt.edu/benchmarks/archives/2004/september04/eis.htm>.
- Gredler, M. E., (2005) *Learning and Instruction: Theory into Practice – 5th Edition*, Upper Saddle River, NJ, Pearson Education.
- Kleiner, A. (2002). *Karen Stephenson's Quantum Theory of Trust*. Retrieved December 10, 2004 from <http://www.netform.com/html/s+b%20article.pdf>.
- Landauer, T. K., Dumais, S. T. (1997). *A Solution to Plato's Problem: The Latent Semantic Analysis Theory of Acquisition, Induction and Representation of Knowledge*. Retrieved December 10, 2004 from <http://lsa.colorado.edu/papers/plato/plato.annotate.html>.
- Rocha, L. M. (1998). *Selected Self-Organization and the Semiotics of Evolutionary Systems*. Retrieved December 10, 2004 from <http://informatics.indiana.edu/rocha/ises.html>.
- ScienceWeek (2004) Mathematics: Catastrophe Theory, Strange Attractors, Chaos. Retrieved December 10, 2004 from <http://scienceweek.com/2003/sc031226-2.htm>.
- Stephenson, K., (Internal Communication, no. 36) *What Knowledge Tears Apart, Networks Make Whole*. Retrieved December 10, 2004 from <http://www.netform.com/html/icf.pdf>.
- Vaill, P. B., (1996). *Learning as a Way of Being*. San Francisco, CA, Jossey-Blass Inc.
- Wiley, D. A and Edwards, E. K. (2002). *Online self-organizing social systems: The decentralized future of online learning*. Retrieved December 10, 2004 from <http://wiley.ed.usu.edu/docs/ososs.pdf>

E-learning 2.0

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E-learning as we know it has been around for ten years or so. During that time, it has emerged from being a radical idea—the effectiveness of which was yet to be proven—to something that is widely regarded as mainstream. It's the core to numerous business plans and a service offered by most colleges and universities.

And now, e-learning is evolving with the World Wide Web as a whole and it's changing to a degree significant enough to warrant a new name: E-learning 2.0.

Where We Are Now

Before talking about where e-learning is going, it is worth spending a few words to describe here we are now.

When we think of learning content today, we probably think of a [learning object](#). Originating in the world of computer-based delivery (CBT) systems, learning objects were depicted as being like [lego blocks](#) or [atoms](#), little bits of content that could be put together or organized. Standards bodies have refined the concept of learning objects into a [rigorous form](#) and have provided specifications on how to sequence and organize these bits of content into [courses](#) and package them for [delivery](#) as though they were books or training manuals.

Today, e-learning mainly takes the form of online courses. From the resources distributed by MIT's [OpenCourseware project](#) to the design of learning materials in [Rice's Connexions project](#) to the offerings found from colleges and universities everywhere, the course is the basic unit of organization.

As a consequence, the dominant learning technology employed today is a type of system that organizes and delivers online courses—the learning management system (LMS). This piece of software has become almost ubiquitous in the learning environment; companies such as WebCT, Blackboard, and Desire2Learn have installed products at thousands of universities and colleges and are used by tens of thousands of instructors and students. The learning management system takes learning content and organizes it in a standard way, as a course divided into modules and

lessons, supported with quizzes, tests and discussions, and in many systems today, integrated into the college or university's student information system.

In general, where we are now in the online world is where we were before the beginning of e-learning [1]. Traditional theories of distance learning, of (for example) transactional distance, [as described by Michael G. Moore](#), have been adapted for the online world. Content is organized according to this traditional model and delivered either completely online or in conjunction with more traditional seminars, to cohorts of students, led by an instructor, following a specified curriculum to be completed at a predetermined pace.

Trends

As we approach the halfway mark of the new millennium's first decade, the nature of the Internet, and just as importantly, the people using the Internet, has begun to change. These changes are sweeping across entire industries as a whole and are not unique to education; indeed, in many ways education has lagged behind some of these trends and is just beginning to feel their wake.

One trend that has captured the attention of numerous pundits is the changing nature of Internet users themselves. Sometimes called "digital natives" and sometimes called "n-gen," these new users approach work, learning and play in new ways [2].

They absorb information quickly, in images and video as well as text, from multiple sources simultaneously. They operate at "[twitch speed](#)," expecting instant responses and feedback. They prefer random "on-demand" access to media, expect to be in constant communication with their friends (who may be next door or around the world), and they are as likely to create their own media (or download someone else's) as to purchase a book or a CD [3].

The manner in which this new generation of users is changing markets is captured evocatively in a document called [The Cluetrain Manifesto](#). First posted online in April 1999, the document begins with the declaration that "markets are conversations" and continues with a redefinition of the relation between producer and consumer. "Markets are getting smarter, more informed, more organized... People in networked markets have figured out that they get far better information and support from one

another than from vendors." Jay Cross, writing in the same vein, talks about the "augmented learner" and the "hyper-organization" [4].

In learning, these trends are manifest in what is sometimes called "learner-centered" or "student-centered" design. This is more than just adapting for different learning styles or allowing the user to change the font size and background color; it is the placing of the control of learning itself into the hands of the learner [5].

"The changing demographics of the student population and the more consumer/client-centered culture in today's society have provided a climate where the use of student-centered learning is thriving" [6]. Learning is characterized not only by greater autonomy for the learner, but also a greater emphasis on active learning, with creation, communication and participation playing key roles, and on changing roles for the teacher, indeed, even a collapse of the distinction between teacher and student altogether [7].

Taking this approach even further is George Siemens's *Connectivism*. "We derive our competence," writes Siemens, "from forming connections... Chaos is a new reality for knowledge workers... Unlike constructivism, which states that learners attempt to foster understanding by meaning-making tasks, chaos states that the meaning exists— the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities." Readers of Douglas Rushkoff's *Cyberia* will recognize a similar theme as knowledge-working is no longer thought of as the gathering and accumulation of facts, but rather, the riding of waves in a dynamic environment [8].

The breaking down of barriers has led to many of the movements and issues we see on today's Internet. File-sharing, for example, evolves not of a sudden criminality among today's youth but rather in their pervasive belief that information is something meant to be shared. This belief is manifest in such things as [free and open-source software](#), [Creative Commons licenses](#) for content, and [open access](#) to scholarly and other works. Sharing content is not considered unethical; indeed, the hoarding of content is viewed as antisocial [9]. And open content is viewed not merely as nice to have but essential for the creation of the sort of learning network described by Siemens [10].

Numerous writers, even, have called for what is often referred to as the "open society." Tapscott, for example, writes about ["the transparent burger"](#) and ["the naked corporation."](#) Mougayar tells us that "the future organization is an ["open corporation."](#) And in a widely popular online essay Rob Paterson asked, "Is not the new "big idea" of our time to disintermediate the institutional middleman and to enable direct relationships? Are supermarkets eternal? Do we need factory universities to learn? Is our health dependent on a doctor? Is the news what we see on TV?" [\[11\]](#).

In short, the structures and organization that characterized life prior to the Internet are breaking down. Where intermediaries, such as public relations staff, journalists or professors, are not needed, they are disregarded. Consumers are talking directly to producers, and more often than not, demanding and getting new standards of accountability and transparency. Often, they inform the productive process itself, and in many cases, replace it altogether. Passive has become active. Disinterested has become engaged. The new Internet user may not vote, but that is only because the vote is irrelevant when you govern yourself.

The Web 2.0

The first sign that something was changing on the Web was the underground popularity of a site called [LiveJournal](#) and the very visible surge of interest in a site called [Friendster](#). These sites, which came to be called "social networking sites," were rapidly emulated by such services as [Tribe](#), [LinkedIn](#), [Google's Orkut](#), [Flickr](#), and [Yahoo 360](#). Writers conversant with the works of social network analysts, people like [Duncan J. Watts](#) and [Mark Buchanan](#), for example, noticed that similar patterns existed in these online networks [\[12\]](#). Something was happening here.

What was happening was that major parts of the World Wide Web were acquiring the properties of communications networks, the sorts of networks found to exist (albeit on a much smaller scale) in the physical world. And that the Web itself was being transformed from what was called "the Read Web" to the ["Read-Write Web,"](#) in accordance with [Tim Berners-Lee's original vision](#). Proponents of this new, evolving Web began calling it Web 2.0 and in short order the trend became a movement.

"Enter Web 2.0, a vision of the Web in which information is broken up into "microcontent" units that can be distributed over dozens of domains. The

Web of documents has morphed into a Web of data. We are no longer just looking to the same old sources for information. Now we're looking to a new set of tools to aggregate and remix microcontent in new and useful ways" [13].

In a nutshell, what was happening was that the Web was shifting from being a medium, in which information was transmitted and consumed, into being a platform, in which content was created, shared, remixed, repurposed, and passed along. And what people were doing with the Web was not merely reading books, listening to the radio or watching TV, but having a conversation, with a vocabulary consisting not just of words but of images, video, multimedia and whatever they could get their hands on. And this became, and looked like, and behaved like, [a network](#).

Nowhere is this clearer than in the world of blogging. In a few short years the blog went from a few idiosyncratic Web sites to something used by millions of people empowered by content creation tools such as [Blogger](#) and [Wordpress](#). Even more importantly, these blogs were *connected* to each other through the mechanism of [RSS](#), a simple XML format that allows bloggers to send their content to a network of readers (called 'subscribers').

But it wasn't just blogging. Creating an online community became a snap with tools such as [Plone](#) and [Drupal](#). Moreover, using a collaborative writing tool called the [wiki](#) Jimmy Wales and a few thousand of his friends created a site called [Wikipedia](#), rendering Encyclopedia Britannica obsolete in the process. Others, using the free audio-recording tool [Audacity](#), began recording their own talk and music; this, when combined with RSS, became [podcasting](#), a rapidly rising phenomena that is transforming what we think about radio.

For all this technology, what is important to recognize is that the emergence of the Web 2.0 is not a technological revolution, it is a social revolution. "Here's my take on it: Web 2.0 is an attitude not a technology. It's about enabling and encouraging participation through open applications and services. By open I mean technically open with appropriate APIs but also, more importantly, socially open, with rights granted to use the content in new and exciting contexts" [14].

E-Learning 2.0

In the world of e-learning, the closest thing to a social network is a

community of practice, articulated and promoted by people such as [Etienne Wenger](#) in the 1990s. According to Wenger, a community of practice is characterized by "a shared domain of interest" where "members interact and learn together" and "develop a shared repertoire of resources."

For the most part, though, what constituted "community" in online learning were artificial and often contrived "discussions" supported by learning management systems [\[15\]](#). These communities were typically limited to a given group of learners, such as a university class, had a fixed start and end-point, and while substantially better than nothing, rarely approached Wenger's theory.

That's not to say no communities of practice were forming. There were some attempts to foster them, as for example [MuniMall](#), directed toward the municipal governance sector, and [PEGGasus](#), directed toward engineers and geophysicists. Moreover, as commentator [Erin Brewer](#) has noted, places on the Internet like Yahoo! Groups have become a locus for community learning activities. But in general, the uptake has been slow, and the support from traditional institutions almost nonexistent.

Educators began to notice something different happening when they began to use tools like wikis and blogs in the classroom a couple of years ago. All of a sudden, instead of discussing pre-assigned topics with their classmates, students found themselves discussing a wide range of topics with peers worldwide. Imagine the astonishment, for example, when, after writing a review of a circus she had viewed, a Grade 5 student received a response from one of the performers [\[16\]](#). In a very short time, blogs were used for a wide variety of purposes in [education](#); an [educational bloggers' network](#) formed and by this year thousands of teachers were encouraging their students to blog.

Blogging is very different from traditionally assigned learning content. It is much less formal. It is written from a personal point of view, in a personal voice. Students' blog posts are often about something from their own range of interests, rather than on a course topic or assigned project. More importantly, what happens when students blog, and read reach others' blogs, is that a network of interactions forms—much like a social network, and much like Wenger's community of practice.

It's not just blogging. Educators have also taken an interest in podcasting. Some have started broadcasting, such as at McMaster, where engineering professors now host an online show [\[17\]](#).

"We're talking to the download generation," said Peter Smith, associate dean, Faculty of Engineering. "Why not have the option to download information about education and careers the same way you can download music? It untethers content from the Web and lets students access us at their convenience." Moreover, using an online service such as [Odeo](#), [Blogomatrix Sparks](#), or even simply off-the-shelf software, students can create their own [podcasts](#).

What happens when online learning ceases to be like a medium, and becomes more like a platform? What happens when online learning software ceases to be a type of content-consumption tool, where learning is "delivered," and becomes more like a content-authoring tool, where learning is created? The model of e-learning as being a type of content, produced by publishers, organized and structured into courses, and consumed by students, is turned on its head. Insofar as there is content, it is used rather than read— and is, in any case, more likely to be produced by students than courseware authors. And insofar as there is structure, it is more likely to resemble a language or a conversation rather than a book or a manual.

The e-learning application, therefore, begins to look very much like a blogging tool. It represents one node in a web of content, connected to other nodes and content creation services used by other students. It becomes, not an institutional or corporate application, but a personal learning center, where content is reused and remixed according to the student's own needs and interests. It becomes, indeed, not a single application, but a collection of interoperating applications—an environment rather than a system.

It also begins to look like a personal portfolio tool [\[18\]](#). The idea here is that students will have their own personal place to create and showcase their own work. Some e-portfolio applications, such as ELGG, have already been created. IMS Global has put together an e-portfolio specification [\[19\]](#). "The portfolio can provide an opportunity to demonstrate one's ability to collect, organize, interpret and reflect on documents and sources of information. It is also a tool for continuing professional development,

encouraging individuals to take responsibility for and demonstrate the results of their own learning" [20].

This approach to learning means that learning content is created and distributed in a very different manner. Rather than being composed, organized and packaged, e-learning content is syndicated, much like a blog post or podcast. It is aggregated by students, using their own personal [RSS reader](#) or some similar application. From there, it is remixed and repurposed with the student's own individual application in mind, the finished product being fed forward to become fodder for some other student's reading and use.

More formally, instead of using enterprise learning-management systems, educational institutions expect to use an interlocking set of open-source applications. Work on such a set of applications has begun in a number of quarters, with the [E-Learning Framework](#) defining a set of common applications and the newly formed [e-Framework for Education and Research](#) drawing on an international collaboration. While there is still an element of content delivery in these systems, there is also an increasing recognition that learning is becoming a creative activity and that the appropriate venue is a platform rather than an application.

In the future it will be more widely recognized that the learning comes not from the design of learning content but in how it is used. Most e-learning theorists are already there, and are exploring how learning content—whether professionally authored or created by students—can be used as the basis for learning activities rather than the conduit for learning content.

A great amount of work is being done, for example, in educational gaming and simulations. Theorists such as Clark Aldrich, and [23].

A similar motivation underlies the rapidly rising domain of mobile learning [24]—for after all, were the context in which learning occurs not important, it would not be useful or necessary to make learning mobile. Mobile learning offers not only new opportunities to create but also to connect. As Ellen Wagner and Bryan Alexander note, mobile learning "define(s) new relationships and behaviors among learners, information, personal computing devices, and the world at large" [25].

As this trend progresses, we find ourselves in a world characterized by the phrase "ubiquitous computing." "Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people" [26]. The "Father of ubiquitous computing," Mark Weiser, compares computing of the future to writing. "Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti" [27].

In the world of learning, what this means is having learning available no matter what you are doing. Jay Cross captures this idea in the concept of "workflow learning." Sam Adkins writes, workflow learning is "a deep integration with enterprise applications assembled from Web Services into composite applications" with "task and work support fused into the aggregated business processes that make up the real-time workflow" and supported by "contextual collaboration with people and systems" and "design and modification achieved by modeling and simulation" [28].

Of course, there is no reason to expect that this form of learning would be restricted to the workplace. Learning integrates into every aspect of our lives, from daily household chores to arts and culture. Learning and living, it could be said, will eventually merge. The challenge will not be in how to learn, but in how to use learning to create something more, to communicate.

About the Author

Stephen Downes is a senior researcher with the National Research Council of Canada based in Moncton, New Brunswick at the Institute for Information Technology's e-Learning Research Group. Stephen is a leading voice in the areas of learning objects and metadata, as well as the emerging fields of weblogs in education and content syndication and is perhaps best known for his daily research newsletter, [OLDaily](#). His work also includes the development of educational content syndication systems and the design of a digital rights management system for learning resources. Stephen is a member of the [eLearn editorial advisory board](#) and also frequently gives seminars and lectures on the field of online learning, including the notable Buntine Oration delivered in Perth, Australia, in October 2004