TOWARDS A THEORY OF ONLINE LEARNING

TERRY ANDERSON
Athabasca University

It is the theory that decides what we can observe.
– Albert Einstein

There is nothing more practical than a good theory.
– Lewin, K., Field Theory in Social Science

INTRODUCTION

Theory has been both celebrated and condemned in educational practice and research. Many proponents have argued that theory allows and even forces us to see the big picture and makes it possible for us to view our practice and our research from a broader perspective than envisioned from the murky trenches of our practice. This broader perspective helps us make connections with the work of others, facilitates coherent frameworks and deeper understanding of our actions, and perhaps most importantly, allows us to transfer the experience gained in one context to new experiences and contexts. Critics of theory (McCormick & McCormick, 1992) have argued that too strict adherence to any particular theoretical viewpoint often filters our perceptions and thus blinds us to important lessons of reality. The intent of this chapter is to look at learning theory generally, and then to focus in on those attributes of the online learning context that allow us to focus and develop deeper and more useful theories of online learning.

Wilson (1997) has described three functions of a good educational theory. First, it helps us to envision new worlds. Few of us need help envisioning new worlds in the midst of the hype and exuberance of online learning proponents that flood the popular press. We do need theory, however, to help us envision how education can best take advantage of the enhanced communication, information retrieval, creative tools, and management capability provided by the Net. It is all too easy to consider new innovations in a horseless-carriage manner, and attempt to develop new actions based on old adaptations to now obsolete contexts.

Second, a good theory helps us to make things. We need theories of online learning that help us to invest our time and limited resources most effectively. There are many opportunities, but always critical shortages of resources – time being perhaps the scarcest of these – demanding that we maximize the efficiency of our development and educational delivery efforts. This book has a number of chapters with particular recommendations and suggestions for online course development and teaching. Hopefully, this chapter provides a theoretical big picture to make sense of these specific recommendations. Third, Wilson argues that a good theory keeps us honest. Good theory builds upon what is already known, and helps us to interpret and plan for the unknown. It also forces us to look beyond day-to-day contingencies and ensure that our knowledge and practice of online learning is robust, considered, and ever expanding.

This chapter begins with a general assessment of how people learn, based on Bransford, Brown, and Cocking's (1999) work. It then assesses the unique characteristics or affordances of the Web to enhance these generalized learning contexts. The chapter then discusses the six forms of interaction and their critical role in engaging and supporting both learners and teachers. It then presents a model of e-learning, a first step towards a theory, in which the two predominate forms of e-learning – collaborative and independent study modes – are presented with a brief discussion of the advantages and disadvantages of each. The chapter ends with a discussion of the emerging tools of the Semantic Web, and the way they will affect future developments of theory and practice of online learning.

ATTRIBUTES OF LEARNING

As many theorists have argued (Herrington & Oliver, 1999) and practitioners have experienced for themselves, online learning is but a subset

of learning in general – thus, we can expect issues relevant to how adults learn generally to also be relevant in an online learning context. Bransford, Brown and Cocking (1999), in an insightful book on the new science of learning, provide evidence that effective learning environments are framed within the convergence of four overlapping lenses. They argue that effective learning is community-centred, knowledge-centred, learner-centred, and assessment-centred. Discussing each of these lenses helps us to define learning in a general sense before we apply this analysis framework to the unique characteristics of online learning.

Learner-Centred

A learner-centred context is not one in which the whims and peculiarities of each individual learner are slavishly catered to. In fact, we must be careful to recognize that learner-centred contexts must also meet the needs of the teacher, the institution, and of the larger society that provides support for the student, the institution, and often for a group or class of students, as well as for the particular needs of individual learners. For this reason, I have argued earlier (Anderson 2005) that this attribute may be more accurately labelled learning-centred, as opposed to learner-centred.

Learner-centred, according to Bransford and colleagues (1999), includes awareness of the unique cognitive structures and understandings that learners bring to the learning context. Thus, a teacher makes efforts to gain an understanding of students' prerequisite knowledge, including any misconceptions that the learner starts with in their construction of new knowledge. Further, the learning environment respects and accommodates the particular cultural attributes, especially the language and particular forms of expression that the learner uses to interpret and build knowledge. Learner-centred activities make extensive use of diagnostic tools and activities to make visible these pre-existing knowledge structures to both the teacher and the students themselves.

Online learning can present challenges to educators, as the tools and opportunities to discover students' preconceptions and cultural perspectives are often limited by bandwidth constraints, which limit the users' view of body language and paralinguistic clues. Some researchers argue that these restrictions negatively affect communication efficacy (Short, Williams, & Christie,1976). Others argue that the unique characteristics that define online learning (appropriate combinations of asynchronous and synchronous voice, text, and video) can actually lead to enhanced or hyper communications (Richardson, 2000). For example,

we have found evidence of significant social presence in text-based computer conferencing contexts (Eggins & Slade, 1997a; Smolensky, Carmondy, & Halcomb, 1990). Nonetheless, it is fair to say that assessing student preconditions and cultural prerequisites is often more challenging in an online learning context, because teachers are less able to interact transparently with students – especially in the critical early stages of learning community formation. It is for this reason that experienced online learning teachers must make time at the commencement of their learning interactions to provide incentive and opportunity for students to share their understandings, their culture, and the unique aspects of themselves. This can be done formally through electronically administered surveys and questionnaires, but is often more effectively accomplished by virtual icebreakers (Dixon, 2007) and providing opportunities for students to introduce themselves and express any issues or concerns to the teacher and the class.

The online learning environment is also a unique cultural context in itself. Benedikt (1991) argues that cyberspace "has a geography, a physics, a nature, and a rule of human law" (pp. 123). Increasingly, students come to online learning with preconceptions gathered from both formal and informal experience in virtual environments. They exercise their mastery of communication norms and tools, some of which are not be appropriate to an educational online context. Researchers have attempted to quantify students' proficiency and comfort with online environments through use of survey instruments that measure learners' Internet efficacy (Kirby & Boak, 1987). They argue that it is not Internet skills alone which determine competency, but the users' strong sense of Internet efficacy that enables them to effectively adapt to the requirements of working in this environment. Thus, the effective online teacher is constantly probing for learner comfort and competence with the intervening technology, and providing safe environments for learners to increase their sense of Internet efficacy. Learner-centred online learning contexts thus are sensitive to this cultural overlay that interacts with the technical affordances and skill sets acquired in offline contexts.

Knowledge-Centred

Effective learning does not happen in a content vacuum. John McPeck (2000) and other critical thinking theorists argue that teaching general thinking skills and techniques is useless outside of a particular knowledge domain in which they can be grounded. Similarly, Bransford et al. (1999)

argue that effective learning is both defined and bounded by the epistemology, language, and context of disciplinary thought. Each discipline or field of study contains a world view that provides unique ways of understanding and talking about knowledge. Students need opportunities to experience this discourse and the knowledge structures that undergird discipline thinking. They also need opportunities to reflect upon their own thinking; automacy is a useful and necessary skill for expert thinking, but automacy without reflective capacity greatly limits learners' capacity to transfer their knowledge to unfamiliar contexts or to develop new knowledge structures.

Online learning neither advantages or disadvantages knowledge-centred learning in comparison to campus-based learning. As I discuss below, however, the Net provides expanded opportunities for learners to plunge ever deeper into knowledge resources, providing a near limitless means for them to grow their knowledge and find their own way around the knowledge of the discipline, benefitting from its expression in thousands of formats and contexts. This provision of resources, however, can be overwhelming, and the skillful e-teacher needs to provide the big-picture scaffolding upon which students can grow their own knowledge and discipline-centred discoveries. The recent emergence of theories of learning that are based on networked contexts, such as "heutagogy" (Phelps, Hase, & Ellis, 2005) and "connectivism" (Siemens, 2005), helps us to understand that learning is about making connections with ideas, facts, people, and communities. Obviously the Net excels at allowing users to both find and utilize these connections.

Assessment-Centred

Bransford et al. (1999) present the necessity for effective learning environments to be assessment-centred. By this term, they do not give unqualified support for summative assessments (especially those supposedly used for high stakes accountability), but they look at formative evaluation and summative assessment that serve to motivate, inform, and provide feedback to both learners and teachers.

Quality online learning provides many opportunities for assessment – opportunities that involve the teacher, but also ones that exploit the influence and expertise of peers and external experts, others that use simple and complex machine algorithms to assess student learning, and perhaps most importantly, those that encourage learners to reflectively assess their own learning. Understanding what is most usefully – rather than most easily – assessed is a challenge for online learning designers.

Development in cognitive learning theories and their application to assessment design are helping us to develop assessments that are aligned with the subject content and assess cognitive processes, in addition to end results. For example, Baxter, Elder, and Glaser (1996) find that competent students should be able to provide coherent explanations; generate plans for problem solution; implement solution strategies; and monitor and adjust their activities. However, when reviewing assessments that my own children are subjected to in school and at university, I am continually disappointed to note the very high percentage of recall questions and the lack of strategies that effectively measure the four sets of competencies identified by Baxter and others.

Can we do any better in online learning? The diminution of opportunities for immediate interaction between learners and teachers may reduce opportunities for process assessment. The enhanced communication capacity of online learning, as well as the focus of most adult online learning in the real world of work, however, provide good opportunities to create assessment activities that are project- and workplace-based, that are constructed collaboratively, that benefit from peer and expert review, and that are infused with opportunity and requirement for self-assessment.

A danger of assessment-centred learning systems is the potential increase in workload demanded of busy online learning teachers. Strategies that are designed to provide formative and summative assessment with minimal direct impact on teacher workload are most needed. A growing list of tools provide such assessment without increased teacher participation. These tools include

- the use of online computer-marked assessments that extend beyond quizzes to simulation exercises, virtual labs, and other automated assessments of active student learning;
- collaborative learning environments that students create to document and assess their own learning in virtual groups;
- mechanisms such as online automated tutors that support and scaffold students' evaluation of their own work and that of their peers;
- student agents who facilitate and monitor peer activities to allow students to informally assess and aide each other;
- the development of project-based and product-based assessment in which artefacts are created and their value is attested to by users within the formal learning class or program, as well as those lifelong learners spread out on the long tail of the Net (Anderson, 2004);

- use of sophisticated software tools, such as LSA (see http://lsa.colorado.edu/), or neural networks to machine score even complicated tasks, such as students' essays (Lee, 2006);
- informal social networks wherein students can post and reflect upon the ideas of others enrolled in the course and beyond (Farmer, 2005).

Thus, the challenge of online learning is to provide very high quantity and quality of assessment, while maintaining student interest and commitment – something that is often best done by developing a learning community, to which we turn next.

Community-Centred

The community-centred lens allows us to include the critical social component of learning in our online learning designs. Here we find Vygotsky's (2000) popular notions of "social cognition" relevant, as we consider how students can work together in an online learning context to collaboratively create new knowledge. These ideas have been expanded in Lipman's (1991) "community of inquiry," and Etienne Wenger's (2002) ideas of "community of practice," to show how members of a learning community both support and challenge each other, leading to effective and relevant knowledge construction. Wilson (1997) has described the characteristics of participants in online communities as having a shared sense of belonging, trust, expectation of learning, and commitment to participate in and contribute to the community.

Although many online learning researchers celebrate the capacity to create learning communities at a distance (Byrne, Flood, & Willis, 1999), others note problems associated with lack of attention and participation (Morris & Ogan, 1996), economic restraints (Annand, 1999), and an inbuilt resistance among many faculty and institutions to threatening competition from virtual learning environments (Cutler, 1995). Ethnographic studies of the Net (Jonassen & Carr, 2000) illustrate how the lack of "placedness" and the complications of anonymity attenuate different components of community when located in virtual space. In short, it may be more challenging than we think to create and sustain these communities, and the differences may be more fundamental – differences that are linked to lack of placedness and synchronicity in time and place, the mere absence of body language, and the development of social presence.

I have been struck by the wide variation in expectation of learners towards participation in a community of learners. Traditionally, the

independent modes of distance education have attracted students who value the freedom and independence of time and place. Contrary to popular belief, the major motivation for enrolment in distance education is not physical access per se, but the temporal freedom that allows students to move through a course of studies at a time and pace of their choice. Participation in a community of learners almost inevitably places constraints upon this independence – even when the pressure of synchronous connection is eliminated by use of asynchronous communications tools. The demands of a learning-centred context at times may force us to modify the proscriptive participation in communities of learning, even though we may have evidence that such participation will likely advance knowledge creation and attention. The flexibility of virtual communities allows for more universal participation, but a single environment that responds to all students' needs does not exist. Thus, the need for variations that accommodate the diverse needs of learners and teachers at different stages of their life cycles is necessary. Finally, we are seeing the proliferation of new types of communities and networks that exist far from the formal constraints of educational communities. These social software networks, such as *mySpace*, *flickr*, *SecondLife*, and *Facebook*, support millions of participants in the creation of friendship and sharing networks. We are only beginning to understand how these environments can be useful for formal education, or if they truly are "myspaces" and not institutional or school spaces.

All of these potential barriers and opportunities argue for a theory of online learning that accommodates but does not prescribe any particular format of time and place "boundedness," and that allows for appropriate substitution of independent and community-centred learning. To this requirement, we add the need for a theory of e-learning to be learning-centred, provide a wide variety of authentic assessment opportunities, and be attuned to – and grounded in – existing knowledge contexts.

AFFORDANCES OF THE NET

Effective educational theory must address the affordances and the limitations of the context for which it is designed (McDonald, 1998). The World Wide Web is an extremely multifaceted technology that provides a large – and seemingly ever-growing – set of communication and information management tools which can be harnessed for education

provision. Similarly, it suffers from a set of constraints that are also briefly overviewed in this section.

Online learning, as a subset of all distance education, has always been concerned with provision of access to educational experience that is, at the least, more flexible in time and in space than campus-based education. Access to the Web is now nearly ubiquitous in developed countries. In Canada, 2005 data shows that 68% of the population are regular Internet users – figures that are undoubtedly higher today, and much higher again among younger users and students. This high percentage of users would likely include well over 95% of those interested in taking a formal education course. Access to the Web is primarily through home or workplace machines, followed by computer placements in public libraries, Internet cafes, and by personal wireless devices. In sum, access is non-problematic for the vast majority living in developed countries. Access is also faster and more convenient, as demonstrated by annual increases of 33% in broadband connectivity in the thirty-member Organisation for Economic and Cooperative Development countries between 2005 and 2006 (OECD, 2006). I have also been surprised by access availability in developing countries, as exemplified by numerous Internet cafes in nearly every major city of the world. Access is still problematic for those with a variety of physical handicaps. However, in comparison to books or video media, the Web provides much greater quality and quantity of access to nearly all citizens – with or without physical disabilities.

Not only is access to technology increasing, but access to an ever-growing body of content is also increasing. The number of open-access scholarly journals (see http://www.doaj .org/); educational objects (see www.merlot.org); educational discussion lists and communities (see http://lists.topica.com/dir/?cid=4); online courses and educational resources (see http://www.oercommons.org/); and general references to millions of pages of commercial, educational, and cultural content (see www.google.com) is large and increasing at an exponential rate. Thus, online learning theory must acknowledge the change from an era of shortage and restriction to an era of abundant content; content resources are now so large that filtering and reducing choice is as important as provision of sufficient content itself.

The Web is quickly changing from a context defined by text content and interactions to one in which all forms of media are supported. Much of the early work on instructional use of the Internet (Smith, Feld, & Franz, 1992) assumed that asynchronous text-based

interaction defined the medium (Short, Williams, & Christie, 1976), thus techniques were developed to maximize interaction using this relatively lean media. We are now entering an era, however, where streaming video, video, and audio-conferencing, pod and videocasts, and immersive worlds are readily available for educational use. Thus, online learning theory needs to help educators decide which of the numerous technological options is best suited for their application.

The Web's inbuilt capacity for hyperlinking has been associated with the way in which human knowledge is stored in mental schema and the subsequent development of mental structures (Jonassen, 1992). Further, the capacity for students to create their own learning paths through content that is formatted with hypertexts links is congruent with constructivist instructional design theory, which stresses individual discovery and construction of knowledge (Shank, 1993).

Finally, the growing ease with which content can be updated and revised, both manually and through use of autonomous agent technology, is making online learning content much more responsive and potentially more current than content developed for any other media. The explosion of web blogs (Richardson, 2006) and user-friendly course content management systems built into web delivery systems, such as *Blackboard*® and *Moodle*, are creating environments in which teachers and learners can easily create and update their course contents without the aide of programmers or designers. Naturally, this ease of creation and revision leads to potential for error and less than professional standard output; however, educators who are anxious to retain control of their educational content and context welcome this openness and freedom.

Education, however, is not only about access to content. The greatest affordance of the Web for education use is the profound and multifaceted increase in communication and interaction capability. The next section discusses this affordance in greater detail.

ROLE OF INTERACTION IN ONLINE LEARNING

Interaction has long been a defining and critical component of the educational process and context (Anderson, 2003b). However, the term itself is used in many ways to describe many different types of exchanges between different actors and objects associated with teaching and learning.

Defining and Valuing Interaction in Online Learning

It is surprisingly difficult to find a clear and precise definition of this multifaceted concept in the education literature. In popular culture, the use of this term to describe everything from toasters to video games to holiday resorts further confuses precise definition. I have discussed these varying definitions at greater length in an earlier document (Anderson 2003a), and so I will confine discussion here to an acceptance of Wagner's (2001) definition as "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another" (p. 8).

Interaction – or its derivative term *interactivity* – serves a variety of functions in the educational transaction. Sims (1999) lists these functions as allowing for learner control, facilitating program adaptation based on learner input, allowing various forms of participation and communication, and aiding meaningful learning. In addition, interactivity is fundamental to creating the learning communities espoused by Lipman (1991), Wenger (2002), and other influential educational theorists who focus on the critical role of community in learning. Finally, the value of another person's perspective, usually gained through interaction, is a key learning component in constructivist learning theories (Shank, 1993), and in inducing mindfulness in learners (Visser, 2000).

Interaction has always been valued in distance education – even in its most traditional, independent study format. Holmberg (1981) argues for the superiority of individualized interaction between student and tutor when supported by written postal correspondence or via real-time telephone tutoring. Holmberg also introduces us to the idea of simulated interaction, which defines the writing style appropriate for independent study models of distance education programming, and that he refers to as "guided didactic interaction." Garrison and Shale (1990) define all forms of education – including that delivered at a distance – as essentially interactions between content, students, and teachers. Laurillard (1997) constructs a conversational model of learning in which interaction between students and teachers plays the critical role.

As long ago as 1916, John Dewey's writings refer to interaction as the defining component of the educational process that occurs when students transform the inert information passed to them from another and construct it into knowledge with personal application and value (Esposito, 2003). Bates (1991) argues that interactivity should be the

primary criteria for selecting media for educational delivery. Thus, there is a long history of study and recognition of the critical role of interaction in supporting and even defining education.

The Web affords interaction in many modalities. In Figure 1, we see the common forms of interaction media used in distance education charted against their capacity to support independence (of time and place) and interaction. The higher and richer the form of communication, the more restrictions are placed upon independence. Figure 2 shows the capability of the Web to support these modalities. As can be seen, nearly all forms of mediated educational interaction are now supported, and if one adds the use of the Web to enhance classroom-based education, the Web supports them all. Thus, describing the characteristics of online learning in general is usually too large a domain for meaningful discussion until one specifies the particular modality of interaction in use.

Interaction can also be delineated in terms of the actors participating in the interaction. Michael Moore first discussed the three most common forms of interaction in distance education – student-student; student-teacher and student-content (Christenson & Menzel, 1998). These interactions were expanded by Anderson and Garrison (1988) to include teacher-teacher, teacher-content, and content-content interaction. In 2002, I developed an equivalency theorem describing the capacity to substitute one form of interaction for another, based upon cost

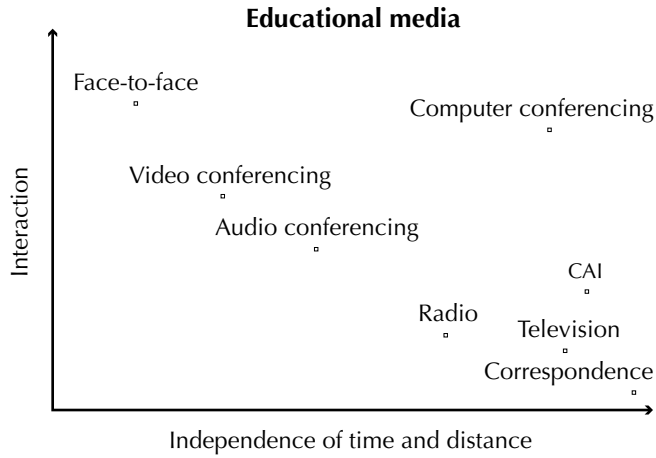

Figure 1. Attributes of educational media

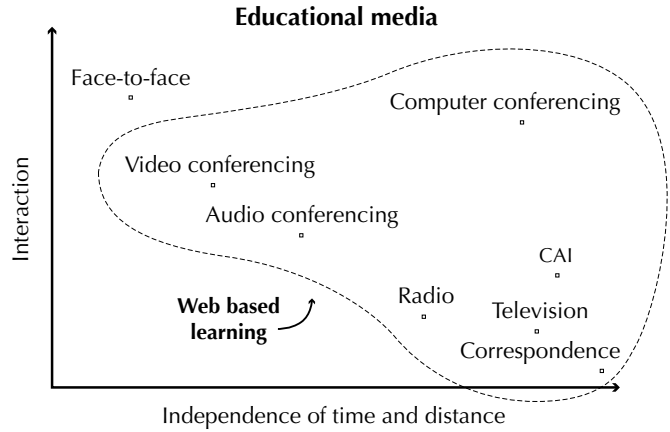

Figure 2. Educational media subsumed by the Web

and accessibility factors (Anderson, 2003b). Figure 3 illustrates these six types of educational interaction; they are also briefly described below.

Student-Student Interaction

Student-student interaction has traditionally been downplayed as a requirement of distance education, due to constraints on availability of technology and an earlier bias amongst distance education theorists towards individualized learning (Andersen et al., 1981). Modern constructivist and connectivist theorists stress the value of peer-to-peer interaction in investigating and developing multiple perspectives. Work on collaborative learning illustrates potential gains in cognitive learning tasks, as well as increasing completion rates and acquisition of critical social skills in education (Kirby & Boak, 1987). Work related to peer tutoring, by Resnick (1996) and others, illustrates the benefits that can result for both tutor and learner from a variety of forms of "reciprocal teaching." In our work, we found that student-led teams can result in higher levels of cognitive, social, and even teaching presence, than those led by teachers (Rourke & Anderson, 2002). Finally, peer interaction is critical to the development of communities of learning (Rumble, 1999; Wenger, McDermott, & Snyder, 2002), that allow learners to develop interpersonal skills and investigate tacit bodies of knowledge shared by community members as well as the formal curriculum of studies (Seely, Brown, & Hagel, 2005).

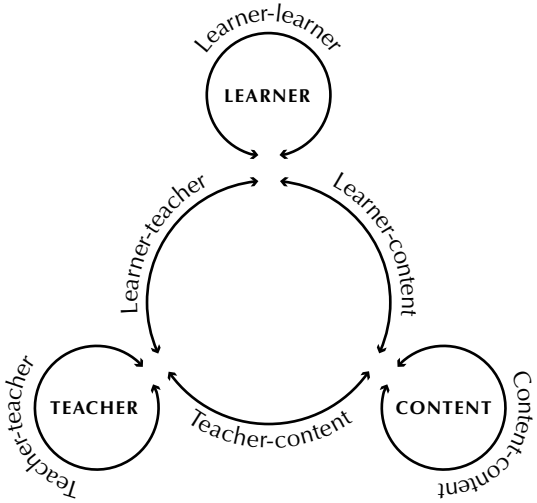

Figure 3. Educational interactions

Student-Content Interaction

Student-content interaction has always been a major component of formal education, even in the forms of library study or reading textbooks in face-to-face instruction. The Web supports these more passive forms of student-content interaction, but also provides a host of new opportunities, such as immersion in micro-environments, exercises in virtual labs, and online computer-assisted learning tutorials. The development of interactive content that responds to student behaviour and attributes (often referred to as a student model) allows for customization of content in unprecedented ways to support the individual needs of each unique learner. Eklund (1995) lists some potential advantages of such approaches to

- provide an online help facility, or an intelligent help, if the user is modelled and their path is traced through the information space;
- use an adaptive interface, based on several stereotypical user classes, that modifies the environment to suit the individual user;
- provide adaptive advice and model users' acquisition of knowledge through their use of the environment (including navigational use,

answers to questions, help requested), to intelligently suggest a preferred individualized path through the knowledge base.

To these must be added the capacity for immediate feedback: not only formal learning guidance, but also just-in-time learning assistance provided by job aides and other forms of performance support tools.

Student-Teacher Interaction

Student-teacher interaction is supported in online learning in a large number of varieties and formats that include asynchronous and synchronous communication in text, audio, and video communications. The volume of such communication often overwhelms many new teachers. Moreover, students often hold unrealistic expectations for immediate responses from their teachers. Emerging best practices now recognize the flow of communication in online courses to be much less "teacher-centric" than in traditional classroom discourse; teachers do not have to respond immediately to every student question and comment, and playing a less dominant role in class discourse can actually support the emergence of greater learner commitment and participation.

Teacher-Content Interaction

Teacher-content interaction focuses on the teacher's creation of content: learning objects as well as units of study, complete courses, and associated learning activities. Teacher-content interaction allows teachers to continuously monitor, construct, and update course content resources and activities.

Teacher-Teacher Interaction

Teacher-teacher interaction creates the opportunity to sustain teachers with professional development and support through supportive communities. These interactions encourage teachers to take advantage of knowledge growth and discovery, in their own subject area and within the scholarly community of teachers.

Content-Content Interaction

Content-content interaction is a new and developing mode of educational interaction wherein content is programmed to interact with other automated information sources to constantly refresh itself and acquire new capabilities, through updates and interaction with other content sources. For example, a weather tutorial may take its data from current meteorological servers, creating a learning context that is up to date and

relevant to the students' learning context. Content-content interaction also provides a means to assert control of rights and facilitate tracking content use by diverse groups of learners and teachers. The recent development of tagging (both "folksonomie" and formal ontological systems) and syndication tools, such as RSS Atom, allow for automated machine harvesting, distribution, and selection of content. Such automation allows for the effective harvesting and selection of content-by-content.

Having exhausted all the pair-wise permeations of student/content/teacher above, I thought I had covered all the bases. I was wrong. I was surprised to read Jon Dron's (2007) paper, in which he argues that the group itself is an educational resource with characteristics that are different than the bounded interaction among two or more learners registered in a course. Dron's groups include responses from strangers retrieved from services like *Google Answers*, referrals from networks of friends and friends of friends, such as those supported in *MySpace* and other social software sites, and discussions in communities of avatars clustered in virtual spaces in immersive environments. These groups support far more diverse and often less reliable interactions. Nonetheless, they are far more generative than the discourse that typically merges from interaction among a bounded class of students and teachers. Thus, learner-group and teacher-group interaction opens the online classroom door to viewpoints, resources, and insights gathered from throughout the Net.

A MODEL OF E-LEARNING

A first step in theory building often consists of model building, in which the major variables are displayed and the relationships between the variables schematized. In Figure 4, the two major modes of online learning (collaborative, community-of-inquiry models, and independent study models) are illustrated.

The model illustrates the two major human actors: learners and teachers, and their interactions with each other and with the content. Learners can, of course, interact directly and spontaneously with any content that they find, in multiple formats and especially on the Web; however, many choose to have their learning sequenced, directed, and credentialed through the assistance of a teacher in a formal education system. This interaction can take place within a community of inquiry, using a variety of net-based synchronous and asynchronous (video, audio,

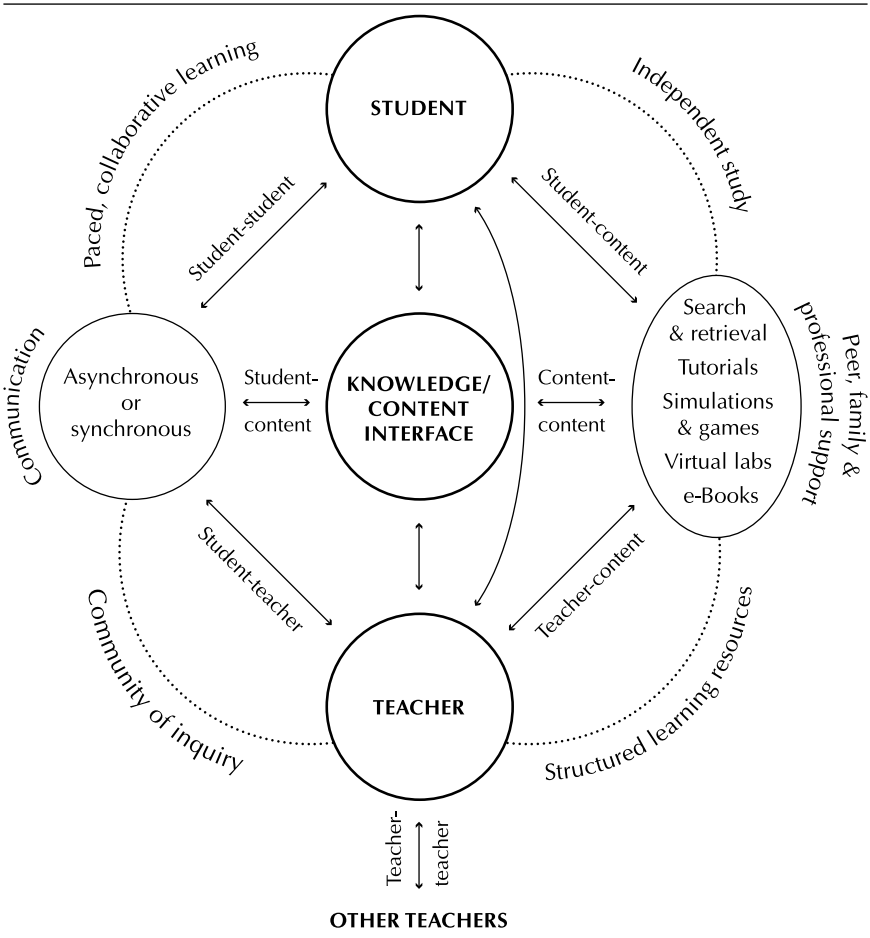

Figure 4. A model of online learning

computer conferencing, chats, or virtual world) interactions. These environments are particularly rich and allow for the learning of social skills, collaboration, and the development of personal relationships among participants. The community, however, binds learners in time, and thus forces regular sessions – or at least group-paced learning. Community models are also generally more expensive simply because they cannot scale up to serve larger numbers of students. The second model of learning (on the right) illustrates the structured learning tools associated with independent learning.

Common tools used in this mode include computer-assisted learning tutorials, drills, and simulations. Virtual labs, where students complete simulations of lab experiments and have access to sophisticated search and retrieval tools, are also becoming common tools. Texts in print – and now distributed and read online – have long served as the basis for conveying teacher interpretations, insights, and knowledge in independent study. It should also be emphasized, however, that although engaged in independent study, the student is not alone. Often colleagues in the workplace, peers located locally or distributed across the Net, formal and informal groups, and family members, have been significant sources of support and assistance to independent study learners (Potter, 1998). Emerging social software solutions also allow students to meet and develop common interests, such as forming study-buddy or study-group relationships or engaging in cooperative course-related activities – even while engaged in independent study programs (Anderson, 2005). Finally, as noted earlier, Dron (2007) argues that knowledge can be created through many knowledge networks and through collective activities – the wisdom of crowds – that are supported and aggregated on the Net.

Using this online model then requires decision making on the part of teachers and designers. A key deciding factor is based on the nature of the learning that is prescribed. Marc Prensky (2001) argues that different learning outcomes are best learned through particular learning activities. Prensky asks not *how students learn*, but more specifically *how do they learn what*?

Prensky postulates that in general, we all learn

- behaviours through imitation, feedback, and practice
- creativity through playing
- facts through association, drill, memory, and questions
- judgment through reviewing cases, asking questions, making choices, receiving feedback, and coaching
- language through imitation, practice, and immersion
- observation through viewing examples and feedback
- procedures through imitation and practice
- processes through system analysis, deconstruction, and practice
- systems through discovering principles and graduated tasks
- reasoning through puzzles, problems, and examples
- skills (physical or mental) through imitation, feedback, continuous practice, and increasing challenge

- speeches or performance roles by memorization, practice, and coaching
- theories through logic, explanation, and questioning (156)[1]

Prensky also argues that forms and styles of games can be used online or off-line to effectively facilitate learning each of these skills.

I would argue that each of these activities can be accomplished through e-learning, using some combination of online community activities and computer-supported independent study activities. By tracing the interactions expected and provided for learners through the model (see Figure 4), one can plan for and ensure that an appropriate mix of student, teacher, and content interaction is uniquely designed for each learning outcome.

ONLINE LEARNING AND THE SEMANTIC WEB

We have entered an era in which the Web has expanded from a medium to display content created by professional designers and publishers, to one where commercial content is augmented, annotated, enhanced, and, in some cases, displaced by content created by the end users themselves. Increasingly, ways are being developed to have content harvested, filtered, repurposed, and transformed, through the manipulation of both human and automated processes. This enhanced capacity is based on two emerging network technologies. The first is the set of formal technologies prominently championed by the original designer of the Web, Tim Berners-Lee, and named the Semantic Web (Berners-Lee, 1999). This technology is used to annotate information using formal taxonomies so that the information becomes aware of itself. For example, a data heading might be "author's telephone number," rather than simply information about the font size and colour in which the information is to be displayed – this is what once defined the HTML capacity of the original World Wide Web. The Semantic Web, on the other hand, allows the defining of the label in taxonomy such that autonomous agents and humans could determine that this set of numbers corresponded to a telephone number, and that in turn, this telephone number is related to an individual or an organization. Given this additional information, autonomous agent programs can then sort, query, format, and even make calculations and inferences based upon the additional information.

The second technology is the development of social technologies that add a self-organizational capacity to the Net, through explicit tagging by users and through the tracking of usage. This data is then used to search, retrieve, reconfigure, and filter information on the Net, a capability that has application for many educational, entertainment, and commercial applications. For example, the CiteULike site (see http://www.citeulike.org/) allows users to upload, annotate, and rate scholarly articles they have read. The resulting database can be used by the individual contributor as an aide in their scholarly production, but more importantly, the database of articles can be searched (and further annotated and evaluated) by others to generate a collective assessment of the article.

In the first edition of this chapter, I perhaps over-optimistically championed the emergence of the Semantic Web. Though work continues in the formal classification and annotation of content, there have been significant problems noted with the near impossible challenges of formally describing all data on the Web using standardized terminology and language (McCool, 2006). In response, advocates of the Semantic Web are turning to a second technology of user-tagged content, informally described by emergent folksonomies to proclaim a Semantic Web 2.0 (Spivack, 2007).

The vision of the Semantic Web includes extensive use of autonomous agents to support and facilitate learning. *Student-alert agents* are used for intelligent searching of relevant content (see *Google Alerts* at http://www.google.com/alerts): secretaries booking and arranging for collaborative meetings (see http://meetingwizard.com); reminding students of deadlines (see http://www.calendarhub.com); and negotiating with the agents of other students for assistance, collaboration, or socialization (see http://ihelp.usask.ca/). *Teacher agents* are used to provide remedial tuition, to assist with record keeping and monitoring of student progress, and even to mark and respond to student communications. The content itself can be augmented with agents that control rights to its use, automatically update content, and track means by which the content is used by students (Yu, Brown, & Billett, 2007; Feng, Shaw, Kim, & Hovy, 2006; Clements & Nastassi, 1988).

The Semantic Web also supports the reuse and adaptation of content through support for the construction, distribution, and retrieval of digitized content that is formatted and formally described, using semantic web technologies (Eggins & Slade, 1997b). The emergence of educational modelling languages (Koper, 2001) allow educators to formally describe, in the language accessible on the Semantic Web, not

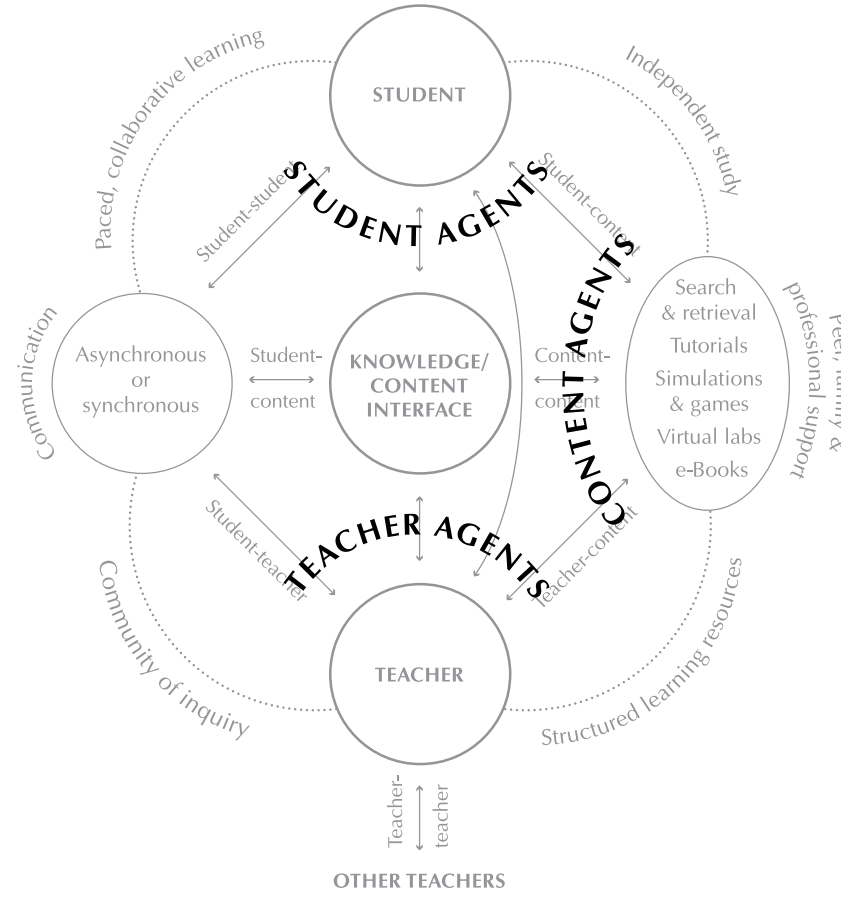

Figure 5. Educational interactions on the Semantic Web

only the content but also the activities and context or environment of learning experiences. Together, these affordances of the Semantic Web allow us to envision an e-learning environment that is rich with student-student, student-content, and student-teacher interactions that are affordable, reusable, and facilitated by active agents (see Figure 5).

TOWARDS A THEORY OF ONLINE LEARNING

The Web offers a host of very powerful affordances to educators. Existing and older education provision have been defined by the techniques and

How People Learn Framework (Bransford et al.)	Affordances of the Current Web	Affordances of the Semantic Web 2.0
Learner-Centred	Capacity to support individualized and community-centred learning activities	Content that changes in response to individualized and group learner models. Content that is created, augmented and annotated through student and teacher use
Knowledge-Centred	Direct access to vast libraries of content and learning activities organized from a variety of discipline perspectives	Agents and user referrals for selecting, personalizing, and reusing content. Social augmentation and book marking by communities of experts, practitioners, and other students filter and qualify information so as to transform to knowledge
Community-Centred	Asynchronous and synchronous; collaborative and individual interactions in many formats	Agents and content management systems for translating, reformatting, time shifting, monitoring, and summarizing community interactions. Communities tagging content and issue of interest and value
Assessment-Centred	Multiple time and place shifted opportunities for formative and summative assessment by self, peers, and teachers	Agents for assessing, critiquing, providing 'just-in-time feedback'

Table 1. Affordances of Network environment and the attributes of the "way people learn."

tools designed to overcome limitations and exploit the affordances of earlier media. For example, the earliest universities were built around medieval libraries that afforded access to rare handwritten books and manuscripts. Early forms of distance education were constructed using text and the delayed forms of asynchronous communications afforded by mail services. Campus-based education systems are constructed around physical buildings that afford meeting and lecture spaces for teachers and groups of students. The Web now provides near-ubiquitous access to quantities of content that are many orders of magnitude larger than that provided in any other medium.

From earlier discussions, we see that the Web affords a vast potential for education delivery that generally subsumes almost all the modes and means of education delivery previously used – with, perhaps, the exception of rich face-to-face interaction in formal classrooms, though even its supremacy is now being challenged by immersive environments such as *Activeworlds* (see http://www.activeworlds.com) and *SecondLife* (see http://secondlife.com/). We have also seen that the most critical component of formal education consists of interaction between and among multiple actors – human and agents included.

Thus, I conclude this chapter with an overview of a theory of online learning interaction which suggests that the various forms of student interaction can be substituted for each other, depending upon costs, content, learning objectives, convenience, technology used, and time availability. The substitutions do not decrease the quality of learning that results. More formally: Sufficient levels of deep and meaningful learning can be developed as long as one of the three forms of interaction (student–teacher; student-student; student-content) is at very high levels. The other two may be offered at minimal levels or even eliminated without degrading the educational experience. (Anderson 2003b)

The challenge for teachers and course developers working in an online learning context, therefore, is to construct a learning environment that is simultaneously learner-centred, content-centred, community-centred, and assessment-centred. There is no single best media of online learning, nor is there a formulaic specification that dictates the type of interaction most conducive to learning in all domains and with all learners. Rather, teachers must learn to develop their skills so that they can respond to both existing and emergent student and curriculum needs. Teacher can do this by developing a repertoire of online learning activities that are adaptable to diverse contextual and student needs. Table 1 illustrates how the affordances of these emerging technologies

can be directed to create the environment most supportive of how people learn.

CONCLUSION

This discussion highlights the wide and diverse forms of teaching and learning that can be supported on the Web today, and the realization that the educational Semantic Web 2.0 will further enhance the possibilities and affordances of the Web, thus making it premature to define a particular theory of online learning. What we can expect, however, is that online learning – like all forms of quality learning – will be knowledge-, community-, assessment-, and learner-centred. Online learning will enhance the critical function of interaction in education, in multiple formats and styles, among all the participants. These interactions will be supported by autonomous agents and the aggregated contribution of other users. The task of the online course designer and teacher now, therefore, is to choose, adapt, and perfect, through feedback, assessment, and reflection, educational activities that maximize the affordances of the Web. In doing so, they will create learning-, knowledge-, assessment-, and community-centred educational experiences that will result in high levels of learning by all participants. Integration of the new tools and affordances of the educational Semantic Web and emerging social software solutions will further enhance and make more accessible and affordable quality online learning experiences.

Our challenge as theory builders and online practitioners, therefore, is to delineate which modes, methods, activities, and actors are most cost- and learning-effective in creating and distributing quality e-learning programs. The creation of a model is often the first step towards theory creation. The model presented illustrates most of the key variables that interact to create online educational experiences and contexts. Our next step is to theorize and measure the direction and magnitude of the effect of each variable on relevant outcome variables, including learning, cost, completion, and satisfaction. The models presented in this chapter do not yet constitute a theory of online learning per se, but hopefully they will help us to deepen our understanding of this complex educational context, and lead us to hypotheses, predictions, and most importantly, improvements in our professional practice. Hopefully, the model and discussion in this and other chapters in this book will lead us towards a robust and comprehensive theory of online learning.

NOTES

1. I am grateful to Joo Khim Tan (email JooKhim@np.edu.sg) for making this link between the model and the work of Marc Prensky in a discussion on ITForum in September, 2002.

REFERENCES

Anderson, T. (2003a). Modes of interaction in distance education: Recent developments and research questions. In M. Moore & W. Anderson (Eds.), *Handbook of distance education.* (pp. 129–144). Mahwah, NJ: Lawrence Erlbaum.

Anderson, T. (2003b). Getting the mix right: An updated and theoretical rational for interaction. *International Review of Research in Open and Distance Learning,* 4(2). Retrieved August 27, 2007, from http://www.irrodl.org/index.php/irrodl/article/view/149/230

Anderson, T. (2004). Student services in a networked world. In J. Brindley, C. Walti, & O. Zawacki-Richter (Eds.), *Learner support in open, distance and online learning environments.* Oldenburg, Germany: Bibliotheks-und Informationssystem der Universität Oldenburg.

Anderson, T. (2005). Distance Learning – Social software's killer app? *Proceedings of the Open & Distance Learning Association (ODLAA) of Australia.* Adelaide: ODLAA. Retrieved August 27, 2007, from http://www.unisa.edu.au/odlaaconference/PPDF2s/13%20odlaa%20-%20Anderson.pdf

Anderson, T., & Garrison, D.R. (1998). Learning in a networked world: New roles and responsibilities. In C. Gibson (Ed.), *Distance learners in higher education* (pp. 97–112). Madison, WI: Atwood.

Andersen, T., Norton, J.R., & Nussbaum, J. (1981). Three investigations exploring relationships between perceived teacher communication behaviours and student learning. *Communication Education, 30,* 377–392.

Annand, D. (1999). The problem of computer conferencing for distance-based universities. *Open Learning, 14*(3), 47–52.

Bates, A. (1991). Interactivity as a criterion for media selection in distance education. *Never Too Far, 16,* 5–9.

Baxter, G. P., Elder, A. D., & Glaser, R. (1996). Knowledge-based cognition and performance assessment in the science classroom. *Educational Psychologist, 31*(2), 133–140.

Benedikt, M. (1991). Cyberspace: Some proposals. In M. Benedikt (Ed.), *Cyberspace: First steps* (pp. 119–224). Cambridge, MA: MIT Press.

Berners-Lee, T. (1999). *Weaving the Web: The original design and ultimate destiny of the World Wide Web by its inventor.* San Francisco: Harper.

Bransford, J., Brown, A., & Cocking, R. (1999). *How people learn: Brain, mind experience and school.* Washington, DC: National Research Council. Retrieved August 27, 2007, from http://www.nap.edu/html/howpeople1/

Byrne, M., Flood, B., & Willis, P. (1999). Approaches to learning of Irish students studying accounting. *Dublin City University Business School Research Paper Series, 34.* Retrieved August 27, 2007, http://www.dcu.ie/business/research_papers/no36.html

Christenson, L., & Menzel, K. (1998). The linear relationship between student reports of teacher immediacy behaviors and perceptions of state motivation, and of cognitive, affective, and behavioral learning. *Communication Education, 47*(1), 82–90.

CiteULike. (n.d.). *CiteULike homepage.* Retrieved August 28, 2007, from http://www.citeulike.org/

Clements, D., & Nastassi, B. (1988). Social and cognitive interactions in educational computer environments. *American Educational Research Journal, 25*(1), 87–106.

Cutler, R. (1995). Distributed presence and community in cyberspace. *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century, 3*(2), 12–32. Retrieved August 27, 2007, from http://www.helsinki.fi/science/optek/1995/n2/cutler.txt

Dewey, J. (1916). *Democracy and Education.* New York: Macmillan.

Dixon, J. (2007). Breaking the ice: Supporting collaboration and the development of community online. *Canadian Journal of Learning and Technology, 32*(2). Retrieved August 27, 2007, from http://www.cjlt.ca/content/vol32.2/dixon.html

DOAJ. (n.d.). *Directory of Open Access Journals (DOAJ) web site.* Retrieved August 15, 2007, from http://www.doaj.org/

Dron, J. (2007). *Control and constraint in e-learning: Choosing when to choose.* Hershey, PA: Information Science Pub.

Eggins, S., & Slade, D. (1997a). *Analyzing casual conversation.* Washington, DC: Cassell.

Eggins, S., & Slade, D. (1997b). Approaches to analyzing casual conversation. In S. Eggins & D. Slade (Eds.), *Analyzing casual conversation* (pp. 23–66). Washington, DC: Cassell.

Eklund, J. (1995). *Cognitive models for structuring hypermedia and implications for learning from the World Wide Web.* Retrieved Feb. 2008, from http://ausweb.scu.edu.au/ aw95/hypertext/eklund/

Esposito, J. (2003). The processed book. *First Monday, 8*(3). Retrieved August 15, 2007, from http://firstmonday.org/issues/issue8_3/esposito/index.html

Farmer, J. (2005). Communication dynamics: Discussion boards, weblogs, and the development of communities of inquiry in online learning environments. *James Farmer's BlogSavvy blog.* Retrieved August 15, 2007, from http://www.commoncraft.com/james-farmers-blogsavvy

Feng, D., Shaw, E., Kim, J., & Hovy., E (2006). An intelligent discussion-bot for answering student queries in threaded discussions. Paper presented at the *International Conference on Intelligent User Interfaces (IUI-2006.* Sydney, Australia.

Garrison, D. R., & Shale, D. (1990). A new framework and perspective. In D. R. Garrison & D. Shale (Eds.), *Education at a distance: From issues to practice* (pp. 123–133). Malabar, FL: Robert E. Krieger.

Google. (n.d.). *Google search engine.* Retrieved August 15, 2007, from http://www.google.com

Google Answers. (n.d.). *Google Answers homepage.* Retrieved August 28, 2007, from http://answers.google.com/answers/

Herrington, J., & Oliver, R. (1999). Using situated learning and multimedia to investigate higher-order thinking. *Journal of Interactive Learning Research 10*(1), 3–24.

Holmberg, B. (1989). *Theory and practice of distance education.* London: Routledge.

Jonassen, D. (1992). Designing hypertext for learning. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology* (pp. 123–130). Berlin: Springer-Verlag.

Jonassen, D., & Carr, C. (2000). Mindtools affording multiple knowledge representations for learning. In S. Lajoie (Ed.), *Computers as cognitive tools: No more walls* (pp. 65–96). Mahwah, NJ: Lawrence Erlbaum.

Kirby, D., & Boak, C. (1987). Developing a system for audio-teleconferencing analysis. *Journal of Distance Education, 2* (2), 31–42.

Koper, R. (2001). Modeling units of study from a pedagogical perspective: The pedagogical meta-model behind EML. In R. Koper (Ed.),

Modeling units of study from a pedagogical perspective: The pedagogical meta-model behind EML. Heerlen: Open University of the Netherlands. Retrieved August 28, 2007, from http://dspace.ou.nl/bitstream/1820/36/1/Pedagogical+metamodel +behind+EMLv2.pdf

Laurillard, D. (1997). *Rethinking university teaching: A framework for the effective use of educational technology*. London: Routledge.

Lee, A. (2006). Learning and transfer in two web-based and distance applications. *Web-based learning: Theory, research and practice*. In H. O'Neil & R. Perez (Eds.), Mahwah, NJ: Lawrence Erlbaum.

Lipman, M. (1991). *Thinking in Education*. Cambridge: Cambridge University Press.

McCool, R. (2006). Rethinking the Semantic Web. *IEEE Internet Computing, 10*(1), 93–96.

McCormick, N., &McCormick. J. (1992). Computer friends and foes: Content of undergraduates' electronic mail. *Computers in Human Behavior, 8*(4), 379–405.

McDonald, J. (1998). Interpersonal group dynamics and development in computer conferencing: The rest of the story. *American Journal of Distance Education, 12*(1), 7–25.

McPeck, J. (1990). *Teaching critical thinking*. New York: Routledge.

MERLOT. (n.d.). *Multimedia Educational Resource for Learning Online Technology (MERLOT) homepage*. Retrieved August 15, 2007, from http://www.merlot.org/merlot/index.htm

Morris, M., & Ogan, C. (1996). The Internet as mass medium. *Journal of Computer Mediated Communications, 4*(1), 39–50.

MySpace. (n.d.). *MySpace homepage*. Retrieved August 28, 2007, from http://www.myspace.com/

OECD. (2006). *Organisation for Economic and Cooperative Development 2006 factbook*. Retrieved August 15, 2007, from http://lysander.sourceoecd.org/vl=8150559/cl=19/nw=1/rpsv/fact2006/

Opencontent.org. (n.d.). *Opencontent.org homepage*. August 15, 2007, from http://opencontent.org/

Phelps, R., Hase, S., & Ellis, A. (2005). Competency, capability, complexity and computers: Exploring a new model for conceptualising end-user computer education. *British Journal of Educational Technology, 36*(1), 67–85.

Potter, J. (1998). Beyond access: Student perspective on support service needs in distance education. *The Canadian Journal of University Continuing Education, 24*(1), 59–82.

Prensky, M. (2001). *Digital game-based learning*. New York: McGraw-Hill.

Resnick, M. (1996). Distributed constructivism. *Proceedings of the International Conference on the Learning Sciences Association for the Advancement of Computing in Education.* Chicago: Northwestern University.

Richardson, J. (2000). *Researching student learning: Approaches to studying in campus-based and distance education.* Buckingham, UK: Open University Press.

Richardson, W. (2006). *Blogs, wikis, podcasts and other powerful Web tools for classrooms.* Thousand Oaks, CA: Corwin Press.

Rourke, L., & Anderson, T. (2002). Using peer teams to lead online discussions. *Journal of Interactive Media in Education, 1.* Retrieved August 15, 2007, from http://www-jime.open.ac.uk/2002/1/rourke-anderson-02-1.pdf

Rumble, G. (1999). Cost analysis of distance learning. *Performance Improvement Quarterly, 12*(2), 122–137.

Seely Brown, J., & Hagel, J. (2005, April). IT platforms for business innovation. *Milestone Group.* Retrieved August 15, 2007, from http://www.milestone-group.com/news/05_04/seely-hagel.htm

Shank, G. (1993). Abductive multiloguing: The semiotic dynamics of navigating the Net. *The Arachnet Electronic Journal on Virtual Culture, 1*(1). Retrieved August 15, 2007, from http://infomotions.com/serials/aejvc/aejvc-v1n01-shank-abductive.txt

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications.* Toronto: John Wiley and Sons.

Siemens, G. (2005). A learning theory for the digital age. *Instructional Technology and Distance Education, 2*(1), 3–10.

Sims, R. (1999). Interactivity on stage: Strategies for learner-designer communication. *Australian Journal of Educational Technology, 15*(3), 257–272.

Smith, C., Feld, S., & Franz, C. (1992). Methodological considerations: Steps in research employing content analysis systems. In C. Smith (Ed.), *Motivation and personality: Handbook of thematic content analysis* (pp. 515–535). New York: Cambridge University Press.

Smolensky, M., Carmondy, M., & Halcomb, C. (1990). The influence of task type, group structure and extraversion on uninhibited Speech in computer-mediated communication. *Computer in Human Behavior, 6*(3), 261–272.

Spivack, N. (2007). Minding the planet: The meaning and future of the Semantic Web. *Lifeboat Foundation Special Report.* Retrieved August 15, 2007, from http://lifeboat.com/ex/minding.the.planet

TOPICA. (n.d.). *TOPICA email discussion list webpage.* Retrieved August 15, 2007, from http://lists.topica.com/dir/?cid=4

Visser, J. (2000). Faculty work in developing and teaching web-based distance courses: A case study of time and effort. *American Journal of Distance Education, 14*(3), 21–32.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wagner, E. D. (1994). In support of a functional definition of interaction. *The American Journal of Distance Education, 8*(2), 6–26.

Wenger, E., R. McDermott, R. & and W. Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Cambridge, MA: Harvard Business School Press.

Wilson, B. (1997). Thoughts on theory in educational technology. *Educational Technology, 37*(1), 22–26.

Yu, J., Brown, D., & Billett, E. (2007). Design of virtual tutoring agents for a virtual biology experiment. *European Journal of Open and Distance Learning*. Retrieved August 24, 2007, from http://www.eurodl.org/materials/contrib/2007/Yu_Brown_Billett.htm

ABOUT THE AUTHOR

Terry Anderson (terrya@athabascau.ca) is a professor and Canada Research Chair in Distance Education at Athabasca University – Canada's Open University. He has published widely in the area of distance education and educational technology and has co-authored three books: Anderson and Kanuka (2002) *eResearch: Methods, Issues and Strategies*; Garrison and Anderson (2002), *Online Learning in the 21st Century: A Framework for Research and Practice*; and Haughey and Anderson, *Networked Learning: Pedagogy of the Internet*. Terry graduated with a PhD from the University of Calgary in Educational Psychology, has a MSc from the University of Oregon in Computer Education, and a BA and BEd from the University of Alberta. He teaches educational technology courses in the Centre for Distance Education at Athabasca. He is the founding director of the *Canadian Institute for Distance Education Research* (see http://cider.athabascau.ca) and currently serves as the editor of the *International Review of Research in Open and Distance Learning* (see www.irrodl.org).