Handbook of Emerging Technologies for Learning

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Preface

Over the last decade, in seminars, conferences, and workshops, Peter Tittenberger and I have had the opportunity to explore the role of technology in transforming learning.

From conversations during these engagements, a set of concerns has emerged:

1. Educators express interest in improving their teaching and learning practices, particularly emphasizing the need to improve engagement of learners (online or in-class).

2. While concerned about improving teaching and learning, educators generally resist:

    a. Advanced pedagogical discussions that are not readily transferable to the online or face-to-face classroom

    b. Technology-heavy hype and suggestions that the social element of learning can somehow be replaced.

This Handbook of Emerging Technologies for Learning (HETL) has been designed as a resource for educators planning to incorporate technologies in their teaching and learning activities.

HETL has been developed for a workshop delivered to Athabasca University faculty and reflects several years work with Peter at the Learning Technologies Centre at University of Manitoba.

Distance and online universities such as Athabasca, are well positioned to play a bridging role between tradition and emergence in transforming higher education. Universities that recognize the value of online learning and are able to "get the model right"[1] will be well positioned to respond creatively to developing change pressures.

To extend the dialogue on the concepts expressed in this book, and to ensure information is current, a wiki has been set up to solicit feedback, contributions, reactions, and present updates: http://ltc.umanitoba.ca/etl

This workbook also supports and leads into the Certificate in Emerging Technologies for Learning (http://ltc.umanitoba.ca/blogs/cetl/) offered by University of Manitoba's Learning Technologies Centre and Extended Education.

George Siemens
March, 2009
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Introduction:

Transformative Change...

Higher education is in the midst of transformative (but exciting) change. Over the next decade, the practices of teaching and learning "will undergo fundamental change"[2] as universities and colleges respond to global, social, political, technological, and learning research trends. A duality of change – conceptual and technological – faces higher education. Large-scale transitions, such as were evident in the democratic revolutions across Europe in the late 18th century (conceptual) and industrial revolution in the late 18th and early 19th century (technological), transform the large institutions of society: government, education, and religion.

Today, the duality of conceptual (new models of education, advancement of social learning theory) and technological (elearning, mobile devices, learning networks) revolutions offers the prospect of transformative change in teaching and learning.

Education and fragmented information

The aim of education to "arm every single person for the vital combat for lucidity"[3] appears more difficult in a world of hyper-fragmentation, reflected in the development of the Internet and in the breakdown of traditional information structures such as newspapers, journals, and books.

How is education to fulfill its societal role of clarifying confusion when tools of control over information creation and dissemination rest in the hands of learners[4], contributing to the growing complexity and confusion of information abundance?

We now differently relate to information. The roles of experts (educators) and novices (learners) have been altered substantially. What once involved mediators and experts (journals, books, encyclopaedias) can now be handled informally through the aggregated actions of many (Wikipedia, blogs, ebooks).

Coherence and Fragmentation

As little as ten years ago, information was generally pre-packaged in the form of a textbook, a CD, a newscast, a newspaper, or a course. Not any more. The subtlety of the transition leaves many unable to see its depth.

Information can now be acquired in any manner desired by the individual. Learners piece together (connect) various content and conversation elements to create an integrated (though at time contradictory) network of information. Our learning and information acquisition is a mashup. We take pieces, add pieces, dialogue, reframe, rethink, connect, and ultimately, we end up with some type of pattern that symbolizes what's happening "out there" and what it means to us. And that pattern changes daily.

The fragmentation of information (Image 1) has resulted in an emphasis on individuals creating personal frameworks of coherence to understand sources information. Control over *personal coherence making* has significant implications for higher education.

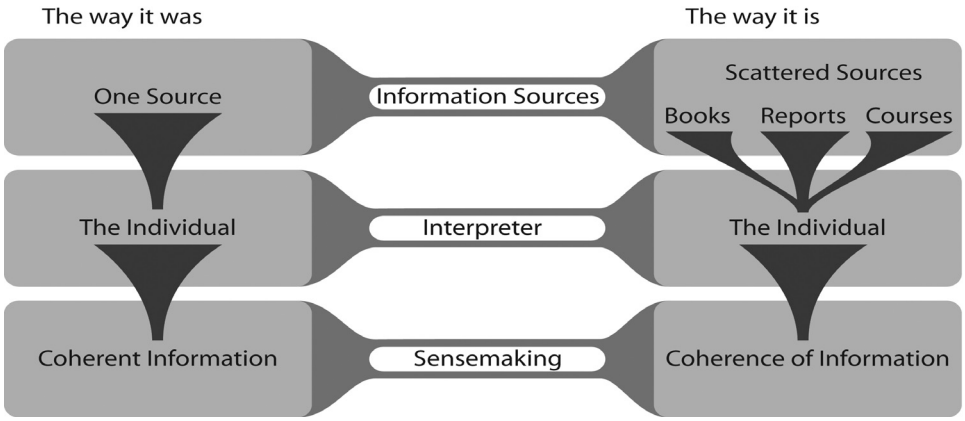

Image 1: Information Fragmentation and Coherence

The Information Cycle

The *creation of information* is now largely in the hands of individuals. The growth of user-generated content prompted Time Magazine to declare the 2006 *person of the year* to be, well, you – the individual contributing to video sites, blogs, and wikis. While information creation has always been possible for individuals (such as providing a letter to the editor in a newspaper), the barriers are now significantly lower.

The *packaging of information* has been altered as well. While not everyone has aspirations of creating content, everyone has interest in organizing and packaging information. The use of news feed aggregators gives learners greater control in how they experience learning content. Services like iGoogle, Google News, tags, and numerous others, permit learners greater control over the type of content they encounter. Instead of content being pre-packaged, information can today be packaged according to the needs and interests of each individual learner. As a result, different skills are required of learners (Image 2). Making sense of fragmented information through networks of peer learners offers an indication of future learning tasks and even pedagogical models.

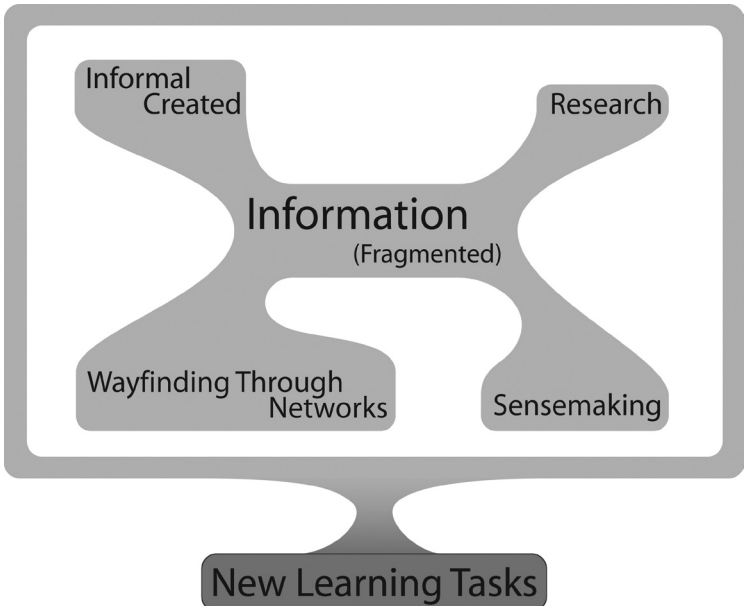

Image 2: Fragmentation, Wayfinding, and Sensemaking

The *validation of information* has also experienced change over the last decade. Wikipedia – an online encyclopaedia where anyone can contribute – presents an alternative mode of information validation ("the many") from what is used in education ("the expert"). Instead of relying on experts, Wikipedia (and sites like Digg) rely on the activity of many to discuss and validate information. The aggregated actions of many, according to this view, are more effective than the actions of a few privileged experts[5].

The *dissemination of information* still retains many of the attributes long valued in education: peer review and critical discussion. Unfortunately, the long process of traditional scholarship is no longer suitable when information is developing at an accelerated rate. Online journals (such as Innovate and IRRODL) are helping to reduce the timelines of writing and publication. PLOS One has adopted a peer review and annotation model *after* publication, not only prior to. New models of scholarship will permit individuals a greater role in the formation of ideas, rather than only encountering the ideas after publication[6]. These alternative models of information dissemination place sustained pressure on scholarship in higher education[7].

The *sharing and publication of information* is occurring at an unprecedented pace. Online journal systems such as OJS, blogs and wikis, enable more rapid sharing of information and research than higher education has encountered to date. The use of conferencing tools – Elluminate and Adobe Connect – permit a more timely sharing of research.

The *accreditation of the learner with regard to information* has not experienced significant pressure to date. While alternative models have been used (Microsoft and Oracle certification for example) the model of accreditation in higher education remains firm. The advancements of "community-validated experts" – such as eBay and Amazon - have not altered how competence is determined in formal education.

Changes to the information cycle (from creation to validation) are at the core of change in higher education.

Learners have increased educational opportunities due to the internet's affordance of connectivity. What once rested under the control of a privileged expert or organization is now under the control of individuals. Even the organization, sequencing, and structuring of information is now largely under the control of individual learners.

Content is generally viewed as something that learners need to cognitively consume in order to learn. But learning is like opening a door, not filling a container. Content can be created through the process of learning, not only in advance of learning. And increasingly, content co-creation and re-creation (building on and using the content created by others to create something new) are becoming the norm for online participants.

Is Technology Effective for Learning?

Research indicates that "effective [distance education] depends on the provision of pedagogical excellence"[8] and limited variability in results indicates "no significant difference" in Distance Education (DE) and face-to-face learning (though calls have been made for greater variability in research methods including discourse analysis and learner interviews)[9]. Attitudes toward e-learning, as "reflected by scholarly and academic reviews, range from neutral to positive"[10], indicate DE courses offer similar effectiveness to traditional instructional approaches.

While learner control is desirable, "dramatic tension" (provided by course designers and instructors) is required "in order to sustain a high level of participation"[11]. Athabasca University faces an additional challenge of keeping learners motivated and engaged while permitting them the freedom to progress at their own pace, often in isolation from, and absence of social interaction with, peers.

Unfortunately, in many universities "web technology...[is]...primarily used for support of logistical processes rather than for pedagogical change"[12]

Change Pressures and Trends

On Change and Becoming

Jean Baudrillard[13] offers a distinction between *change* and *becoming* that informs the discussion of technology and educational change:

> We are changing our system of values, changing all our identities, our partners, our illusions, and so on. We are obliged to change, but changing is something other than becoming, they are different things. We are in a "changing" time, where it is the moral law of all individuals, but changing is not becoming. We can change everything, we can change ourselves, but in this time we don't become anything. It was an opposition put forth by Nietzsche, he spoke about the era of chameleons. We are in a chameleonesque era, able to change but not able to become.

This quote gets to the core problem in changing schools, colleges, universities, or corporate training. Organizations recognize that they are facing tremendous change pressures and are grasping for clarity on what they are becoming (or will become).

While many of the change pressures are well beyond our control, education has always played a dual role in society:

- **Emergence:** Reacting to emerging trends, adjusting our approaches to influence learners, etc. Those who advocate for "teaching to the millenials" see this part of education's role. Our task here is primarily about understanding our learners, embracing their tools, and trying to speak their language. That's why educators zealously try to use blogs, wikis, Facebook, iPods, etc. The mindset is: *if they use it for fun, maybe we can get them to use it for school*. This is not a bad idea with technology and curriculum (i.e. change what and how we teach to prepare learners) but a disastrous idea when applied without thought to learning environments.

- **Tradition:** Influencing and transforming society in pursuit of "higher ideals" and a vision of equality and democracy in the rights of all people. Piaget, Illich, and Freire have contributed their voices in a call to make education more equitable, more accessible, and more reflective of the nature of learning. Theorists like Papert suggest learning requires "active doing" not lecture-based telling. Vygotsky, Wenger, and others emphasize the importance of social, cultural, community, and historical components to learning. Engestrom, building on the work of Vygotsky, suggests activity theory as a means of framing desirable education models. We can add almost indefinitely to the list of theorists, activists, politicians, and business people calling for education reform (Toffler and Gates, for example, both suggest education is fundamentally flawed in its architecture).

Transforming the University

David Poole suggests that we "live in the era of the transforming university"[14]. Consider the following:

- Europe's Bologna Process[15] places increased attention on the state's role in universities.
- Enrolment in online learning is growing at a significantly faster pace than traditional higher education[16].
- The internet is "changing traditional behaviour" as daily activities (shopping, playing games, research) are increasingly done online[17]. Canadians, in particular, enjoy high levels of broadband connectivity[18] and make extensive use of the internet for social, information, and entertainment purposes[19].

Higher education's response to change pressures must be holistic, attending to the varying needs of stakeholders. E-learning does not function in isolation. Multiple stakeholders are involved in the credibility and success of elearning: learners, employers, instructors, higher education institution, accreditation bodies, and so on[20]. The growth and value of elearning is directly related to the ability of institutions to attend to the needs of each stakeholder member.

Pressures of Change

Change pressures impacting the future design of education can be grouped into four broad categories:

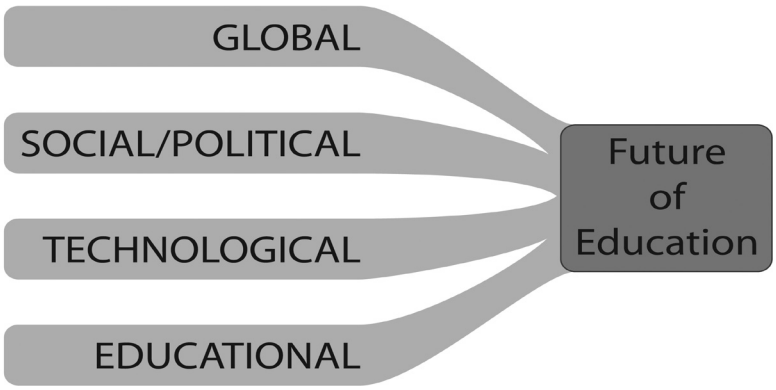

Image 3: Trends influencing the future of education

1. **Global:** Global change pressures are large-scale phenomenon such as global warming, globalization, economics, changing "power centres" (the economic and political development of BRIC (Brazil, Russian, India, China) countries, population growth and demographic shifts (aging population of developed countries such as Japan, US, Canada, and many European countries), and so on. Global shifts impact all aspects of a society. Higher education has limited influence over these trends but must be aware of these developments to ensure long term survival. For example, universities in developed countries are responding to reduced enrolment (driven by slowing population growth in traditional learner markets) by seeking international students[21]. The hegemony of higher education in western countries is also being challenged[22], raising the need for increased university partnerships between established and emerging economies. Universities are "at a historical juncture, transitioning from the industrial era to the information era, and from a national perspective to a globalized one"[23].

2. **Social and political:** Societal and political factors also contribute to the future of universities. Networks are now seen as potential means of societal and institutional organization[24]. The participative, democratic ideals of open source software are reflected in scholarship (PLoS ONE) and open educational resources. The process of knowledge production is moving to more social models ("socially distributed knowledge production"[25]) as businesses and organizations are placing greater emphasis on distributed teams and collaboration. Emphasis on information and knowledge economies results in greater prominence of creative work in contrast with traditional manufacturing work[26].

3. **Technological:** Technology has become more prominent in most aspects of society. The participative web (also known as web 2.0), mobile phones, social networking services, and netbooks have given individuals greater control over information creation and sharing. Information services like Google Search, Google Scholar, GPS-enabled devices, and e-books, are improving access and communication for learners. Technological innovations in bandwidth, storage, processing speed, and software directly impact education[27], creating new opportunities for learner-learner/educator and learner-information interactions.

4. **Educational:** Educational change pressures are those specific to higher education. Global, social, and technological change factors impact higher education, but research specific to teaching and learning provides greater direction into how the process of learning should best be facilitated. In particular, the development of *learning sciences*[28] as a field offers promise in assisting administrators, educators, and designers in creating effective learning environments. However, as with new and emerging fields, the emphasis on *sciences* creates some unease among educators. Some researchers have turned to complexity theory to advance education, suggesting that emphasis be placed on the *whole system* rather than reductionist views often found in "mainstream science"[29]. Increased collaboration in a model of "interlocking partnerships among researchers, among universities, and across international borders"[30] promises a new model of not only "what it means to be an academic" but also "what it means to be an academic institution". Many tools are now available for educators to open wide the doors to learning, reducing barriers to information access and to increase the opportunities for learning with colleagues and peers from around the world. As more information is freely available online (OCW, Open Yale, Open Learn and numerous related projects), tools of collaboration grow in prominence (wikis and blogs), and means of discovering and networking with others (social network resources) become more popular, substantial change can be expected in education.

Finding new points of balance

Global, political, social, technological, and educational change pressures are disrupting the traditional role (and possibly design) of universities.

Higher education faces a "re-balancing" in response to growing points of tension along the following fault lines:

1. **Education/business:** More than a century of calls for academic reform have not generated substantial change. The current technological revolution promises greater impact, though it raises questions about "the ends and purposes of education" and "what we are doing and trying to achieve in our educational practices and institutions"[31].

2. **Accreditation/reputation:** Competence in rapidly changing fields like information communication technology is often tied to reputation, not accreditation. Software developers and online community forum members (on sites like Digg and Slashdot) gain prominence and reputation through writing high quality code and providing insightful forum/community contributions. The growth of collectives (where members rate and filter contributions as well as services like Technorati or Google Search that provide an algorithmic valuation of contribution) that measure the competence of individuals presents an opportunity for universities to augment existing accreditation methods with ones that acknowledge contributions outside of academic activities.

3. **Transformation/utility:** The ideal of education as a model for developing individuals capable of preserving and advancing democratic ideals and rights of individuals is somewhat at odds with a utilitarian view (learning for employment). With certain regions reporting that universities are increasingly autonomous from the state, but pursuing "closer engagement with industry"[32], the question of humanity vs. utility balance in higher education is far from settled.

4. **Research/responding:** The internet allows "academics and students in higher education institutions with fewer resources"[33] access to research and information previously only available at well-funded institutions. Technology and the prominence of mobile devices and social networking services in the personal lives of learners has not been matched by the adoption of educational technology in universities[34]. This gap raises an important question: how rapidly should universities respond to larger social and communication technology trends in society? Current research on the impact of communication technology on learners and the learning process is still underdeveloped. Researching vs. responding to

societal trends will be a challenging field for academic institutions to navigate.

5. **Formal/informal:** With the exceptions of initiatives such as Prior Learning Assessment and Recognition[35], learning is generally only formally acknowledged when occurring under the aegis of schools and universities. Yet, as has always been the case, many important skills are developed outside of classrooms. Learning occurs through volunteering, hobbies, work-based, communities of interest, political and social activism, and raising or being a part of a family. As expressed by the Canadian Council on Learning, limitless dimensions[36] exist in our learning.

6. **Open/Closed:** Open source has moved from software to politics/business/education. Closed, "locked-down" learning management systems, journal articles, and research stand in stark contrast to openness in journals like IRRODL and personal learning environments. The struggle between open/closed, free/proprietary will continue as a major point of tension in business and education in the foreseeable future.

7. **Expert/Amateur:** Can a group (or network) of amateurs duplicate what experts do? In spite of controversy about the validity of information, Wikipedia is one of the most popular web sites. Amateur-produced information is generally easily accessible (in language and format), whereas expert-produced information is often inaccessible (in language and format).

8. **Hierarchy/Network and Command/Foster**: Leading network theorists (Barry Wellman[37], Albert-László Barabási[38], Duncan Watts[39], Manuel Castells[40], and Yochai Benkler[41]) promote networks as the model for organizing society. Hierarchical command and control models are limited in their ability to respond to complex interactions and information abundance. When applied to education, this line of reasoning suggests that networked models of learning will replace existing curricular models.

9. **Pace/Depth:** The growth of information worldwide[42] influences how individuals interact with content. Extensive time, effort, and commitment are required to develop expertise in a field[43]. Continual change and distraction may contribute to developing expertise in managing high flows of information, but may not develop particular subject matter expertise as extensive thought is not applied to the content itself (only the process).

10. **Epistemology/Ontology:** Rapid growth of information requires higher education to change its focus from *knowing* (epistemology) to *being* (ontology)[44] (see Image 4). For example, Harvard's new "core curriculum"[45] focuses on attributes and qualities of learners, rather than particular knowledge elements.

Image 4: Shifting from Knowing to Being

Firm Foundations

Academics, and particular administrators, face the difficultly of determining appropriate responses to broad change pressures. Growing hype over the last five years suggests "web 2.0" or the "read/write web" are of sufficient force to require universities to alter the process of curriculum creation and teaching and learning. Caution is required in this regard.

The stability of higher education is often cast as a negative by individuals seeking reform. Yet this stability ensures that false, often expensive, missteps are avoided. Administrators have an opportunity to look beyond the *current instantiation of change, and focus instead on the foundational change itself*. Many tools currently under the web 2.0 banner will likely fade and be replaced by new innovations.

What serves as a suitable foundation for considering change?

Humanity, through creation of new technology and processes, demonstrates a long timeline of change in (see Image 5):

- how individuals are able to create and interact with information (language, Gutenberg, Internet) and,
- how individuals are able to interact with each other and function in distributed (often social) networks.

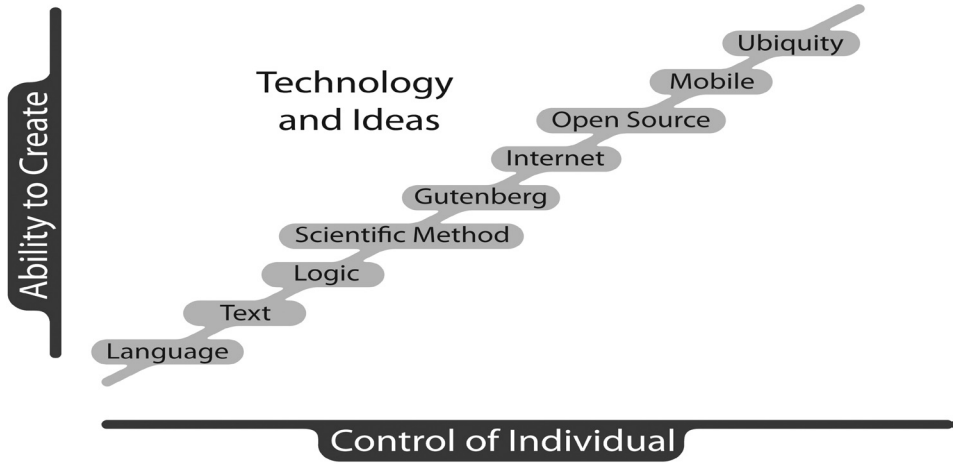

Image 5: Long timeline of change in information creation and individual control[46]

The foundational change in how information is created, shared, and disseminated (with greater control assigned to individuals) forms the basis on which organizations can build new systemic structures.

What we know about learning

Over the last century, educator's understanding of the process and act of learning has advanced considerably. In the early 20th century researchers viewed learning through the lens of behaviourism – relegating the inner workings of the mind to the status of a black box, seeking instead to focus on observable and manipulate-able external behaviours. This view served well the industrial age in which it developed – the information age was still decades in the future.

As researchers and educators probed more deeply into the process of learning, the weaknesses of behaviourism became evident. How can depth of understanding be discerned under a behaviourist model? How are emotions and learner motivation accounted for in behaviourism? Since the mid 20th century, cognitivism and constructivism have developed as learning theories to address the weaknesses of behaviourism. In the last decade learning sciences have advanced sufficiently to provide educators with a fairly well developed body of research, that can be used as a guide in making decisions about developing learning activities and approaches for effective learner engagement. Learning sciences are an interdisciplinary science, bringing "together researchers in psychology, education, computer science, and anthropology"[47].

A review of existing literature on learning reveals four broad components and three distinct processes through which these components are enacted. The components (detailed in Image 6), include:

- **Social**. Learning is a social[48] process. Knowledge is an emergent property of interactions between networks of learners.
- **Situated.** Learning occurs within particular situations or contexts. Both "learning and cognition...are fundamentally situated"[49], raising the importance of educational activities mirroring actual situations of use.
- **Reflective.** Learners requires time to assimilate new information. Learners require the "opportunity to reflect on, defend, and share what they have learned if it is to become part of their available repertoire"[50]
- **Multi-faceted**. Learning incorporates a range of theory, engagement, "tinkering" or bricolage, and active construction[51].

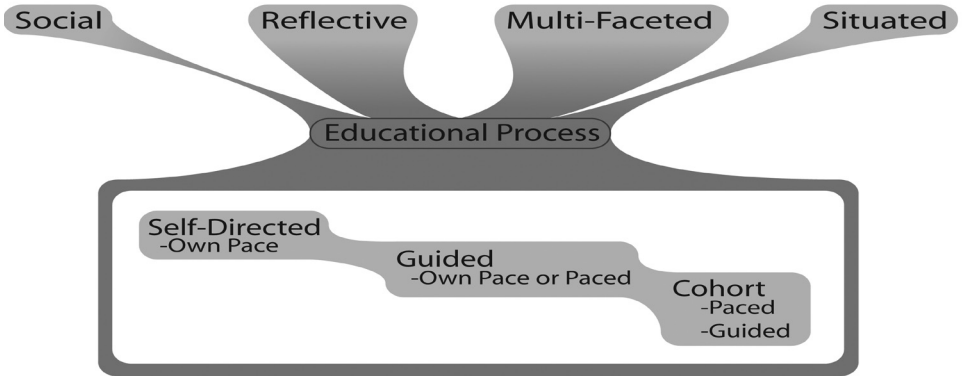

Image 6: Learning and Process

The social, situated, reflective, and multi-faceted aspects of learning are expressed through various educational approaches:

- **Self-paced**. Reflected in traditional distance education models relying on open enrolment

- **Guided.** Increased assistance (through tutors or instructors) provided to learners. May be self-paced in an open enrolment model or through a paced (fixed start/end date)
- **Cohort.** With peers - paced and guided

Social software can play an important role in self-directed distance education environments[52], allowing learners the freedom of self-paced instruction with the social support of contact with peers. Through forums, blogs, social networking tools such as ELGG, and others, a sense of connectedness to other learners can be fostered that is currently lacking in many distance education programs.

Distributed Knowledge & Cognition

All the knowledge is in the connections
David Rumelhart

Knowledge is distributed across a network that includes people and objects. To navigate, make sense, and come to understand (even grow and advance) knowledge, the process of cognition is also distributed across networks,[53] and includes "interactions between people and with resources and materials in the environment"[54]. Building an airplane is a complicated task, involving engineers, electricians, managers, and others. The capacity to build an airplane is realized when special knowledge domains and skills are connected.

Participatory sense-making – the view that learners coordinate activity in "interaction, whereby individual sense-making processes are affected and new domains of social sense-making can be generated that were not available to each individual on her own"[55] - is particular valuable in a networked world. The personal network an individual has created (which can include blogs, trusted experts, communities, informal learning tools like online search) plays a vital role in his/her ability to make sense of changes and trends. The network, in essence, becomes a filtering agent assisting educators and learners to make sense of, and manage, the incessant waves generated by an increasing sea of information.

Attrition

Attrition – particularly in online and distance learning – may be minimized through increased attention on the components of effective learning. The importance of engagement ("creating habits of mind"[56]) and motivation cannot be overstated as foundational to learner retention. In traditional institutions, attrition can be reduced when students are academically and socially integrated with the institution of study[57]. The need for social contact is arguably more important online that in regular face-to-face institutions. In addition to high levels of self-motivation, appropriate institutional support, and access to needed learning resources, distance (and online) learners need to "develop interpersonal relationships with peers, faculty, and staff"[58].

Existing centralized learning models (learning management systems) are conceptually mismatched to the distributed, social, situated, and personal agent views of learning. Social software may provide a better model for educators to consider, as it places greater emphasis on "self-governed, problem-based and collaborative learning processes"[59].

Limitless Dimensions of Learning

The full spectrum of learning (Image 7) - formal, informal, simulation, mentoring, performance support, self-learning (awareness of self and thinking habits), and communities - must be attended to by the educational process. Learning as capacity-development emphasizes attention to each of these domains. An engineer working in a distributed team requires different learning assistance

than a salesperson making contact with a new client. Classroom and course-based learning are only a single aspect of a broad spectrum of learning needs. To date, universities have focused on formal education. With increased attention, in corporations and society, being paid to lifelong learning, and with the advancement of prior learning assessment and recognition (PLAR), it is conceivable that universities will begin acknowledging a broader spectrum of learning experiences than they have in the past.

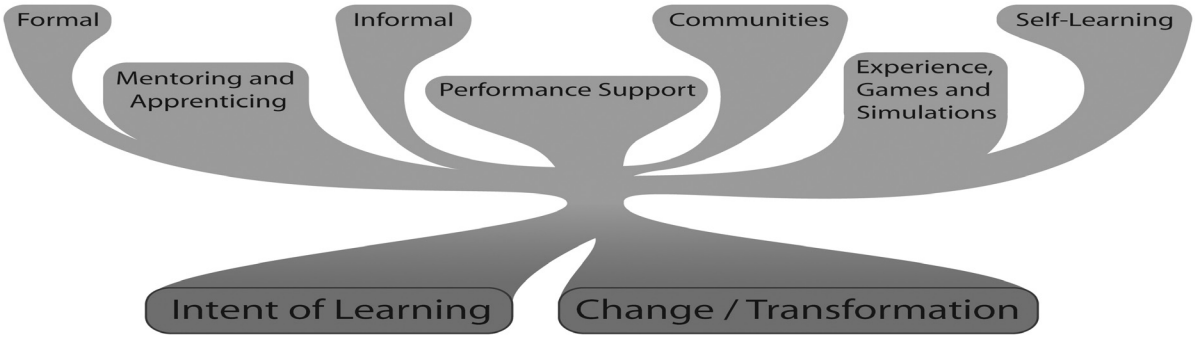

Image 7: Limitless dimensions of learning

Connectivism and Networked Learning

> "Only connect! That was the whole of her sermon. Only connect the prose and the passion, and both will be exalted, and human love will be seen at its height. Live in fragments no longer."
> *E.M. Forster, 1910*

Given the increasingly complex world of information, and the social, multi-faceted dimensions of learning, it's appropriate to address new views of learning and teaching.

Net pedagogy has been suggested as a means to consider the "changing landscape of teaching and learning online"[60].

Connectivism[61,62] has also been suggested as a model of learning in an age defined by networks.

Networks and connections are deceptively simple. It would not appear that the formation of a simple connection has the capacity to reverberate across a network, rewriting both form and function. And yet it does. Latent semantic analysis suggests that "people have much more knowledge than appears to be present in the information to which they have been exposed"[63], or put another way, the addition of a new element of information yields a greater impact than what exists within the information itself.

New information (a node) creates a ripple effect altering the meaning of other nodes within a network. A new node of information results in new connections, which in turn results in new knowledge, and thereby increased understanding on the part of the learner. Knowledge is a function of connections and understanding is the emergent shape of the network.

What is connectivism

Connectivism is the view that knowledge and cognition are distributed across networks of people and technology and learning is the process of connecting, growing, and navigating those networks.

What does it mean to say that learning is networked? Learning can be described as a network on three separate levels (see Image 8).

1. Neural level – the formation of neural connections as new stimuli, input, and experiences shape the physical development of the brain[64]. Research suggests connections and networks are prominent in memory formation and activation[65]. Knowledge and learning are not held at any particular point in the human brain. Instead, they are distributed across numerous sections. Knowledge is an emergent attribute of patterns of neural connectivity.

2. Conceptual level - within a discipline or field of knowledge. Key concepts of a field – those which are foundational to the knowledge of a discipline – are networked in structure[66]. Novice learners seeking to develop advanced understanding of a discipline do so through the formation of conceptual connections similar to those held by experts within the field.

3. External. The formation of networks has been significantly aided through the development of participatory web technologies. Blogs, wikis, social bookmarking, and social networking sites, raise the capacity of individuals to connect with others, with experts, and with content. Understanding, in a networked sense, is an emergent element related to the shape and structure of the learner's personal information and social networks. The development of RSS as a means of aggregating information and mashups as a means of combining information in various contexts, contributes to the external formation of networks which in turn assist learners in forming accurate conceptual relationships within the field. High levels of participation in social networks, especially with younger learners, "suggests new ways of thinking about the role of education"[67].

While network attributes are similar in all three levels of networked learning, a node, however, differs in each instance. A node in a neural network is a neuron. In a conceptual network, a node is an idea or collection of ideas (networks can serve as nodes when connected to larger network structures). In an external network, a node is a person, an information source, or similar entity capable of accepting connections and thereby participating in a network.

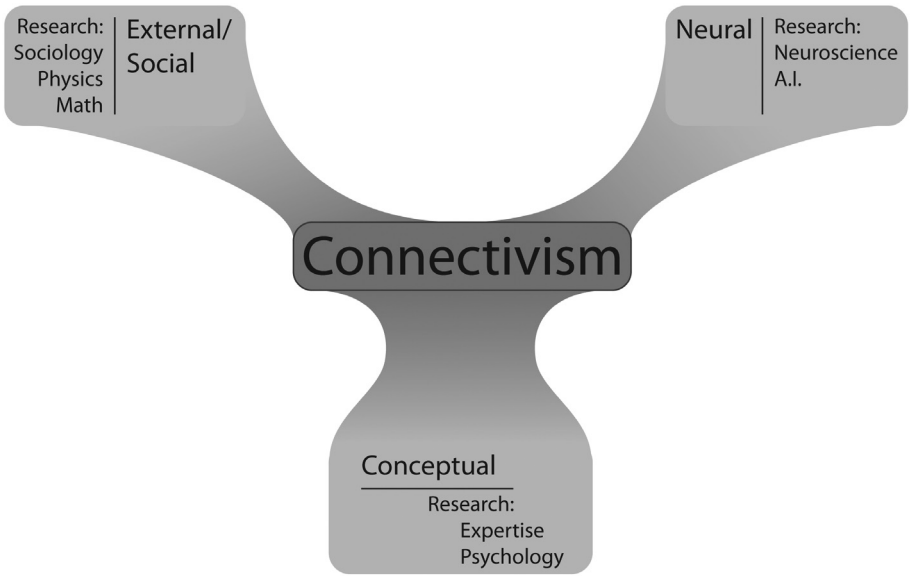

Image 8: Connectivism

Expertise

> "More than anything else, being an educated person means being able to see connections so as to be able to make sense of the world and act within it in creative ways. All of the other qualities that I've just described—listening, reading, writing, talking, puzzle-solving, seeing the world through others' eyes, empowering others, leading—every last one of these things is finally about connecting."
>
> *William Cronon*

Developing expertise requires sustained attention and focus, a concept at odds with the rapidly changing, sometimes transient relationships many individuals have with information. Educators must balance what is known about the development of expertise with the motivational aspects of new technologies and the innovative (sometimes motivating) uses of these tools.

Expertise is "largely a matter of amassing considerable skills, knowledge, and mechanisms that monitor and control cognitive processes to perform a delimited set of tasks efficiently and effectively"[68].

Is a simple connection sufficient? Numerous taxonomies (Fink, Wiggins, Bloom) indicate that knowledge and learning can be characterized by gradients, levels, and stages. Perhaps we have been conditioned to expect something as complex as learning to require a complex process or explanation. But what if forming a connection is enough? What if learning is as simple (for the purposes of most educators) of getting learners to form diverse networks representing divergent viewpoints and cultures? What if exposing learners to rich networks of content and conversation is sufficient? The learners will, after all, begin to "play", make sense, interact, and grow in knowledge and understanding.

A second component requires consideration: the depth and quality of learning in a network. Sometimes learning involves forming networks and connections at a basic Level (often with the intent of creating awareness of related fields which may impact our own area of expertise). This is *weak tie learning*. Learning in this instance is defined by creating connections to peripheral fields or simply interacting briefly with new information and then moving on. *Strong tie learning*, on the other hand, involves more time, effort, expertise, and sustained focus. Geetha Narayanan defines this as slow learning where emphasis shifts from speed to depth and wholeness of learning[69].

Sometimes educators want learners to gain an awareness of factors, other times we want them to interact with elements in order to understand deeply. Sometimes educators want learners to develop knowledge for foundation building. Different knowledge-network connections, defined by strength of the tie, result in different depth of learning. Perhaps "only connect" is still (almost 100 years later) a sufficient motto. Perhaps the elimination of barriers to connection is the greatest systemic challenges our institutions face. And the role of teaching is one of guiding, directing, and curating the quality of networks learners are forming.

Technology, Teaching, and Learning

Technology is concerned with "designing aids and tools to perfect the mind"[70]. As a means of extending the sometimes limited reach of humanity, technology has been prominent in communication and learning. Technology has also played a role in classrooms through the use of movies, recorded video lectures, and overhead projectors. Emerging technology use is growing in communication[71] and in creating, sharing, and interacting around content[72].

Learning Management Systems

In late 1990's, learning management systems (LMS) such as WebCT and BlackBoard became fixtures of many campuses. Faculty members who had previously relied on web pages for posting course notes, resources, and links, started utilizing the increased functionality of LMS. In addition to providing course resources and notes, faculty and students could interact in discussion forums and live chats.

Technology and software have the potential to reduce the separation between learner, instructor, or resources. Interactive activities, tutorials, and other learning activities, have moved beyond the four walls of a classroom. MIT's iLabs offer an innovative approach to online lab experiments. Students from around the world can (and do) conduct experiments in MIT's labs from their own school, classroom, or home.

Personal Learning Environments

Social technologies have been developing rapidly for several years - to the point where the loose collection of many tools is often seen (and used) as an alternative to an LMS. Through the use of Google Docs, Skype, blogs, wikis, podcasts, flickr, YouTube, del.icio.us and other tools, academics can provide a rich learning experience often exceeding the static experience of an LMS. Unfortunately, to participate in these multi-tool learning experiences, often described as "personal learning environments", learners require a high degree of technical proficiency and comfort in online environments.

A few tools to consider in adding functionality to, or replacing an LMS:

- Blogs
- Wikis
- Skype or other voice over IP tools
- Second Life or virtual world interactions
- Voicethread – multiple perspective dialogue centred on an artefact
- Integrated suites or classrooms (Elluminate)
- Discussion forums: within an LMS or an external application
- Text chat: IM, IRC, chat rooms
- Image-based discussions (Flickr)
- Group-based software (Sharepoint or Groove)
- Informal: Google Groups, mailing list software
- Social networking tools: Facebook, ELGG
- Social bookmarking: del.icio.us

As with other aspects of teaching online, the security or privacy of the conversation is an important consideration. Tools such as blogs, del.icio.us are often open for others to read. Many learners (and educators) may find this freedom disconcerting. LMS developers are beginning to include social tools for interaction in secure environments. Similarly, group-based software (such as Sharepoint) can be configured to require authentication in order to read or contribute.

Is technology neutral?

Debate surrounds the question of whether technology is neutral on non-neutral. Researchers and theorists express two broad, polar opposite, views[73]:

- Technology is neutral, to be used as a tool
- Technology is non-neutral, embodying philosophies and ideology

Within educational technology, the affordances (action potential) of particular tools suggest the latter perspective is more accurate. The choice to use a particular technology also reflects an accompanying world view or existing mindset. Using an open system (such as blogs and wikis) in comparison to a closed tool (LMS) is a reflection of values.

Teaching with Technology

Early adopters of new technology often employ a grassroots approach – using resources outside of formal institutional support. This model is effective for individuals with high technical skill or an interest in innovating and reforming teaching practices.

Successful organizational e-learning initiatives require support and strategic ownership[74]. Grassroots innovation frequently encounters organizational barriers. Adopting a department-level view of elearning is important in creating learning material, creating a support infrastructure, allocating resources, and building a "comprehensive program of continuing professional development"[75].

Many of the principles of effective instruction online are similar to classrooms. Chickering and Ehrmann[76] advocate for seven key "good practice" elements in online instruction:

1. encourages contact between students and faculty
2. develops reciprocity and cooperation among students
3. encourages active learning
4. gives prompt feedback
5. emphasizes time on task
6. communicates high expectations
7. respects diverse talents and ways of learning

While the above list can be augmented to include affordances inherent to technology (handling technology, integrating into teaching activities, or fostering dialogue with distributed learner groups), they suffice as an introduction to the similarity of teaching well with technology and teaching well in a classroom.

What traits and mindsets are required to successfully teach with technology?

Research mindsets required by academics to succeed in their discipline are also important in

teaching with technology. Through an ongoing cycle of personal research, theory and practice, educators are able to create an approach to technology that fits within the scope of their discipline, and the expectations of learners.

Teaching successfully with emerging technologies requires:

- A spirit of experimentation
- Willingness to engage learners in the creation of learning resources (co-creation of content)
- Willingness to "let go" of control and content presentation approaches to teaching
- Tolerance of failure

Augmented, Blended, and Online Learning

Teaching with technology can be viewed as gradients within three broad categories[77]:

1. Augmented – the use of technology to extend a physical classroom. This may be as simple as incorporating web quests into student work, or the use of an online discussion forum. In a traditional university, the learners still meet regularly with faculty in classrooms. In distance education system, such as Athabasca University, existing paper-based courses could be augmented through online forums or blogs.

2. Blended – technology partly replaces in-classroom learning. Part of the course is face-to-face and part is online. For example, the instructor may initiate a course with a series of classroom lectures, with the rest of the course held online. In distance education programs, online resources such as video and podcasts could be added to existing distance materials.

3. Online – technology entirely replaces face-to-face classroom teaching or paper-based distance education. Fully online programs often employ a learning management system to assist designers and educators with managing student grades, interaction, and content delivery.

Augmenting classrooms

Integrating new tools into existing teaching activities can appear as a formidable challenge. Educators prepared to experiment can move into the process at a pace of personal comfort. An "all or nothing" mindset is not helpful. Small steps are often the best approach for both educators and learners. Augmenting traditional classrooms and distance education courses with emerging technologies is one such approach.

Instructors can move content acquisition activities (which learners can do on their own), such as read a text or listen to audio lectures, online so class time can be spent on dialogue and learning activities. Online quizzes can improve the learner's ability to self-assess as well. Completion rates for advanced readings can be improved as well if learners are required to complete a short quiz in an LMS, for example, based on readings. These short quizzes may contribute to the overall course mark and provide motivation for learners to read material in advance of class discussions.

Classes can also be augmented through the use of online discussion forums, web quests, a class listserv, blogs, and group-work in wikis. The primary intent of augmenting classroom instruction is to increase effectiveness of learning by providing contact with experts, diverse viewpoints, and dialogue.

Blended learning

Blended learning occurs partly in a classroom (or paper-based in distance education institutions) and partly online. In contrast with augmented learning – where regular scheduled classes are held – blended learning may include an initial face-to-face class, followed by several weeks of online classes, and a wrap up face-to-face class.

Online classes may be synchronous (real time) or asynchronous (time delay).

Synchronous tools include:

- Virtual class tools (like Adobe Connect or Elluminate). These tools are integrated suites, for presenting content (via PowerPoint), application sharing, polling, shared whiteboard, web-browsing and other functionality.
- Chat or instant messaging. Chat can occur within a tool like Moodle, or in stand alone applications like MSN messenger or IRC.
- Voice over IP – through the use of free tools like Skype or GoogleTalk

Asynchronous tools include:

- Discussion forums (in an LMS or online platforms)
- Email, commonly with listserv (like Mailman) or group-based lists like Yahoo or Google Groups
- Blogs or wikis for reflection or collaborative writing

Online Learning

Courses delivered completely online may be offered through platforms like Desire2Learn, Moodle, or Blackboard (for content presentation, discussion, and evaluation) or offered through a combination of blogs, emails, podcasts, and group-based activities (for example, Yahoo Groups).

Fully online courses offer challenges not evident in augmented or blended models. A common concern expressed by learners in online courses is the sense of isolation from other learners and instructors. This challenge can be addressed through utilization of social technologies and collaborative learning.

For example, if an online course is cohort based or has a set start and end date (in contrast to open enrolment) activities can be utilized which allow learners to dialogue about course content. Each week can include a variety of content resources (readings from a text or online, podcast, online video), combined with personal reflection (comments to a discussion forum), group activity (web quests, collaborative writing in a wiki), and interaction with the instructor (synchronous chat or skype call or email).

Regular virtual office hours (in Elluminate, on Skype, or Second Life) offer another opportunity for educators to increase social contact with learners. Learners can enter a chat space (or if you have access to a virtual classroom, audio can be used) and ask questions and clarify concerns. Podcasts are also an effective means of adding audio to a course. Even a short weekly podcast review can provide a strong sense of connection to an instructor.

While the online medium has many affordances it also has many “lost affordances” over physical classrooms. As discussed, sense of isolation, learner expectations and experience, and other factors are important for educators to consider in their design and delivery of online courses. Continual experimentation and reflection will produce a model that works well for the individual educator, learners, and subject matter.

Move to Facilitation

Learning online or at a distance is a different experience from learning in classrooms. When the physical cues and processes are eliminated, it is imperative that the instructor reviews course material and learning activities to ensure clear communication (consider having a colleague or student review the material or pilot the course before initial offering so potential challenges can be attended to in advance of delivery). In a face-to-face course, confusing sections of an assignment can be easily clarified by approaching an instructor after class. Online, small questions, combined with a sense of isolation, can rapidly develop into high level of learner frustration.

Seymour Papert suggests two broad approaches to learning: instructing or having students actively involved in doing[78]. While this view may be a bit narrow for the diverse disciplines found in higher education, it provides an important dichotomy between instructor and learner involvement. Effective learning online requires an instructor to focus less on lecturing and content presentation, and more on assisting learners in creating personal learning or knowledge networks. Through access to resources and experts, learners are guided to explore content and ideas, and engage actively in conversation with each other, the instructor, and often, members of the larger discipline. Learners actively “forage for knowledge”, instead of passively consuming knowledge dispensed by the instructor.

Use of facilitative learning techniques does not negate the value of lecture. Lectures (via video or podcast), when appropriately used, are a valuable tool in the process of learning. But instead of being viewed as a primary tool, lectures are a tool in the toolbox of instructors. The nature of the particular learning task determines the best approach. For example, if basic content is being presented, a lecture may be an effective approach. If learners are being asked to evaluate and synthesize certain aspects of a discipline, conversation, discussion, and group learning may be the best option.

Same tools in the instructors learning tookit include:

- Lecture
- Course readings
- Web quests
- Group exploration
- Group presentations to the larger class
- Podcasts or video files available online
- Learner membership in online communities in a particular subject matter
- Learners contacting experts in the field via email or interview (Skype, for example)
- Collaborative wikis with other educators
- Blogs as reflective journals
- Contribution to Wikipedia to ensure accuracy
- Use of social book marking to connect with other disciplines and related concepts (the creation of a personal learning network or web)

This list is only a starting point. Educators can add, refine, and adjust the balance of instructor presentation with learner exploration in a manner that works best for a particular course. Enlarging learning opportunities to include online resources provides a richer, connected model of learning that often permits learners to stay connected to a community even after completing a course or program.

Teaching and learning activities

Teaching and learning activities fall into four areas:

- Dissemination – the provision of key material relating to a particular course. Through lectures, video, readings, audio recordings, and more recently, simulations, learners are exposed to the key components of a course. Whether handled in a traditional presentation model (like a lecture) or with more recent approaches (which begin to blend content presentation with learning activities, such as problem based learning)

- Discussion – in a teaching context, involves direct learner to educator contact (learner to learner discussion is classified as a learning activity). This dialogue is important to move learners toward higher order thinking, or what corporations are increasingly calling “deep smarts” – a combination of experience and sustained participation in a particular field of study.

- Discovery – directly involve the learners in “doing” – as individuals or as a group. The activities generally arise from the content within a course. The purpose of a learning activity is to assist learners in forming deeper understanding of subject matter. A biology lab, for example, involves the practical (and thereby, more meaningful) application of textbook theory.

- Demonstration - is often perceived as separate from the act of teaching. However, assessment can provide valuable additional learning. Through the use of formative assessment techniques, learners can self-assess their understanding, and instructors can evaluate their teaching approach.

When contrasted with the activities of the mechanical, electronic and digital eras, these four activities are achieved in different ways and with the prominent tools of each era.

	Mechanical age	Electronic age	Digital Age
Dissemination Presentation teacher to learners.	Course content provided by the teacher using the blackboard and the textbook. Delivered through lecturing and talking. Students take hand written notes. Prepared notes handed out (typewriters, stencils, gestetner, mimeograph).	Course content provided by the teacher using overhead projectors, slides, films and the textbook. Delivered through lecturing, talking and presentation. Students take hand written notes. Prepared notes handed out (electronic typewriters, Xerox).	Course content provided by the teacher using PowerPoint, web sites, cds, dvds, videos, computer applications, and the textbook. Delivered through lecturing, talking and presentations. Students take notes on laptops or PDAs. Prepared notes made available on the network.
Discussion Communication from teacher to learner and learner to learner.	Talk to teacher in class, or during office hours. Talk to students outside of class. Write a letter. Mechanical media limit the speed and geography limits the scope.	Telephones expand the speed (instantaneous) and remove geographic limits but introduce a mediated experience.	Learners have direct and instant access to a range of communication tools and applications from email, bulletin boards, chat, social networking, webcams, voip using a wide range of devices, mobiles, gaming platforms, computers. Geography no longer a barrier to communication. All communication mediated.
Discovery Discovery encompasses all those activities that learners engage in to expand their learning beyond the classroom. These may be scheduled activities such as experiments, labs, field trips, or independent investigation - research.	Additional course content available through the library. Science labs, experiments, and field trips are scheduled as part of courses.	Experiments use electronic equipment.	Learners have direct and instant access to a range of resources and learning activities that far exceeds what is found in the classroom: web searches, database searches, digital resources, virtual laboratories, simulations, virtual environments, augmented reality. Libraries become a secondary source of information as they are constrained by speed, scope and scale (although the Library 2.0 movement is trying to address this).

Demonstration Demonstration is most often seen in the form of formative and summative assessment. Assessment activities are designed to demonstrate mastery or understanding.	By learners in labs, tests	Increased use of technology in demonstrating competence (similar to instructor use of technology to teach)	Online labs (MIT), move to authentic assessment, eportfolios

Teaching in online environments increases the workload and responsibilities for many educators as new conceptual views and technical skills are required. Isolation and depersonalization impacts educators as well as learners, creating concerns about burnout in online faculty[79]. Most academic considerations of engagement focus on learners and ignore the needs of faculty. Opportunities also exist for organizations to utilize social software to also improve the faculty sense of connectedness to peers.

IRIS Model of Moving From Innovation to Systematization

The process of innovating differs from the process of systematizing learning innovations (see Image 9). Innovation is concerned with exploring "what is possible" and pushing the boundaries of existing practices and views of teaching and learning. To determine the impact and suitability of innovations in various educational contexts, a cycle of research and implementation must be employed. During these stages, educators are focusing on answering questions like "how does it work?" and "what is the real world impact?". Insight gleaned from research and implementation then leads to the formulation of a systemic approach to duplicating teaching and learning. Confusion often results in organizations when an innovator expresses "what is possible" and is met with an organizational response of "we can't duplicate that". Innovations expand what is possible, but in most cases, before broad implementation, additional research and contextual analysis is required.

Image 9: *IRIS model of learning technology implementation*

Media and technology

A transition from epistemology (knowledge) to ontology (being) suggests media and technology need to be employed to serve in the development of learners capable of participating in complex environments.

A quick review of media selection and design-related concerns provides a glimpse of current thinking in media and technology:

- Cognitive load theory states that brains process different media differently (even by different channels – i.e. audio and images), resulting in "instructional implications of this interaction between information structures and cognitive architecture"[80].

- A focus on "perception and action rather than memory and retrieval" produces a "very different conceptualization of instructional design"[81]. Using technology for active learning requires different approaches than when used for knowledge acquisition.

- Complexity of situated learning is reflected in the view that "real-world situations are much more complex and ill-structured than most instructional systems reflect, and that these underlying biases and assumptions in the design of instruction lead to poor learning"[82]

- To be successful in implementing educational technology, designers and educators must balance learning needs, context, and affordances of tools[83]. Selecting one media format over another is not sufficient. Holistic views of media, learners and context are required.

- Instead of emphasizing media and technology selection (as tied to particular learning outcomes or intended tasks), contextual analysis may be a more critical first task[84].

- Problems arise with online learning in universities when there is a "lack of fit between a policy and its context, namely, the organization and the actors within it"[85]. Even universities advocating use of technology have a limiting barrier in place (bureaucratic procedures for setting up an online course, limited student support resources, lack of a strategic plan for technology use).

- The traditional role of education as planned enculturation is at odds with the view that knowledge emerges "as human beings participate in the world"[86]

Media: A vehicle or an influencer?

Theorists have debated media effectiveness from two opposing views:

1. That media do not influence learning and are "mere vehicles that deliver instruction"[87]. Methods employed by designers are of primary importance.

2. That media do influence learning as they have certain "cognitively relevant characteristics" and may influence the "ways learners represent and process information"[88].

Recent research in multimedia learning suggests that tools do influence learning because the human brain processes different media in different ways[89], supporting the cognitively relevant characteristics of media and technology.

Affordances

An affordance is the action potential of a technology, where "attributes of something in an environment" relates to "an interactive activity by an agent"[90]. This view of media seems to better account for the range of technologies available today and their potential uses.

Transactional control suggests that given a choice in the selection of software and processes, learners, may fulfill "a teacher role of providing control over the learning trajectory"[91]. In contrast to designed learning paths, social software that facilitates interaction with peers, has the potential to provide emergent learning paths.

Many media formats are available to designers of learning materials (for elearning, classroom learning, or any stage on the continuum). Selecting media requires determining the most effective manner to presents the learning material and foster interaction in order to achieve intended learning goals.

Process

The following are the steps involved in selecting media type to achieve learning outcomes:

1. **Clarify the learning intent**. What will the student be required to do/demonstrate/produce at the conclusion of the lesson/module/unit?
2. **Evaluate media affordances** - What is possible with different technologies, given the current context.
3. **Select media** based on availability, expense, time, expertise, and general considerations (bandwidth, technology (i.e. do learners have video/sound cards))

In addition to matching the affordances of particular media to the requirements of a particular learning activity, the characteristics (and context) of learners must also be considered[92].

Media characteristics need to match the requirements of the learning outcome. In some cases, circumstances (time, expense) may not allow the selection of the most desirable technology, but a clear understanding of learning activities and media traits can still ensure quality learning.

Effective learning is linked to media characteristics and learning context. It is useful to remember that sometimes, text is still the best way to learn, and that no tool is perfect for every situation.

Text

Text is the venerable back bone of learning. Paper, digital, manuals, online chats, discussion questions, blogs, and wikis are examples of text. For most learners, this is still the area of greatest comfort (possibly because they've spent decades in text-based learning). With elearning, text still remains central but can easily be enhanced through simple graphics and audio. The biggest benefit of text: surveyable and portable. Drawback: it's overused and abused.

Positives	Negatives	Uses
Surveyable	Overused	Simple to complex
Easy to produce	Passive	learning activities
Low bandwidth	100% learner motivation	Suited to synthesis/
Familiar	Time lag	evaluation
Many readers		Ideal for reflection
Not much specialization		

Audio

Audio has been a component in distance education for decades. Many colleges/universities had departments strictly focused on duplicating audio resources for distance learners. Today, podcasts have revived interest in audio for learning. Tools such as Skype are valuable for instructors to hold two-way audio-based learning sessions. Voice-to-text translators allow learners with underdeveloped typing skills to contribute more to text chats. Audio pronunciations (foreign language terms) can also be very useful for learners. Biggest benefit: auditory learners/speed.

Drawback: learners can tune out.

Positives	Negatives	Uses
Two-way interaction Enrich a text only course Useful for explanations, accessibility, pronunciations Great for auditory learners Speed – faster than typing (and less inhibitive)	Easy to tune out **May** need professional "voice" Extended audio needs to be indexed – time/expense	Across spectrum Presentation Explanations Dialogue Analysis Synthesis

Visuals

The Internet is a visual medium, and as bandwidth improves, it will become more so. One of the biggest values of visuals is the ability to liven up existing text through the use of graphics, diagrams ("picture is worth a thousand words"), and digital pictures. Flickr and web-based photo sharing are popular uses of social media. Benefit: visual learning. Drawback: expense/quality trade off.

Positives	Negatives	Uses
Abundance Low cost (if using clip art/digital camera) Versatile – use for any learning task Low bandwidth (if done right) Enrich learning material	Can be poor quality Motion/animation can be expensive Time consuming Involved if using graphic artist	Digital pictures Graphics – Internet Graphic artist – designing Enriches text – "picture is worth a thousand words" Animations

Video

Digital, streaming, and two-way video over the Internet offer distance education opportunities to improve the quality and personalization of the learner experience. Services such as YouTube and blip.tv allow instructors to easily share video introductions to new courses or demonstrations of lab setups, etc. Benefit: visual/personal. Drawback: can be expensive, especially if professionally produced.

Positives	Negatives	Uses
Visual Personal medium Many viewers/large audience Detail complex tasks Ability to review Increased variety – CD, Streaming	Specialized team – i.e. producer, editor, camera Expensive Not easy to modify Sequential, difficult to survey Passive	Demonstrations Explanations Lecture Complex – i.e. whiteboard – physics problem solving Two way (expensive) – instructor observes student

Games and Simulations

Games and simulations promise effective, engaging, and situated learning. Benefit: re-usable, self-paced. Negative: simulations are expensive to create and virtual worlds (such as Second Life) can be complex, requiring time for new users to acclimate.

Positives	Negatives	Uses
Simulation Self-paced Re-usable Team based Memorable Game-like – "edutainment"	Expensive Time consuming Complex to design Team based Added complexity for learners	Demonstrations Knowledge Broad knowledge Practice complex skill in safe environment Synthesis

Lectures: F2F or Online

Classroom lectures are a prominent fixture of education. Now with the tools such as Elluminate, Articulate, Camtasia and Adobe Connect, similar interaction can occur over the Internet. Benefit: effective and familiar. Drawback: expense

Positives	Negatives	Uses
Highly interactive Familiar – students and instructors Effective Proven history Can incorporate other media	Only synchronous Expensive No "knowledge" trail (classrooms) Limited audience size Not surveyable	Full spectrum of learning Main determinant of success is the skill of the instructor

Integration

Each media type and format has its own strengths and weaknesses. Yet, using the media with affordances that are mismatched to intended learning tasks can be a frustrating experience for the learner. Proper integration of media formats presents students with rich, varied learning, and minimizes the weaknesses of each format.

Positives	Negatives	Use
Combine best features, minimize weaknesses Enriched learning Asynchronous Synchronous	Instructors have to combine tools to achieve outcomes "Ideal" elearning tool doesn't exist yet Complexity High skill required	Various learning and opportunities

Change cycles and future patterns

It is not uncommon for theorists and thinkers to declare some variation of the theme “change is the only constant”. Surprisingly, in an era where change is prominent, change itself has not been developed as a field of study. Why do systems change? Why do entire societies move from one governing philosophy to another? How does change occur within universities?

Change is rarely a linear process. Reflecting on major revolutions (French, American, and Industrial) a pattern of the characteristics of change emerges. Change is a process of reacting to pressures, catalysts, pushback, and negotiation (see Image 10).

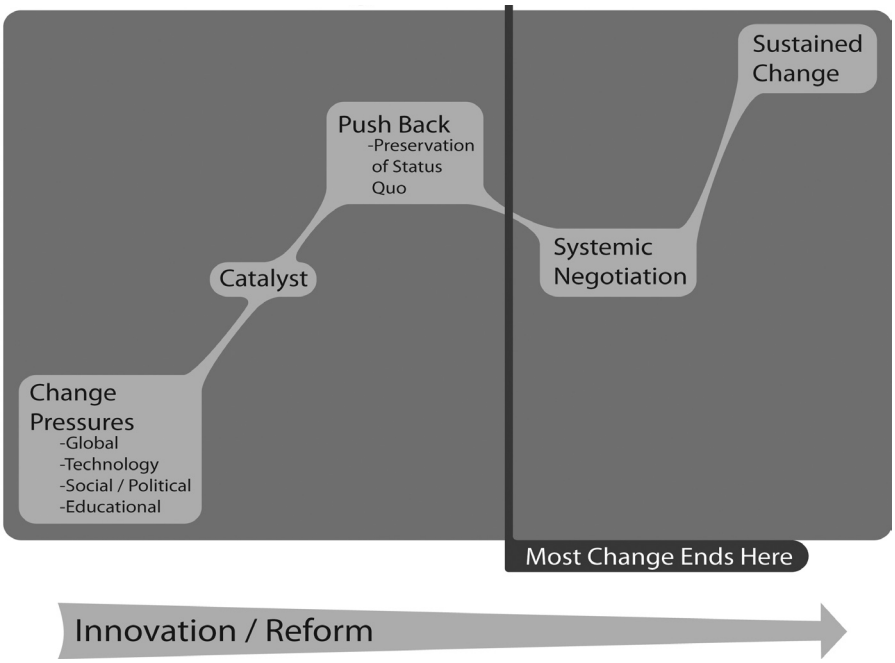

Image 10: Cycles of Change

1. **Change pressures** – change is ongoing. In most instances, organizations are able to adapt to change without systemic redesign. For example, universities have to date adapted practices to reflect changing external environments through use of learning management systems and in-classroom technologies (LCD projectors, PowerPoint).

2. **Catalyst** – periodically, change pressures are of such a substantial nature that a catalyst can set off a cascade effect of reforms, ultimately transforming an entire system. When external environments (political, economic, social, and technological) are fundamentally different from the design of organizations, accommodation is no longer possible. Systemic change is required. The political, industrial, and social revolutions of the 18th century in America and Europe are illustrations. Monarchical models of government were incapable of meeting the growing democratic calls of the French population. Colonial rule was fundamentally opposed to the desire of self-governance in America. Catalysts can occur rapidly (such as an event that mobilizes a population) or slowly over a period of many decades (such as the industrial revolution).

3. **Resistance** – a catalyst for change calls into question existing practices and organizational design. Those with power are reluctant to acquiesce. Resistance to new or transformative approaches can be expected. Resistance may involve attempts to control through legal, political, or financial means. The music and recording industries sought first to control innovation, and have only more recently reacted with fundamental change (Hulu embodies

the spirit of experimentation in response of disruptive trends in the traditional field of television programming).

4. **Counter pressures** – many change initiatives are slowed, or even halted, due to resistance by those with existing power and control. However, when change pressures are of a significant level, resistance is at best a temporary setback (consider the re-establishment of the French monarchy for a short period in the 19th century). As organizations and individuals align practices and systemic design with the nature of external factors, transformative change is enacted.

5. **Sustained change and innovation** – sustained change and innovation is a by-product of periods of uncertainty, where systems react to, resist, and respond to change pressures. Broad scale changes - where societies and corporations morph into new entities - are rare. When they do occur, a period of uncertainty and even confusion ensues. Organizations built on existing value generation models (such as General Motors, newspapers) must conceive a new role and a new identity. For many, this change is difficult as existing mindsets prevent the recognition of a new value basis. Some organizations, like IBM in the 1990s, are able to create a compelling vision of the future as well as a strategy of response. Most, however, are bypassed due to their inability to respond to disruptive changes.

Current trends – globalization, economic turmoil, creative work and the networked design of organizations, are exerting pressure on organizations to rethink their approach to learning. The catalyst for systemic reorganization of learning and development may be found in the current constellation of change pressures. Resistance and counter pressures will be mounted, but reorganization – either by recreating our field or being subsumed by another - as a response to major trends seems likely.

Process of Education

Higher education offers three value points for learners (see Image 11):

1. Content
2. Interaction
3. Accreditation

Academic institutions often post education content online without charge (open educational resources). Interaction around educational content is occurring, with increasing frequency, in online forums, blogs, online conferences, and virtual worlds. Given the free and open nature of online learning opportunities, accreditation is, for now, the last competitive value point universities provide for learners.

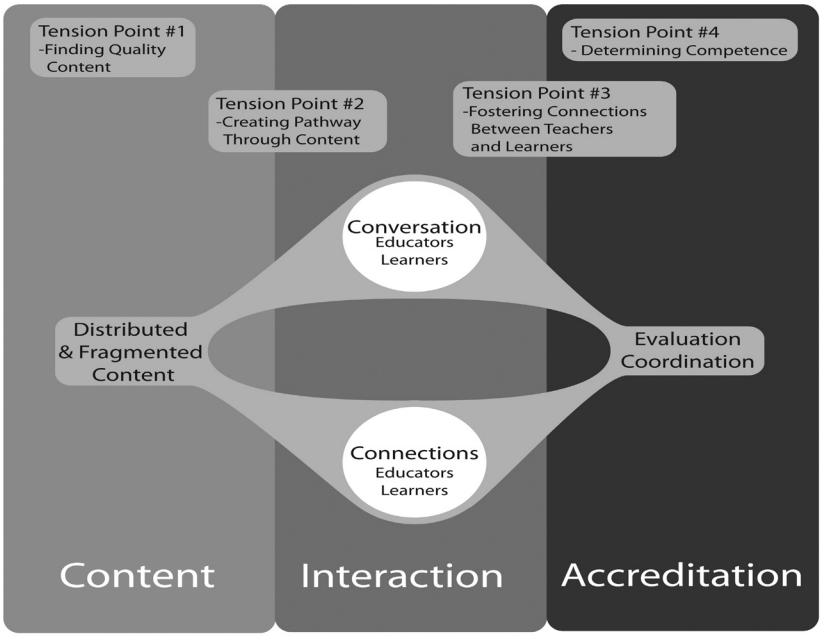

Image 11: Content, Conversation, and Evaluation

New Learners? New Educators? New Skills?

Moore argues that fluency with technology must be linked to specific disciplines. The implication is that disciplines and their specific content might use technologies in varying ways for learning: "in order to use domain-specific digital information in beneficial ways, students must simultaneously demonstrate (technological fluency) and information literacy related to domain competencies."[93]

National Survey of Student Engagement's 2007 report advocates for high impact activities where learners "interact with faculty and peers about substantive matters"[94]. High impact activities increase learner engagement and results in greater success in learning. EDUCAUSE Center for Applied Research reports many younger students prefer an appropriate balance of technology and face-to-face contact with faculty[95]. Even though technology enables greater learner control and autonomy, learners generally value social contact and faculty guidance, especially when entering a new field or course of study[96]. A model of learning is required that addresses the apparent dichotomy between faculty guidance and learner self-direction.

Are younger learners different from previous generations? While younger learners often use more technology, existing research[97], [98]does not support the notion that learners differ based on generational distinctions.

Being Literate

Calls for reform to the balance of power between educators and learners have been made by numerous theorists and activists, including Dewey[99], Friere[100], and Illich[101].

In online environments, personal agency on the part of learners - "to influence intentionally one's functioning and life circumstances" [102]– is particularly important. The cues and guiding elements of physical environments and traditional academic schedules are often lacking online.

New literacies (based on abundance of information and the significant changes brought about technology) are needed. Rather than conceiving literacy as a singular concept, a multi-literacy view is warranted[103]. Use of aggregators, reading and visualizing data, mashing up various types of information, and recognizing new patterns in existing information are key skills.

Additional key skills required today include[104]:

Anchoring	Staying focused on important tasks while undergoing a deluge of distractions.
Filtering	Managing knowledge flow and extracting important elements.
Connecting with each other	Building networks in order to continue to stay current and informed.
Being human together	Interacting at a human, not only utilitarian, level…to form social spaces.
Creating and deriving meaning	Understanding implications, comprehending meaning and impact.
Evaluation and authentication	Determining the value of knowledge…and ensuring authenticity.
Altered processes of validation	Validating people and ideas within an appropriate context.
Critical and creative thinking	Questioning and dreaming.
Pattern recognition	Recognizing patterns and trends.
Navigate knowledge landscape	Navigating between repositories, people, technology, and ideas while achieving intended purposes.
Acceptance of uncertainty	Balancing what is known with the unknown…to see how existing knowledge relates to what we do not know.

Contextualizing (understanding context games)	Understanding the prominence of context…seeing continuums… ensuring key contextual issues are not overlooked in context-games.

Minimal or guided learning?

Kirschner, Sweller & Clark question the tenets of problem-based learning[105], highlighting the unsettledness of the debate between instructor or learner control in learning activities. They argue that the constructivist views of learning are accurate, but the "instructional approaches suggested by constructivists" are not necessarily effective. Of particular concern for the authors of the paper is the degree of instructor (or expert) presence during the learning process. They assert that minimal guidance is not as effective as guided instruction due to different approaches evident in how experts function (epistemology) in a domain and how learners best learn.

Gardner states that the distinction between an expert and novice is found in the how information and ideas are related to each other: "But shorn of their connections to one another, to underlying ideas, to a disciplined way of construing this pile of information, facts are simply "inert knowledge""[106]. The conceptual network of an expert is more richly connected, nuanced, and diverse than that of a novice.

In contrast with strong guidance, Sugata Mitra details an experiment he conducted in India (now commonly known as the "hole-in-the-wall" experiment) where he placed a computer with an Internet connection in a wall facing a ghetto[107]. Within days children aged 6-12, with minimal education and limited understanding of English, were able to browse the web and perform other tasks – such as drawing - on the computer. The self-taught, minimally-guided nature of the experiment led Mitra to the conclusion that children do not require direct instruction to acquire basic computer literacy skills.

Research by Darken and Sibert on "wayfinding"[108] explores a similar theme of the learner-in-control approach to learning; how participants in large virtual worlds orient themselves in their environments in order to achieve certain tasks or arrive at certain locations. With wayfinding, the effectiveness in achieving objectives for learners/participants is determined by the design and incorporation of environmental cues. Whether self-directed and initiated (Mitra's research) or aided through advance consideration of design (Darken and Sibert), it is clear that many learning objectives can be achieved without direct guidance.

The concern of minimal guidance in learning is compounded by the growth of online content created by amateurs. The criticisms levelled at knowledge sources created by the self-organizing "masses" are often applied to the concept of learner-directed activity. Two significant challenges arise when considering learning as being largely under the control of learners themselves. The first is generally found in some variation of "how will the learners know what they need to know?". The second relates to the rapid decentralization and distribution of most of societies channels of communication - newspapers, television, radio, and, more recently, academic publishing – and raises concerns of how learners are to make sense of information in a field that is fragmented and distributed, rather than well organized and coherent (such as information found in a traditional textbook).

Personal learning environments (PLEs) offer a future model of learning that incorporates a greater range of tools, largely under the control of the individual. PLEs are "not a piece of software...[but] an environment where people and tools and communities and resources interact in a very loose kind of way"[109].

The Role of Educators in a Networked World

The role of the educator and the process of instruction have been under pressure to change for over a century[110]. While camps, as discussed, often fall into conflict on principles of minimal or

guided instruction and instructivism or constructivism, the nuanced and complex nature of learning suggests each approach may have value in different contexts.

Several educators have put forward models of educator and learner roles and interaction in a technologically enabled era:

- John Seely Brown's notion of studio or atelier learning
- Clarence Fischer's notion of educator as network administrator
- Curtis Bonk's notion of educator as concierge
- George Siemens' notion of educator as curator

Atelier Learning

John Seely Brown draws inspiration for his atelier model of learning from artists and architects and describes learning as "enculturation into a practice"[111]. An art studio is generally an open space where students create their paintings, sculptures, and other art forms in full view of fellow artists. The "master" is then able to observe the activities of all students and can draw attention to innovative approaches. Students are not limited to learning based solely on the expertise of the instructor. The activities of all students can serve to guide, direct, and influence each individuals work. Blogs are particularly amenable to the atelier model of learning. For example, a class on creative writing – where each students posts their work in their own blog – permits the educator to highlight (and comment on) exceptional instances of writing. Students are able to read each other's work and gain insight from both instructor and their fellow students.

Network Administrator

Clarence Fisher, blogger and classroom teacher, suggests a model of "teacher as network administrator"[112]: Just as our mind is a continuously evolving set of connections between concepts, so our students and their learning can become placed at the centre of a personal learning network which they construct with our help. Helping students to gain the skills they require to construct these networks for learning, evaluating their effectiveness, and working within a fluid structure is a massive change in how the dynamics of classrooms are usually structured.

In Fisher's model, a primary task of the educator is to assist learners in forming connections and creating learning networks. As learners encounter new information sources, they are encouraged to critically evaluate the source's suitability as part of a holistic and diversified learning network. Gaps in the learning network are addressed by both learner (self-directed by active participation in the network and through self-reflection) and educator (through evaluating, with the learner, the nature and quality of the learning network (external) and how key concepts are related and understood (conceptual)).

Concierge Learning

Curtis Bonk presents a model where the educator is a concierge directing learners to resources or learning opportunities that they may not be aware of. The concierge serves to provide a form of soft guidance – at times incorporating traditional lectures and in other instances permitting learners to explore on their own. He states:

> We need to push students into the many learning possibilities that are ripe for them now. Concierges sometimes show you things you did not know were available or possible. Teachers as concierges can do the same things. We need to have quick access to such resources, of course, but as this occurs increasingly around the planet, so too will we sense a shift from prescribed learning checkboxes toward more learner designed programs of study. Now the Web of Learning offers this chance to explore and allow teachers to be their tour guides[113].

Curatorial Learning

Curatorial Learning[114] acknowledges the autonomy of learners, yet understands the frustration of exploring unknown territories without a map. A curator is an expert learner. Instead of dispensing knowledge, he creates spaces in which knowledge can be created, explored, and connected. While curators understand their field very well, they don't adhere to traditional in-class teacher-centric power structures. A curator balances the freedom of individual learners with the thoughtful interpretation of the subject being explored. While learners are free to explore, they encounter displays, concepts, and artifacts representative of the discipline. Their freedom to explore is unbounded. But when they engage with subject matter, the key concepts of a discipline are transparently reflected through the curatorial actions of the teacher.

Blending Expertise and Learner Control

The four models presented above share a common attribute of blending the concept of educator expertise with learner construction. The concerns of instructivist and constructivist education are addressed in the focus on connection forming in learning. Whether seen as master artist, network administrator, concierge, or curator, the established expertise of the educator plays an active role in guiding, directing, and evaluating the activities of learners.

Sensemaking, Wayfinding, and Pattern Recognition

Knowledge is not only internally held and socially negotiated, but a function of context, voice (annotating the work and thoughts of others), and distributed across the networks we create. Knowledge, therefore, does not neatly fit into traditional taxonomies (innate, interpreted, or constructed), but functions instead across a larger more complex (and interdependent) cloud.

Taxonomies are the fertile soil of dogma. To resist classifications and constructions is to enlarge the potential for new understandings reflective of the challenges experienced by learners and educators today. "People think together and engage in collaborative activities by continuously trying to understand each other's motives, understanding and ideas"[115].

Sensemaking Tools

Sensemaking is not a task of isolation. It is "an emergent property of social interaction"[116]. Our ability to created shared patterns of understanding attest to the social nature of making sense of our world. Due to advancements in technology and global consciousness software itself can now create a space where the connections between entities cease to be simply a conduit for information, but become part of the sensemaking space.

As a simple metaphor, an oil pipeline serves the function of transporting oil. It is valuable only to the degree that it delivers oil. Today's social software tools add an additional dimension beyond transporting information. These social tools have essentially become the space, not the conduit for sensemaking. The value of connections formed exceeds the value of the particular information and knowledge flowing through a network at a particular time. Unlike the oil analogy provided, software tools exist not to transport knowledge, but have become the value point themselves.

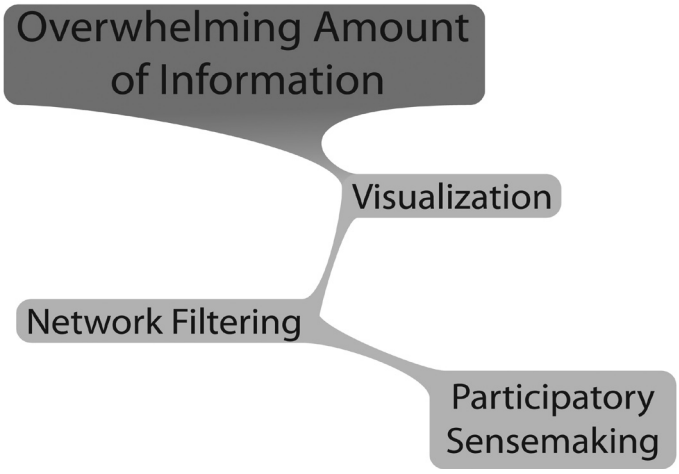

Image 12: Responding to information abundance

A few examples may assist in clarifying this concept. Individuals who read blogs often rely on feed readers (aggregator software which "visits" the blogs an individual has subscribed to, and returns any changes since the last visit). Feed readers permit individuals to follow dozens (even hundreds) of blogs. While the blogs selected are important to the reader, the real point of value rests on the creation of a personal learning network. The aggregated network of blogs and other news sources is the key element in learning – a framework for participatory sensemaking and network filtering (Image 12) - not the content experienced at a particular time.

Learning Activities

Littlejohn and Pegler in Preparing for Blended e-Learning outline five learning activity techniques based on Laurillard's Conversational Model. They produce the following matrix (reformatted)[117]:

type of learning activity	**what is it?**	**media forms**	**technique (how)**	**technologies**	**tools**
assimilative	processing narrative media - managing and structuring information	lectures, DVD's or reading texts	concept mapping, brainstorming, buzzwords, crosswords, defining, mind maps, web search	word processor, presentation software, text, image, audio, video	CMAP, Hot Potatoes, Google, Office Products, Social Bookmarking, Blogs, Wikis, Pageflakes, Google Reader
adaptive	an environment that changes according to learner input	simulations, games	modelling	virtual worlds, models, simulations, games	Second Life, MMORPG

communicative	discussing	asynchronous or synchronous discussions, chats, text messages	reasoning, arguing, coaching, debate, discussion, negotiation, performance	electronic whiteboards, email, discussion boards, chat, instant messaging, voip, video conferencing, web conferencing, blogs, wikis	online bulletin boards, skype, IM, Facebook, Social Bookmarking, Blogs, Wikis
productive	learners producing something	creating, producing, writing, drawing, composing, synthesizing, remixing, mashups	artifact, book report, thesis, essay, exercise, journaling, literature review, multiple choice questions, puzzles, portfolio, product, test, voting	creative applications (image editing, CAD, design software) computer aided assessment tools, electronic learning environments	InDesign, Photoshop, YouTube, Google Video, Office Software, Sketch
experiential	interactive activities that focus on problem solving	practising, applying, mimicking, experiencing, exploring, investigating, performing	case-study, experiment, laboratory, field trip, game, role-playing, scavenger hunt	virtual lab, 3D immersive environment	Google Earth, MMORPG, Second Life

New options to create and share information (through aggregation and visualization) have significant implications. How we as educators teach, present content, allow learners to interact with content, and how we keep content sources current require new approaches. For many educators, however, the task may appear onerous or too complex.

Tools like Google Alerts (which generate email updates of topics you are interested in or currently tracking) provide a starting point. Or perhaps setting up a NetVibes account and following a handful of blogs or journals in your field is a more suitable beginning point. If visual imagery is important, create a flickr badge to pull photos from an account into a web page.

Small scale experimentation - with high payback - can be motivating. Adopting and exploring additional tools and concepts is more inviting once you've had success with certain tools.

Thinning Walls and Extending Learning

Technology extends the classroom (see Image 13) walls and thins the structure of courses. Experts and resources outside of the university are readily available for educators to use for example, in a

psychology course directing learners to view a presentation of the Stanford Prison Experiment is much more vivid and meaningful than reading an article about the experiment alone. Technology can open doors closed by geographical distance or time.

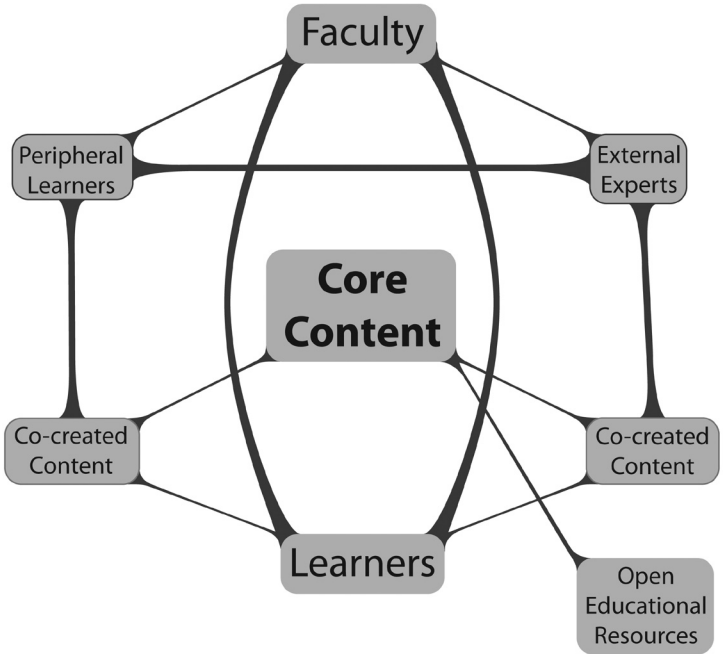

Image 13: Extending courses

Implementation

Planning the use of technology in teaching and learning requires consideration of numerous factors: context of use, traits and characteristics of learners, matching media format to intended learning activities, and so on. This section will explore key considerations for educators in planning, developing, and teaching with technology

Getting Started with Technology

New technology is adopted more rapidly when cast in the "context of...existing teaching and learning activities."[118] A simple framework of the traditional activities of teachers and learners serves as a useful starting point.

Teacher Role	Learner Role
Communicate	Read/listen
Assess	Present a point of view
Provide feedback	Search/collect/analyze information
Observe	Practice
Present information	Create
Organize activities	Respond

Each of the educator and learner tasks can be augmented through use of different technologies. For example, educators can provide a short lecture via a podcast, learners can respond to course materials through a blog post or through a short recording in a tool like Jing.

Planning technology use in your next course

The use of technology for learning and instruction requires demarcation between what learners can (and should) do for themselves and what the instructor (and designer) should do for learners. Traditionally, in a lecture format, the instructor provides motivation (scheduled class time) and content in pre-planned units according to the course's relation to the program of study. As information has become more public and distributed, the role of instructor as organizer and dispenser of information has shifted. Learners can readily access online lectures, articles, podcasts, and other resources to augment the information provided by the instructor.

Media have certain affordances which define their potential use. When applied to learning, certain activities can be utilized to greater effect when appropriate matching occurs between: the technology used, the learning desired, the context of use, the learner experience, the instructor experience, and the nature of content.

While designing a rich interactive software application to demonstrate key learning points may be desired, reality may dictate peer-to-peer discussions online are the main options due to budget constraints. Or, the use of an LMS might enable the management of content, but development time restrictions dictate the use of blogs combined with online lectures.

Planning the effective use technology for learning requires a careful:

1. Evaluation of context
2. Determining depth of technology integration
3. Attributes of technologies planned for use and suitability to subject matter (see previous discussion on media selection methods for promoting intended learning)

4. Evaluating planned technologies against principles of learning

Evaluating Context

Evaluating context requires a consideration of numerous elements and environments that influence both design and delivery of a particular learning task, activity, or program.

Traditional instructional design (ID) captures many of these elements (ADDIE, Dick and Carey, CDT (Merrill)). The very intent of instructional design, however, is its weakness – namely making explicit intended learning and planning clear, concise approaches to achieving intended outcomes. Clearly defined learning assumes "things won't change" (content, nature of interactions, changes in related disciplines which impact the information being discussed) between the point of design and the point of learning.

Instructional design has in the past been broadly concerned with designing the learning/experience and not as concerned with the environment or context. Yet, the context of learning is in continual flux - as presented by numerous learning theories – including situated cognition, activity theory, constructivism and connectivism. Participative technologies contribute to additional contextual fluctuation.

Consider, for example, frequently held views on ID analysis process[119]:

1. Needs assessment
2. Relevant characteristics of learners
3. Characteristics of work setting
4. Job, task, and content

These analyses then lead to the formation of learning (performance) objectives, determining measurements, sequencing, specifying instructional strategies, and designing instructional materials. The process is involved, detailed, and deterministic in orientation.

The Reality

In reality, however, most implementations of technology in classrooms are far less structured than dictated by instructional design. The previous experience of learners, world events, changes in technology, culture of a department, and numerous other factors strongly impact the effectiveness of the designed content and learning intended. Many departments (academic or corporate) do not subject learning design to rigid analysis and structured planning.

The development of new programs, training sessions, workshops, or courses (all terms which continue to carry the notion of start/stop learning which has long been the focus of instructional design) are served by flexible approaches as reflected in established research (though increased attention should be paid to context of implementation). For many learning environments, however, a less structured and more fluid approach is needed.

David H. Jonassen (1991) suggests a key point of failure in Instructional Systems Technology (IST) relates to "fundamental IST processes, such as task analysis, behavioral objectives, criterion-referenced evaluation and mathemagenic strategies all reflect a behaviorist tradition"[120].

Teaching for Learning

As discussed in the introduction, the use of technology for learning can be seen as a continuum with three key marking points:

1. Augmented – the course takes place in a traditional classroom setting, but technology is used to enhance the learning experience. The following are examples:
   a. Pre-readings or post-course discussions occur online
   b. Use of powerpoint to present content

c. Use of online self-review quizzes or interactive activities to allow learners to explore key ideas
d. Podcasts or video lecture recordings of experts in the field for learners wishing a deeper understanding of subject areas

2. Blended – the course takes place partly face-to-face and partly online. Examples include:
   a. Live online lectures with synchronous tools such as Elluminate, iVocalize, or Connect
   b. A face-to-face (f2f) class, with several weeks of online discussion, followed by a wrapup f2f class
   c. A short-term residency at the beginning (and middle or end) of a certificate or degree program, with the balance of learning activities occurring online.
   d. Course readings conducted before class time and lectures made available in podcast form, with reduced class time used for discussion of course content.

3. Online – the course takes place entirely online with no face to face contact. Examples include:
   a. WebCT, Blackboard, Moodle, or similar learning management system used for content presentation, interaction, gradebook, and other online activity
   b. Use of a blend of tools – blogs, wikis, Skype, discussion forums – to present content and foster learner-learner interaction
   c. Use of live online lectures with virtual classrooms (Elluminate) supporting either an LMS or blend of tools approach
   d. Use of podcasts, video lectures, and free online resources with either an LMS or blend of tools approach

What types of activities and resources are required for plan and organize new technology initiatives? Five important steps are involved for individual educators or larger department online learning initiatives:

1. Planning tools
2. Creating content
3. Planning for and fostering interaction
4. Evaluating learners and recording grades
5. Managing digital resources

1. Planning Tools and Inter-team communication

Developing online activities and resources requires consideration and planning.

A complete online learning development team would consist of (Image 14):

- Instructional designer
- Graphic artist
- Programmer
- Media specialist (audio/video)
- Subject matter expert
- Usability specialist

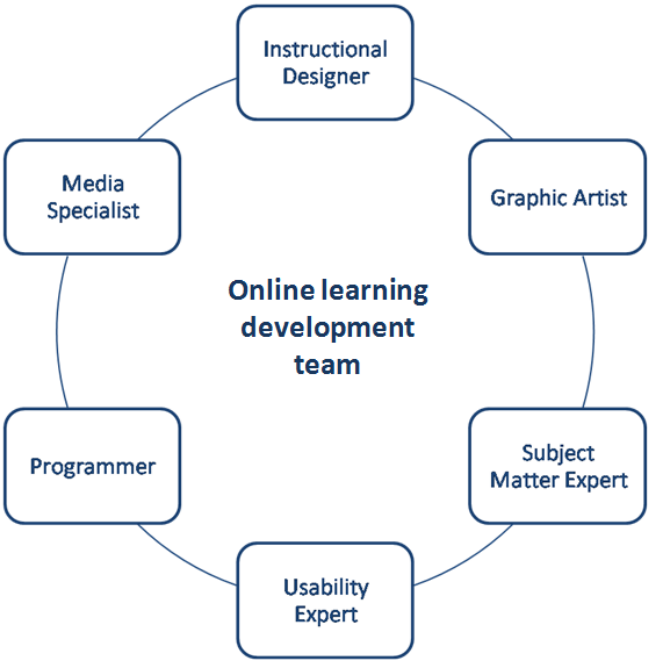

Image 14: Online Learning Development Team

To coordinate the activities of different team members, planning tools and communication guidelines are critical. Most learning and technology projects, however, will not be initiated with a full development team. Regardless of whether the development team consists of a single faculty member or a learning development team, planning tools are important in ensuring deadlines are met.

Beyond ensuring achievement of goals and meeting deadlines, project management tools serve to create a knowledge trail for subsequent development (or developers), project costing (based on resources used and hours required), and determination of contributions from other departments, faculties, or resource providers.

When using a project management approach to learning activity and resources development, it is particularly important for an individual to be assigned to maintaining the project timeline and ensuring goals are consistently met. Teams also require clear communication in terms of meetings, responsibilities, and project protocols (communication, budget codes, decision making).

Even small single-course technology implementations benefit from the development of project guidelines and timetables. Upfront planning and resource considerations can significantly increase the likelihood of project success.

2. Creating (and finding) Content

Tools for creating content for online learning have improved significantly over the last few years. Articulate Presenter, Audacity, Engage, Flash, Jing, and Camtasia are tools that novice users can master in a short period of time.

In addition, the increased proliferation of freely available online learning resources provides an opportunity for educators to link to, rather than create, many educational resources. Projects such as MIT's OpenCourseWare initiative, Connexions, OpenLearn, and others often provide excellent materials, videos, or podcasts. Additionally, textbook publishers often provide valuable tutorials or simulations.

3. Planning for and fostering interaction

The prominence of social technologies has created an opportunity for educators to increase the level of learner-learner and faculty-learner dialogue. Interaction can occur around ideas, content, or simply open discussions. Supporting online learning, like the development of online courses, requires a team-based approach, consisting of (Image 15):

- Instructors
- Technology support
- User-accessible help resources (such as tutorials)
- Tutors
- Learning development support (to provide learners with remedial or learning skills development support)
- Administrative support (grades, enrolment, course status)

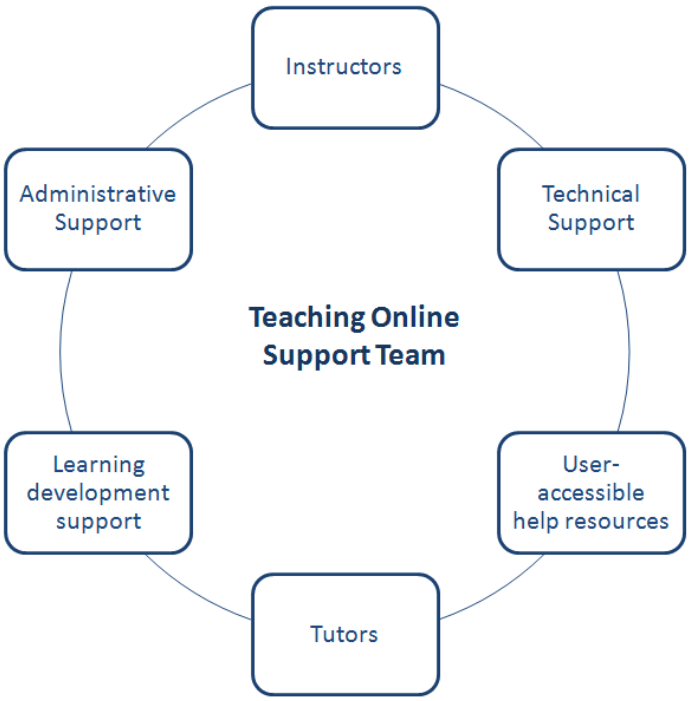

Image 15: Teaching Online Support Team

4. Evaluating learners and recording grades

Many learning management systems offer basic testing/quizzing tools as well as a gradebook for instructors to record learner performance. Other tools (such as Grademark: http://www.turnitin.com/static/grademark.html) often integrate with existing LMS software.

Articulate Quizmaker (http://www.articulate.com/products/quizmaker.php) allows simple Flash-based quizzes, and tools such as Mobile: PodQuiz Maker: http://podquizmaker.com/ or iQuizmaker: http://www.iquizmaker.com/ allow educators to create quizzes for mobile devices.

Gradebook tools which integrate with existing LMS' are particularly valuable in managing student progress (especially when integrated with campus-wide student information system).

5. Managing digital resources

Management of digital resources is an important consideration often overlooked by elearning developers. Numerous open source and proprietary software tools are available to assist in this process. A few considerations:

- Plone
- Atutor
- Microsoft CMS
- Eedo Force Ten
- DSpace

Content management systems, when implemented across a department or institution, can eliminate duplication of content and increase access to resources when needed. Many academics, however, are reluctant to contribute personal resources to publicly-available repositories.

Tools

Frameworks for Sense Making

Frameworks are often utilized to give shape and form to nebulous ideas and concepts. Even a few days spent reading literature on emerging learning technologies reveals an overwhelming array: Twitter, blogs, wikis, podcasts, identity and presence tools, synchronous classrooms, and so on. Making sense of these tools requires a framework. Making sense of the information that flows through these tools requires yet another framework. And, using these tools for teaching and learning requires a third.

Frameworks are a particular way of seeing. As such, a framework is incomplete – it fails to capture a holistic perspective. While this is an inconvenience, it is necessary to take a certain perspective in order to begin to make sense. A holistic perspective is perhaps largely unattainable, but can be approached through the use of multiple perspectives. For the purpose of this text, new tools will be presented based on how they contribute to the changed information cycle.

Defining Social Software

A defining trait of social software today is the ability to *speak into the context others have created*. For example, a newspaper editor is able to project a certain voice (i.e. the slant of a publication) on political or social events. Feedback from readers is limited to letters to the editor – a context again controlled by the editor. Social tools permit individuals – through annotations (PLoSOne, StumbleUpon) and discussions – to have a voice. The ability to speak directly into the context of others reshapes and redistributes power in message control.

New technologies can be grouped by their affordances – action potential – in six categories (see Image 16):

- **Access** resources
- Declare or state **presence** (as currently online or in declaring physical proximity through GPS)
- **Expression** through tools such as Second Life or profile features of most social networking site
- **Creation** of new content and resources through blogs and wikis
- **Interaction** with others through asynchronous and synchronous tools like discussion forums, Twitter, Skype, ELGG
- **Aggregation** of resources and relationships through Facebook, iGoogle, or NetVibes.

Each tool possesses multiple affordances. Blogs, for example, can be used for personal reflection and interaction. Wikis are well suited for collaborative work and brainstorming. Social networks tools are effective for the formation of learning and social networks. Matching affordances of a particular tool with learning activities is an important design and teaching activity.

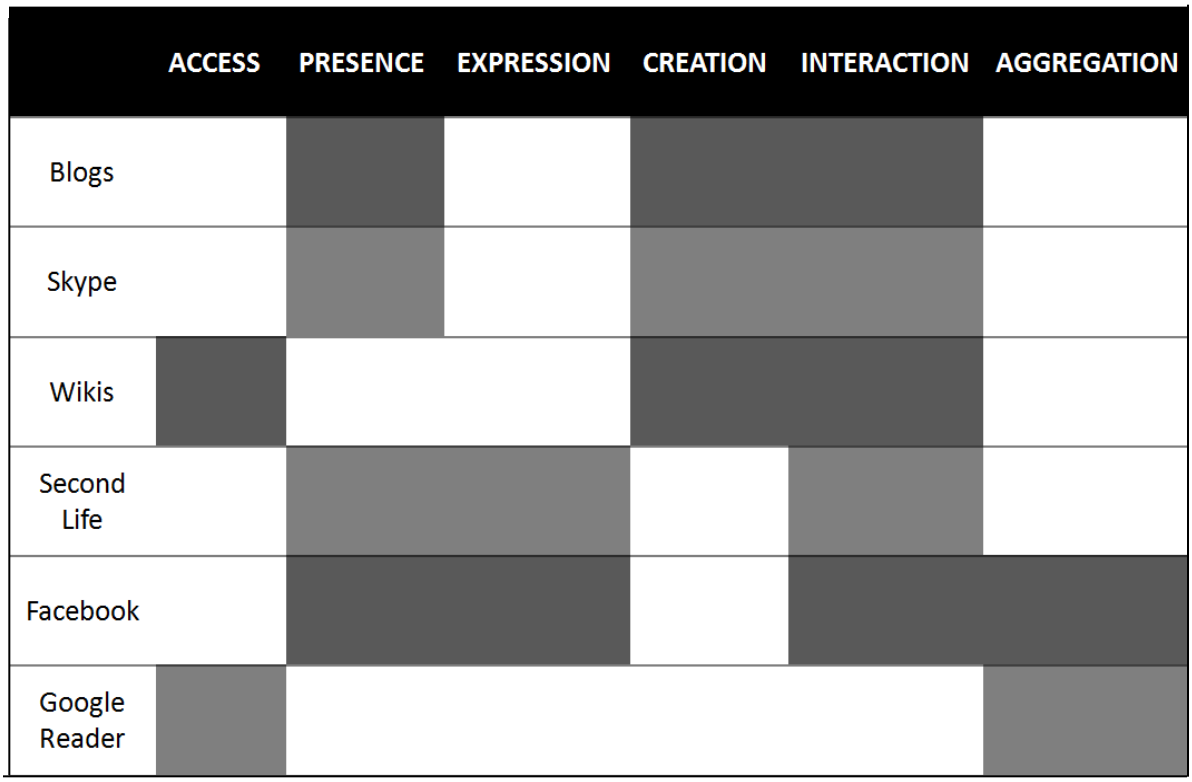

Image 16: Affordances of emerging technologies

Blog

What is it?

A blog is a basic web page with posts presented in reverse chronological order. Posts can be retrieved via an RSS reader (such as Google Reader), negating the need to visit the blog.

Google uses its blog to communicate new products or offerings. CNN uses blogs as an alternative news source. NASA has a launch blog. Well known people like Dave Barry, Scott Adams (Dilbert), and Tom Peters use blogs as well. Even the president of Iran has a blog. Blogs figured prominently into the last American president election, providing candidates with another venue to connect with voters.

The simplicity of blogs is deceptive. Blogging enables unique opportunities for educators to improve communication with (and between) learners, increase depth of learning through reflection, and enable the formation of diverse viewpoints and perspectives. Perhaps most importantly, they enable educators to connect with each other.

How does it work?

Prospective bloggers can sign up with an online services – such as Blogger or Eduspaces – or download software to a server and host their own blog (Movable Type or Wordpress).

Posts can be made through a desktop application (such as Microsoft's Live Writer) or through the interface accessible with a web-browser.

Blogs generally allow readers to provide comments. Due to spam, many bloggers use anti-spam measures such as holding comments in moderation or requiring commentators to enter information (often a captcha) to verify a person, not a script, is entering the comment.

How can it be used for teaching and learning?

Blogs are simple tools for learners and educators to use in teaching and learning. Educators can use a blogs to update learners on course activities, post reflections on in-class or online conversations, and to share journal articles and related course resources.

Learners can use blogs to reflect, connect with others, use as an e-portfolio or journal, and comment on important posts made by other learners.

Wikis

What is it?

Wikis - or more broadly, collaborative writing on the web- have captured the interest of business leaders and academics. Well known, and increasingly referenced, is Wikipedia.

A wiki is basically a simple web page that anyone can edit. At least that's the standard description or what wikis were when first started. The openness of wikis has encountered the reality of human behaviour (or more precisely - spam). Wikis are chaotic, informal knowledge spaces. Wikis enable individuals to create a collective resource. Whereas blogs enable individual voices, a wiki over-writes individuality.

The messiness of wikis can be intimidating to newcomers. Why do people contribute? What motivates individuals to spend time editing and proofreading sites? What about vandals who simply delete text? But wikis are not without governance or management. Wikipedia has extensive resources available on how to handle concerns arising from community conflict. Democracy and

openness drive actions in this space.

How does it work?

Wikis can be remote hosted (such as PBWiki, WetPaint, or collaborative Google Docs) or hosted by an institution – such as MediaWiki or the wiki feature in Moodle. Wikis can be open - where anyone can create an account and edit - or closed - requiring approval from a site administrator. Edits may be handled through simple editing with wiki markup (similar to HTML) or a Word-style formatting bar (in hosted wikis such as PBWiki).

How can it be used for teaching and learning?

Wikis, like any tool for learning, are limited in use primarily by the creativity of the instructor or designer. Common uses include:

- Course notes
- Course syllabus
- FAQ
- Collaborative writing and group work
- Brainstorming
- Inviting experts (whose work may/may not be the focus of the wiki) to review completeness of learner wikis
- Content creation with educators from other universities/schools

Social Bookmarking

What is it?

Social bookmarking is a way to store and organize bookmarks (favorites) on the web. Having bookmarks on the web means they are accessible from any computer with an internet connection and a browser.

How does it work?

Bookmarks can be posted to services such as Delicious directly through the website or through a browser toolbar. When saving a webpage, users can tag the resource, select it for private/public view, and share it with others in a network. The use of a specific tag will allow others with similar interest to discover shared resources. Services like Diigo and Stumble Upon allow users to rate, tag, and comment on specific web pages (comments are only visible to other users of the service).

How can it be used for teaching and learning?

In addition to organizing personal information, social bookmarking is a useful tool for sharing information, articles, and learning resources. For example, a course can be assigned a specific tag, and the contributions of all learners can result in a useful collection of resources.

Social bookmarking is valuable for researchers. Writing an article? Researching an industry? Slaving away on your dissertation? Delicious can be used to keep track of all the source materials and commentary. Or, a special tag can be used for an assignment or group work to easily gather all bookmarks.

Audio & Podcasting

What is it?

Podcasting is the distribution of audio online through RSS. Technology has developed to the point where an educator can record and distribute audio files with only a computer, a microphone, and internet access.

Of particular potential in audio is the increased use of different audio tools for easy collaboration (such as Seesmic or Voice Thread). While podcasting is generally a one-way flow, collaborative audio creation around images adds the learner's/listener's voice to the exchange.

How does it work?

Podcasts can be created with Audacity, Odeo, Garage Band, or digital voice recorders. Audio files can be shared via services such as PodBean, iTunes, or plugins for blogging software (such as Word Press). As with blogs, learners can subscribe to RSS feeds of podcasts. Learners can listen to podcasts on a computer or iPod (or similar audio device).

How can it be used for teaching and learning?

Podcasts can be used to:

- Record lectures
- Include external presenters
- Evaluation and feedback
- Learner created reflections and interviews
- Interviews with notable contributors to a particular field
- News or course-related updates
- Short introductions to new subject areas

Image sharing (with Flickr)

What is it?

Flickr is a web-based image sharing tool.

How does it work?

Learners can upload, tag, share, annotate, and discuss images and photos. Images can be licensed under Creative Commons license, allowing for varying levels of use. Groups can be formed around topics and themes. For example, a conference can set up an image group and all attendees can post and share images. Individual images can geotagged (tagged by location) – useful experiencing (from a local perspective) different parts of the world. Images can be annotated so individual components within the image can be described.

How can it be used for teaching and learning?

Flickr can be used to:

- Share photos within a class, school, department, faculty, college or university.
- Set up a group for a courses - share photos with group members
- Architecture/visual arts groups can use the geo-tag feature to share images/locations, etc.
- Work with international students - i.e. stimulate discussions on countries of origin
- World issues - a map for students - i.e. making it seem like more than a map by using photos and linking to real-life images
- Traveling - flickr journey - share with family, classmates

- Field research
- Use for building community in distance education - i.e. students share images of themselves, where they live, etc. “introduce yourself in flickr” - where you live, work, etc.
- Use in Telemedicine for diagnostic and therapeutic purposes.
- Use in Anatomical Pathology for diagnostic consultations.

Video

What is it?

The last decade has seen the web transition from a text-based medium to a multi-media platform with audio, video, and greater interactivity. For educators, this presents a great opportunity to add diversity and variety to courses.

While video-taped lectures have been common on university campuses for decades, the increased bandwidth available to most computer users has opened the door for a new approach to extend lectures - enabling learners to view missed (or not fully understood) lectures at their convenience.

How does it work?

Video in education runs a spectrum from easy-to-create “talking heads” (recorded with a web cam) to edited professional quality resources. Easy to create video – with a web cam, Flip Video, or video recorder – are more accessible to individual educators than studio-produced recordings.

After videos have been created and edited, they can be uploaded to a university site or posted on a public site such as YouTube or blip.tv.

How can it be used for teaching and learning?

Video can be used for:

- Short demonstrations
- Incorporate video from experts
- Incorporate video developed by other institutions/organizations as open educational resources
- Add recorded presentations of conferences (like TED Talks) as curricular resources
- Pre-class videos to place future lectures into context
- Use videos to review key concepts discussed in class (for learner review or to augment lectures)

Open Education Resources

What is it?

Open educational resources (OERs) are not tools of the same nature as others in this section, but are included here due to their potential to influence higher education.

While LMS’ were gaining acceptance in education, discussion of digital learning resources (largely under the banner of “learning objects”) grew to an almost fevered pitch. Proclamations of learning object repositories as the future of learning abounded. Institutional, discipline-based, provincial, national, and even international groups established repositories for their members. Unfortunately, the idea was too new, or perhaps more accurately, too unlike what educators were comfortable with. While discussions raged on the value (economical and pedagogical) of learning objects, many repositories gently slid into obscurity. A few remained - MERLOT most notably - but many moved to more institutional repositories of educational resources (like DSpace), rather than self-contained

learning objects freely available to the larger academic community.

While interest in learning objects has somewhat abated, interest in OERs has grown. OERs are materials made freely available online for educators and learners to use, repurpose, and extend. MITs OCW initiative raised questions about the value of content. MIT, in making course resources freely available, expressed a view that the economic value point for learners is found in faculty and learner interactions and accreditation not in academic content.

How does it work?

Institutions make learning resources available for others to use or view. Different licensing schemes influence appropriate use (many, for example, limit for-profit use of resources). As materials are accessible online, educators can link to and incorporate simulations, videos, lectures, and other learning activities. Depending on licensing assigned to OERs, educators can incorporate, revise, improve, and extend resources.

Publicity generated by large institutional OER initiatives (MIT, Open University, OpenYale, Connexions) overlooks an important grassroots development: collaborative content development through wiki sites like Wiki Educator.

How can it be used for teaching and learning?

OERs have numerous opportunities for teaching and learning:

- Incorporate videos, lectures, and other materials in existing courses
- Design learning activities around improving existing resources in public sites such as Wiki Educator
- Make resources freely available online (for example, a wiki textbook written by students).

Microblogging

What is it?

Microblogging involves sharing resources and engaging in short conversations with other users of the service. Twitter, Tublr, and Plurk are popular examples.

How does it work?

With Twitter and Plurk, users are limited to maximum responses of 140 characters (including spaces and punctuation). Accounts can be setup without charge. Social networking consists of adding friends (which means you follow their updates/posts) and interacting with others. The key question in Twitter is “what are you doing”. Conversation ranges from meaningless – “I just finished a cup of coffee” – to meaningful “My partner just had a baby”. Twitter enables the creation of strong social networks by sharing the “small details of life” that are often only experienced by people in physical proximity. Blogs lack the immediacy and personal communication found on Twitter. In additions to posts being displayed on a public timeline (or, if you wish to only share with your network, privacy settings are available), direct messages (of 140 character length) are possible.

How can it be used for teaching and learning?

The social dimension of Twitter can be overlooked when focusing on the triviality of many “tweets” (posts). Sample uses in education include:

- Ask learners to “follow” notable thinkers in a particular field
- Forming social networks with other learners
- Sharing resources
- Follow conferences within a field of study

- Track current events
- Participate in conversations with experts in a discipline
- Provide an alternative avenue for student-instructor interaction
- Provide class updates and reminders

Social Networking Software

What is it?

Social networking has been popular in various forms since the development of the internet. Social networking was initially the domain of early adopters or sub/counter-culture individuals. Newsgroups, WELL, and other online "communities" formed with the participants who possessed a degree of technical competence and ability to accept communication untethered from physical contact. As the web developed and grew in prominence, other tools of informal social connections - such as blogs - developed. The audience was again largely confined to a subset of society, often limited by technical skills or the ability to tolerate the conceptual shift of transparency in an open forum.

In the late 90's/early 2000's, social networking sites became more popular with the development of sites such as Friendster. These sites allowed people to create a profile and begin to form a network of connections with others from around the world. The development of sites such as MySpace, Orkut, and more recently, Facebook, moved social networking from the sub-culture domain to mainstream. The ease of use and ability to connect with others of shared interests resulted in rapid adoption.

How does it work?

Social networking sites are often integrated suites of tools with functionality similar to blogs, Twitter, Flickr, discussion forums, etc. Users create an account on a networking service and fill out their profile. Through site search, users can form connections with other people. Information – images, status updates, event invitations, emails, videos – can then be shared with "friends".

How can it be used for teaching and learning?

Educators are afflicted with a desire to use what is popular within society. This is largely rational - after all, if students are comfortable with computers, mobile phones, or certain web applications, why not leverage their existing skills with technology for teaching and learning? In some cases, however, different tools are used for dramatically different purposes. For most people, Facebook is a social space, used for informal conversations, building and maintaining relationships, and the voyeuristic tendency of profile surfing. The value of Facebook for formal teaching and learning is unclear. While learners will likely use Facebook to create small networks, study groups, or use its communication tools for arranging study times or clarify assignment requirements, formal use in college-level instruction may be too much of a stretch for learners.

danah boyd, is more blunt[121]: "In their current incarnation, social network sites (SNSs) like Facebook and MySpace should not be integrated directly into the classroom...I have yet to hear a compelling argument for why social network sites (or networking ones) should be used in the classroom. Those tools are primarily about socializing, with media and information sharing there to prop up the socialization process (much status is gained from knowing about the cool new thing). I haven't even heard of a good reason why social network site features should be used in the classroom."

Web Conferencing

What is it?

Webconferencing is used to facilitate group meetings or live presentations over the Internet.

In its simplest form its text messaging, at its most complex, it's videoconferencing combined with application or desktop sharing. What is common to all forms of webconferencing is that they are synchronous communication (real time) tools using computers and the internet. Most webconferencing programs now have recording capability which allows you to save your conference for later playback.

The advantage of webconferencing to videoconferencing is that webconferencing can be accessed from anyplace that has a computer with the appropriate software and an internet connection. Unlike traditional videoconferencing, expensive videoconferencing equipment is not required and the technical overhead to 'operate' a webconference is much lower. The disadvantage to webconferencing is that the quality of video in videoconferencing systems is usually superior.

How does it work?

Desktop webconferencing or online classrooms can be managed through services like Elluminate or Adobe Connect. A typical service will include an interactive whiteboard, text chat, audio, video, polling, application sharing, web browsing, filesharing, and presentation (Powerpoint) tools. Presentations can be recorded and used for future playback. Elluminate Publish! can be used to create podcasts or Flash videos of Elluminate presentations.

How can it be used for teaching and learning?

Webconferencing software has numerous uses:

- Group meetings
- Virtual classes
- Office Hours
- Grad students meeting with mentors
- Guest lecturers
- Recording classes or meetings
- Online conferences

Aggregation

What is it?

Blogs, news, social bookmarks, academic journals, Flickr images, and YouTube videos produce a sea of information that threatens to inundate us to the point of paralysis. How can learners manage these disparate sources of information in meaningful ways? With more technology of course!

Tools like iGoogle, NetVibes, and Google Reader give learners control of information. By subscribing to blogs, journals, Moodle forums, and other online services, learners can bring together meaningful resources.

How does it work?

Many websites are now producing RSS or web feeds. RSS stands for really simple syndication (or rich site summary, depending on who you ask). It is simply an XML file that can be read by software. An aggregator skims the site and updates any information added since the last visit to the site. Essentially, RSS allows information to come to you (through an aggregator) instead of you having to go to the information. If you are following 20 different websites in your field, and they all produce an RSS feed, an aggregator visits the sites and retrieves new content and displays it in a browser or

on your desktop RSS reader (depending on the type of aggregator).

Aggregators (and the RSS information sharing structure as a whole) differ from email in that the emphasis is on pulling in resources of interest. Email, in contrast, is a push technology. Through RSS, resources are intentionally solicited, whereas anyone can send an unsolicited email. By pulling in information (versus having it pushed), we have greater control over the quantity and type of information we encounter.

How can it be used for teaching and learning?

Creating personal learning environments

Learners can follow key thinkers in a field (blogs)

Learners (and educators) can subscribe to academic journals

Games, virtual worlds, and simulations

What is it?

Virtual worlds and games are common topics discussion in educational conferences. Most educators have at minimum, indirect experience with games - whether through conversations with students, the activities of their children, or their own personal use of virtual games.

Virtual games - such as World of Warcraft - generally involve the achievement of a certain goal, such as mastering a game level. Virtual worlds, in contrast, are environments where individuals can interact with each other, but may not necessarily be focused on achieving a particular goal. Traditional video game systems – XBOX and PS3 – now offer online gaming as well.

Second Life has received considerable attention from educators over the last several years. SL provides an alternative learning experience to a traditional online course, as learners interact with peers and educators through avatars, explore course material (often in a more interactive manner than only reading text), and express personal learning through visual means.

Simulations are particularly valuable as a learning tool in providing learners with a situated experience that is more cost effective than actually performing the task (such as flying). Simulations can be expensive to design and administer.

How does it work?

Games, simulations, and virtual worlds are all distinct. Discussion here will be confined to Second Life. After a user has created an account (free version is available, but to participate in the "Linden" economy, a paid account is required), she can modify her avatar (appearance, body type (or non-human), accessories, etc.). She can then form a social network by adding friends, participating in chat (audio or text), attending conferences, concerts, clubs, and other activities. Users can rent/purchase living spaces, vehicles, build homes, and almost any other activity that is possible in their "first life".

How can it be used for teaching and learning?

Games, virtual worlds, and simulations have many academic uses, including:

- Simulating real experiences (nursing and medical uses in Second Live)
- Interactions in 3D environments (valuable for architecture (design), psychology (human behaviour), and other fields)
- Galleries – art and other exhibits
- Programming and scripting
- Building objects – tables, chairs, furniture, buildings, etc
- Study social behaviour (ethics considerations are important in this instance)

Research

Evaluating the effectiveness of technology use in teaching and learning brings to mind Albert Einstein's statement: "Not everything that can be counted counts, and not everything that counts can be counted". When we begin to consider the impact and effectiveness of technology in the teaching and learning process, obvious questions arise: "How do we measure effectiveness? Is it time spent in a classroom? Is it a function of test scores? Is it about learning? Or understanding?"

Much research has been conducted on how modalities, distance, and models of education influence the quality of learning. This research is commonly cited as the no significant difference phenomenon. Joy and Garcia argue that the research is fundamentally flawed - the emphasis on technology and media is misplaced.

Instead:

> [P]ractitioners should adhere to their time-tested instructional design strategies, regardless of the medium they choose. It is widely accepted that learning effectiveness is a function of effective pedagogical practices. Accordingly, the question for researchers, instructional designers, and consumers of ALNs ought to be: "What combination of instructional strategies and delivery media will best produce the desired learning outcome for the intended audience?"[122]

Carol Twigg, suggests education technique is lagging behind technological development[123]. As McLuhan has stated, we use new tools to do the work of the old. The challenge with this often repeated assertion - namely that we are on the precipice of a complete shift in our framework of education - is that research, by its nature, is not necessarily concerned with trends. Research is intended to describe phenomenon occurring now and ways to unearth or discover important principles on which we can base subsequent action and research.

It is clear that teaching and research in fields of educational technology have yet to achieve required balance. Arthur Levine provides perhaps the most comprehensive analysis in recent memory in his systemic exploration of the research failings of education in general[124].

Randolph[125] views learning and technology research across a full spectrum of resources and approaches, indicating the need for educational technology researchers to broaden their view of research as well as improving the quality of activities within the field. Numerous other researchers and organizations have emphasized the concerns of research on the use of technology in education. Terry Anderson has similarly called for a significant shift in the research methodology of technology-enabled learning, focusing on design-based models[126]. He details the need for quality, relevant research:

> "An essential component of effective strategic change is an active research and development component of the system designed to insure that pedagogical, technological, sociological, political and commercial changes and opportunities are both developed and exploited within that system. These insights from effective research and development, originate both from within education domains as well as being imported from related disciplines"[127].

Design-based research (DBR) has been suggested as a solution to the difficulties facing research quality, relevance, and impact. DBR is particularly appropriate for exploring emerging educational technologies because[128]:

1. It focuses on interventions in real contexts
2. it involves partnerships between practitioners, students and researchers
3. It is iterative as context and technology changes
4. It is emergent as insights are gathered and developed into principles and patterns.

Distinctions between traditional (predictive) research and DBR are detailed in Image 17.

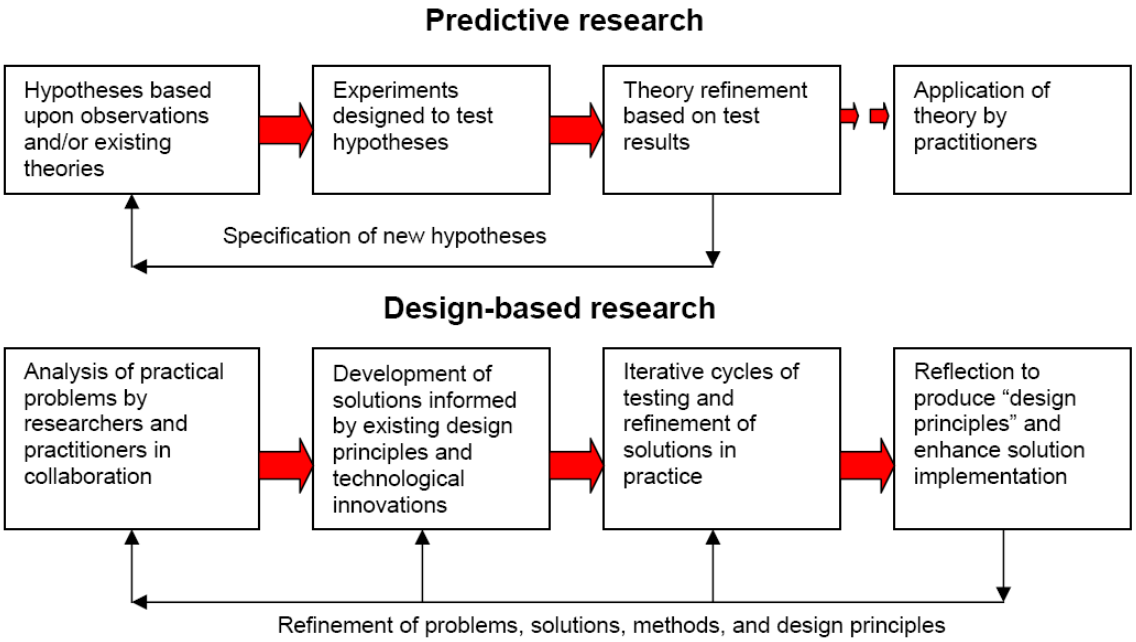

Image 17: Design Based Research[129]

Additional important readings on research in educational technology include:

- Toward a Pan-Canadian e-Learning Research Agenda[130]
- International Perspectives on e-Learning: Mapping Strategy to Practice[131]

Conclusion

The use of technology for learning is influenced by developments in numerous fields: technology itself, global trends (market economy growth, changing immigration patterns, intellectual shifts to emerging economies[132]), societal trends, and trends within educational research.

Much of the change in education over the last several decades has been defined by discussion of content. Should we teach more math? Science? What about ethics? How should we teach? Lecture? Problem-based learning? It seems that much of educational reform has been concerned with determining the content of education, rather than the model and process of learning design and delivery in a technology infused world.

The "arranging of deck chairs" approach requires reconsideration. The change pressures faced in education today (and society as a whole) are much deeper than a shift in content or in pedagogy alone will meet. Leaders and administrators are faced with the task of redefining the role of the academy in a world of constant change and hyper-connectivity.

For individual faculty members and departments, greater use of emerging technology can serve as an important bridging process between the traditional role of education and the not yet clearly defined future. Active participation in the ecology of perpetual change provides organizations with the capacity to sense, recognize, and respond to emerging patterns.

Through a process of active experimentation, the academy's role in society will emerge as a prominent sensemaking and knowledge expansion institution, reflecting of the needs of learners and society while maintaining its role as a transformative agent in pursuit of humanity's highest ideals.

[1] Annand, D. (2007) Re-organizing universities for the information age. International Review of Research in Open and Distance Learning, 8(3) Retrieved January 10, 2008, from http://www.irrodl.org/index.php/irrodl/article/view/372/952

[2] Tuomi, I. (2005). The future of learning in the knowledge society: Disruptive changes for Europe by 2020. Retrieved February 20, 2009, from http://www.meaningprocessing.com/personalPages/tuomi/articles/TheFutureOfLearningInTheKnowledgeSociety.pdf

[3] Morin, E. (1999). Seven complex lessons for the future. Retrieved January 20, 2008, from http://unesdoc.unesco.org/images/0011/001177/117740eo.pdf

[4] Organization for Economic Co-operation and Development (2007). Participative Web: User-created content. Retrieved February 20, 2009, from http://www.oecd.org/dataoecd/57/14/38393115.pdf?contentId=38393116

[5] Raymond, E. S. (1998). The cathedral and the bazaar. Retrieved March 1, 2009, from http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/578/499

[6] Siemens, G. (2007). Scholarship in an age of participation. http://www.elearnspace.org/Articles/journal.htm

[7] Brown, L., Griffiths, R., & Rascoff, M. (2007). University publishing in a digital age. Retrieved February 20, 2009 http://www.ithaka.org/strategic-services/Ithaka%20University%20Publishing%20Report.pdf

[8] Bernard, R. B., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L. et al (2004). How does distance education compare to classroom instruction: A meta-analysis of the empirical literature. Review of Educational Research, 74(3), 379–434.

[9] Saba, F. (2000). Research in distance education: A status report. International Review of Research in Open and Distance Learning, 1(1). Retrieved February 20, 2009 from http://www.irrodl.org/index.php/irrodl/article/viewFile/4/24

[10] Abrami, P. C., Bernard, R. M, Wade, A., Schmid, R. F., Borokhovski, E., Tamin, R., Surkes, M. et al (2006). A review of e-Learning in Canada: A rough sketch of evidence, gaps, and promising directions. Canadian Journal of Learning and Technology, 32(3). Available from http://www.cjlt.ca/index.php/cjlt/article/view/27

[11] Tallent-Runnels, Thomas, J. A., Lan, W. Y., Cooper, S., Shaw, S. M., & Liu, X. (2006). Teaching courses online: A review of the research. Review of Educational Research, 76(1), 934–135. (page 110)

[12] Collis, B., & Moonen, J. (2008). Web 2.0 tools and processes in higher education: Quality perspectives. doi: 10.1080/09523980802107179

[13] Between difference and singularity: An open discussion with Jean Baudrillard. (2002). Retrieved March 1, 2009, from http://www.egs.edu/faculty/baudrillard/baudrillard-between-difference-and-singularity-2002.html

[14] Poole, D. (2005). The possibilities of university transformation. In R. Nata (Ed.), Issues in higher education (pp. 195–216). Hauppauge, NY: Nova Science. p. 196

[15] Keeling, R. (2006). The Bologna process and the Lisbon research agenda: The European Commission's expanding role in higher education discourse. European Journal of Education, 41(2),

203–223.

[16] Allen, E., Seaman, J. (2008). Staying the course: Online education in the United States, 2008. Retrieved February 20, 2009 from http://www.sloan-c.org/publications/survey/pdf/staying_the_course.pdf

[17] Organization for Economic Co-operation and Development (2008). The future of the internet economy: A statistical profile. Retrieved on February 20, 2009 from http://www.oecd.org/dataoecd/44/56/40827598.pdf

[18] Connectivity Scorecard (n.d.). Canada Connectivity Scorecard. Retrieved on February 20, 2009 from http://www.connectivityscorecard.org/countries/canada

[19] Statistics Canada (2008). Canadian Internet Use Survey. Retrieved on February 20, 2009 from http://www.statcan.gc.ca/daily-quotidien/080612/dq080612b-eng.htm

[20] Wagner, N., Hassanein, K., Head, M., (2008). Who is responsible for e-learning success in higher education? A stakeholders' analysis. Educational Technology & Society, 11(3), 26-36.

[21] Organization for Economic Co-operation and Development (n.d.) Australia: World Class Universities or a World Class University System? Retrieved on February 20, 2009 from http://www.oecd.org/document/38/0,3343,en_2649_35961291_40341478_1_1_1_1,00.html

[22] Daniel, J., Kanwar, A., & Uvalic-Trubmic, S. (2006, July). A tectonic shift in global higher education. Retrieved February 1, 2009, from http://www.carnegiefoundation.org/change/sub.asp?key=98&subkey=1841

[23] Freedman, G. (2008). Unlocking the global education imperative: Core challenges & critical response. Retrieved February 20, 2009, from http://www.blackboard.com/CMSPages/GetFile.aspx?guid=6032f8df-b6ba-4510-81d2-3198459529dc

[24] Benkler, Y. (2006). The wealth of networks: How social production transforms markets and freedom. New Haven, CT: Yale University Press.

[25] Gibbons, M. (2002). Globalization and the future of higher education. In Globalisation: What Issues are at Stake for Universities? Retrieved February 20, 2009, from http://www.bi.ulaval.ca/Globalisation-Universities/pages/actes/GibbonsMichael.pdf

[26] Martin Prosperity Institute. (2009, February). Ontario in the creative age. Retrieved February 20, 2009, from http://martinprosperity.org/media/pdfs/MPI%20Ontario%20Report%202009%20v3.pdf

[27] Downes, S. (2009). The future of learning: Ten years on. Retrieved February 20, 2009, from http://www.downes.ca/files/future2008.doc

[28] Sawyer, R. K. (Ed.). (2005). Cambridge handbook of learning sciences. Available from http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780511217685

[29] Mason, M. (2008). Complexity theory and the philosophy of education. Educational Philosophy and Theory, 40(1), 4–18. doi: 10.1111/j.1469-5812.2007.00412.x.

[30] McFadden Allen, B. M., Welch, A., & Zhen, Z. (2007). Global collaboration: Benefits and challenges in developing partnerships. In Realizing the global university. Retrieved February 20, 2009, from http://wiche.edu/attachment_library/Global%20University%20pdfs/Global%20University_Part_5.pdf

[31] Kellner, D. (2004). Technological transformation, multiple literacies, and the re-visioning of education. E-Learning, 1(1).

[32] Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B. R. C. (2000). The future of the university and the university of the future: Evolution of ivory tower to entrepreneurial paradigm. Research Policy, 29(2), 313–330.

[33] Organization for Economic Co-operation and Development. (n.d.b). Four future scenarios for higher education. Retrieved February 20, 2009 from http://www.oecd.org/dataoecd/18/36/42241931.pdf

[34] White, S. (2007). Critical success factors for e-learning and institutional change—Some organizational perspectives on campus-wide e-learning. British Journal of Educational Technology, 38(5), 840–850.

[35] Canadian Information Centre for International Credentials. (2008). Information on prior learning assessment and recognition in Canada [Fact Sheet No. 6]. Retrieved February 20, 2009, from http://www.cicic.ca/412/Prior_Learning_Assessment_and_Recognition_in_Canada_.canada

[36] Canadian Council on Learning. (2008). State of learning in Canada: Toward a learning future. Retrieved August 1, 2008, from http://www.ccl-cca.ca/NR/rdonlyres/6FA0A21C-50D9-481B-A390-73852B4E6CB6/0/SOLR_08_English_final.pdf

[37] Wellman, B. (1999). Networks in the global village: Life in contemporary communities. Boulder, CO: Westview Press.

[38] Barabási, A. L. (2002). Linked: The new science of networks. Cambridge, MA: Perseus Publishing.

[39] Watts, D. J. (2003). Six degrees: The science of a connected age. New York: W.W. Norton.

[40] Castells, M. (1996). The rise of the network society. Malden, MA: Blackwell.

[41] Benkler, Y. (2006). The wealth of networks: How social production transforms markets and freedom. New Haven, CT: Yale University Press.

[42] Gantz, J.F., Reinsel, D., Chute, C., Schlichting, W., McArthur, J., Minton, S., et al. (2007). The expanding digital universe: A forecast of worldwide information growth through 2010. Framingham, MA: IDC. Retrieved December 27, 2007, from http://www.emc.com/about/destination/digital_universe/

[43] Feltovich, P. J., Prietula, M. J., Ericsson, K. A. (2006). Studies of expertise from psychological perspectives. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), Cambridge handbook of expertise and expert performance (Paperback, pp. 41–67). London: Cambridge University Press.

[44] Barnett, R. (2004). Learning for an unknown future. Higher Education Research & Development, 23(3), 247–260. doi: 10.1080/0729436042000235382

[45] Harvard University. (2007). Report of the task force on general education. Retrieved February 20, 2009, from http://www.fas.harvard.edu/~secfas/General_Education_Final_Report.pdf

[46] Image adapted from: Fischer, G., & Konomi, S. (2007). Innovative socio-technical environments in support of distributed intelligence and lifelong learning. Journal of Computer Assisted Learning, 23(4), 338–350.

[47] Sawyer, R. K. (Ed.). (2005). The new science of learning. In The Cambridge handbook of learning sciences. Available from http://www.cambridge.org/us/catalogue/catalogue.asp?isbn=9780511217685

[48] Wenger, E. (1998). Communities of practice: Learning, meaning, and identity. New York: Cambridge University Press.

[49] Seely Brown, J., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32–42.

[50] Merrill, D. (2002). First principles of instruction. Educational Technology Research and Development, 50(3), 43–59.

[51] Papert, S. (1991). Situating constructionism. Retrieved February 20, 2009, from http://papert.org/articles/SituatingConstructionism.html

[52] Anderson, T. (n.d.). Distance learning—Social software's killer ap? Retrieved March 1, 2009, from http://www.unisa.edu.au/odlaaconference/PPDF2s/13%20odlaa%20-%20Anderson.pdf

[53] Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), Distributed cognitions (pp. 47–87). New York: Cambridge University Press.

[54] Hollan, J., Hutchins, E., & Kirsh, D. (2000). Distributed cognition: Toward a new foundation for human-computer interaction research. ACM Transactions on Computer-Human Interaction, 7(2), 174–196.

[55] De Jaegher, H., & Di Paolo, E. (2007). Participatory sense-making: An enactive approach to social cognition. Phenomenology and the Cognitive Sciences, 6(4), 485–507.

[56] National Survey of Student Engagement. (2008). Promoting engagement for all students: The imperative to look within. Retrieved March 1, 2009, from http://nsse.iub.edu/NSSE_2008_Results/docs/withhold/NSSE2008_Results_revised_11-14-2008.pdf

[57] Tinto, V. (1982). Dropout from Higher Education: A Theoretical Synthesis of Recent Research Review of Educational Research, 45(1), 89-125

[58] Rovai, A. P. (2003). In search of higher persistence rates in distance education online programs. Internet and Higher Education. 1-16.

[59] Dalsgaard, C. (2006). Social software: E-learning beyond learning management systems. European Journal of Open, Distance and E-Learning. Retrieved February 20, 2009, from http://www.eurodl.org/materials/contrib/2006/Christian_Dalsgaard.htm

[60] The net pedagogy portal http://www.thewebworks.bc.ca/netpedagogy/

[61] Siemens, G. (2005). Connectivism: A learning theory for a digital age. International Journal of Instructional Technology and Distance Learning, 2(1). Retrieved February 20, 2009 from http://www.itdl.org/Journal/Jan_05/article01.htm

[62] Learning Technologies Centre. (2008, November). Connectivism and connective knowledge online course. Retrieved March 1, 2009, from http://ltc.umanitoba.ca/wiki/Connectivism

[63] 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 February 20, 2009 from http://lsa.colorado.edu/papers/plato/plato.annote.html.

[64] Bechtel, W., & Abrahamsen, A. (2002). Connectionism and the mind: Parallel processing, dynamics, and evolution of networks (2nd ed.). Malden, MA: Blackwell.

[65] Reder, L.M., Park, H., & Kieffaber, P.D. (2009). Memory systems do not divide on consciousness: Reinterpreting memory in terms of activation and binding. Psychological Bulletin, 135(1), 23-49

[66] Novak, J. D., & Cañas, A. J. (2006b). The theory underlying concept maps and how to construct them. Retrieved December 26, 2007, from Institute for Human and Machine Cognition Web site: http://cmap.ihmc.us/Publications/ResearchPapers/TheoryCmaps/TheoryUnderlyingConceptMaps.

htm

[67] Ito, M., Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Patricia G. Lange, P. G., et al. (2008, November). Living and learning with new media: Summary of findings from the digital youth project. Retrieved February 20, 2009, from http://www.macfound.org/atf/cf/%7BB0386CE3-8B29-4162-8098-E466FB856794%7D/DML_ETHNOG_WHITEPAPER.PDF

[68] Feltovich, P. J., Prietula, M. J., Ericsson, K. A. (2006). Studies of expertise from psychological perspectives. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), Cambridge handbook of expertise and expert performance (Paperback, pp. 41–67). London: Cambridge University Press.

[69] Narayanan, G. (2007). A Dangerous but Powerful Idea - Counter Acceleration and Speed with Slowness and Wholeness. Retrieved on February 20, 2009 from http://kt.flexiblelearning.net.au/tkt2007/edition-13/narayaran/

[70] Brown, A. L. (1994). The advancement of learning. Educational Researcher, 23(8), 4–12.

[71] Lenhart, A., Madden, M., Rankin Macgill, A., & Smith, A. (2007). Teens and social media. Washington, DC: Pew Internet. Retrieved December 26, 2007, from: http://www.pewinternet.org/pdfs/PIP_Teens_Social_Media_Final.pdf

[72] Johnson, G. M. (2007). College student internet use: Convenience and amusement. Canadian Journal of Learning and Technology, 33(1), 141–157.

[73] Kanuka, H. (2008) Understanding E-Learning technologies-in-practice through philosophies-in-practice. In Theory and Practice of Online Learning. Terry Andeson ed.

[74] Nichols, M. (2008). Institutional perspectives: The challenges of e-learning diffusion. British Journal of Educational Technology, 39(4), 598–609.

[75] Panda, S., & Mishra, S. (2007). E-learning in a mega open university: Faculty attitude, barriers and motivators. Educational Media International, 44(4), 323–338. (p. 335)

[76] Chickering, A. W., Ehrmann, S. C. (1996). Implementing the seven principles: Technology as lever. Retrieved on February 20, 2009 from http://www.tltgroup.org/programs/seven.html

[77] Sloan-C (2007) Blending in: The extent and promise of blended education in the United States. Retrieved on February 20, 2009 from http://www.sloan-c.org/publications/survey/pdf/Blending_In.pdf

[78] Papert, S. (n.d.). Constructionism vs. instructionism. Retrieved December 27, 2007, from http://papert.org/articles/const_inst/const_inst1.html

[79] Hogan, L. R., & McKnight, M. A. (2007). Exploring burnout among university online instructors: An initial investigation. Internet and Higher Education, 10, 117–224.

[80] Paas, F., Rankl, A, Sweller, J. (2003). Cognitive Load Theory and Instructional design: recent developments. Educational Psychologist. 38(1), 1-4.

[81] Young, M. F. (1993). Instructional design for situated learning. Educational Technology Research and Development, 41(1), 43–58.

[82] Amirault, R. J. & Branson, R. K. (2006). Educators and Expertise: a brief history of theories and models. In K. A. Ericsson, N. Charness, P. J. Feltovich, & R. R. Hoffman (Eds.), Cambridge handbook of expertise and expert performance (Paperback, pp. 69–86). London: Cambridge University Press. (p. 83)

[83] Bower, M. (2008). Affordance analysis: Matching learning tasks with learning technologies.

Educational Media International, 45(1), 1–15.

[84] Tessmer, M., & Richey, R. C. (1997). The role of context in learning and instructional design. Educational Technology Research and Development, 44(2), 85–115.

[85] Mitchell, B., Geva-May, I. (2009). Attitudes affecting online learning implementation in higher education institutions. Journal of Distance Education, 23(1), 71-88.

[86] Osberg, D., & Biesta, G. (2008). The emergent curriculum: Navigating a complex course between unguided learning and planned enculturation. Journal of Curriculum Studies, 40(3), 313–328. doi: 10.1080/00220270701610746.

[87] Clark, R. E. (1983). Reconsidering Research on Learning from Media. Review of Educational Research (53)4, 445-459.

[88] Kozma, R. B. (1991). Learning with Media. Review of Educational Research. 61(9). 179-211.

[89] Fadel, C., & Lemke, C. (2008). Multimodal learning through media: What the research says. Retrieved February 20, 2009, from http://www.cisco.com/web/strategy/docs/education/Multimodal-Learning-Through-Media.pdf

[90] Greeno, J. G. (1994). Gibson's Affordances. Psychological Review. 101(2), 336-342

[91] Dron, J. (2007). Designing the undesignable: Social software and control. Educational Technology and Society, 10(3), 60–71

[92] McLaughlin, A. C., Rogers, W. A., Sierra, Jr., E. A., & Fisk, A. D. (2007). The effects of instructional media. Identifying the task demand/media match. Learning, Media, and Technology, 32(4), 381–405.

[93] Moore, A. H. (2007). The new economy, technology, and learning outcomes assessment. EDUCAUSE. Retrieved on February 20, 2009 from http://connect.educause.edu/Library/EDUCAUSE+Quarterly/TheNewEconomyTechnologyan/44829?time=1235939355

[94] National Survey of Student Engagement (NSSE). (2007). Experiences that matter: Enhancing student learning and success. Bloomington, IN: Author. Retrieved December 27, 2007, from http://nsse.iub.edu/NSSE%5F2007%5FAnnual%5FReport/docs/withhold/NSSE_2007_Annual_Report.pdf

[95] EDUCAUSE Center for Applied Research [ECAR]. (2007). The ECAR study of undergraduate students and information technology. Retrieved December 27, 2007, from http://www.educause.edu/ir/library/pdf/ers0706/rs/ERS0706w.pdf

[96] de Laat, M. (2006). Networked learning. Retrieved December 27, 2007, from http://www.e-learning.nl/files/dissertatie%20maarten.pdf (p. 174)

[97] Bennet, S.. Maton, K., & Kervin, L. (2008). The "digital natives" debate: A critical review of the evidence. British Journal of Educational Technology, 39(5), 775–786.

[98] Kennedy, G. E., Judd, T. S., Churward, A., Gray, K., & Krause, K (2008). First year students' experiences with technology: Are they really digital natives? Australasian Journal of Educational Technology, 24(1), 108–122.

[99] Dewey, J. (1997). Experience & education. New York: Touchstone.

[100] Freire, P. (1970). Pedagogy of the oppressed. London: Continuum.

[101] Illich, I. (1970). Deschooling society. London: Marion Boyars.

[102] Bandura, A. (2002). Social cognitive theory in cultural context. Applied Psychology: An

International Review, 51(2), 269–290.

[103] Lankshear, C., Knoble, M. (2003) Digital Literacies: Policy, Pedagogy and Research Considerations for Education. Retrieved on February 20, 2009 from: http://www.geocities.com/c.lankshear/Oslo.pdf

[104] Siemens, G. (2006). Knowing knowledge. Vancouver, BC, Canada: Lulu Press.

[105] Kirschner, P., Sweller, J., & Clark, R. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educational Psychologist 41(2), 75-86.

[106] Gardner, H. (2006). Five minds for the future. Boston: Harvard Business School Press. (p. 28)

[107] Mitra, S. (2007, June). Technology and higher education — Pedagogy for self organised learning systems. Paper presented at Future of Education Online Conference. Retrieved on December 28, 2007, from https://sas.elluminate.com/site/external/jwsdetect/playback.jnlp?psid=2007-06-04.0738.M.BB2E854755AAFFF4E1A3E2523C4E54.vcr

[108] Darken, R., & Sibert, J. (1996). Wayfinding strategies and behaviors in large virtual worlds. Retrieved December 27, 2007, from http://sigchi.org/chi96/proceedings/papers/Darken/Rpd_txt.htm

[109] Wilson, S. (2008). Patterns of personal learning environments. Interactive Learning Environments. 16(1). 17-34.

[110] Egan, K. (2002). Getting it wrong from the beginning: Our progressivist inheritance from Herbert Spencer, John Dewey, and Jean Piaget. New Haven, CT: Yale University Press. P. 38

[111] Brown, J. S. (2006, March). Learning in the digital age (21st century). Paper [keynote] presented at the Ohio Digital Commons for Education (ODCE) 2006 Conference. Retrieved December 27, 2007, from http://www.oln.org/conferences/ODCE2006/papers/jsb-2006ODCE.pdf

[112] Fisher, C. (n.d.). Teacher as Network Administrator. Retrieved December 27, 2007, from http://remoteaccess.typepad.com/remote_access/files/teacher_as_network_admin.pdf

[113] Bonk, C. (2007). USA Today Leads to Tomorrow: Teachers as online concierges and can Facebook pioneer save face? Retrieved on December 27, 2007 from http://travelinedman.blogspot.com/2007/10/usa-today-leads-to-tomorrow-teachers-as.html.

[114] Siemens, G. (2007). 10 minute lecture – curatorial teaching. Retrieved on February 20, 2009 from http://learnonline.wordpress.com/2007/09/20/10-minute-lecture-george-siemens-curatorial-teaching/

[115] Arnseth, H. C., Solheim, I. (2003). Making Sense of Shared Knowledge. Proceedings of: Computer Support for Collaborative Learning 2002 meeting in Boulder, Colorado, January 7-11, 2002

[116] Furberg, A., Arnseth, H. C. (2009). Reconsidering conceptual change from a socio-cultural perspective: analyzing students' meaning making in genetics in collaborative learning activities. Cultural Studies of Science Education. 4(1), 157-191.

[117] Littlejohn, A., Pegler, C. (2007). Preparing for blended e-learning. Routledge, LONDON: UK

[118] McGee, P., Diaz, V. (2007) Wikis and Podcasts and Blogs! Oh My! What's a faculty member to do? EDUCAUSE. Retrieved on Feruary 20, 2009 from http://www.educause.edu/apps/er/erm07/erm0751.asp

[119] Rothwell, W. J., Kazanas, H. C. (1998) Mastering the instructional design model: a systemic approach (2nd Edition). Jossey-Bass Pfeiffer

[120] Jonassen, D. H. (1991). Objectivism vs. constructivism: Do we need a new paradigm? Educational Technology Research & Development 39(3):5-14

[121] boyd, d. (2008). The Economist debate on "social networking". Retrieved on February 20, 2009 from: http://www.zephoria.org/thoughts/archives/2008/01/15/the_economist_d.html

[122] Joy II, E. H., Garcia, F. E. (2000). Measuring learning effectiveness: A new look at No-Significant-Difference findings. Journal of Asynchronous Learning Networks. 4(1).

[123] Twigg, C. (2002) Innnovations in online learning: Moving beyond no significant difference. Retrieved on February 20, 2009 from http://connect.educause.edu/Library/Abstract/InnovationsinOnlineLearni/37926?time=1235941985

[124] Levine, A. (2007). Educating Researchers. Retrieved on February 20, 2009 from: http://www.edschools.org/EducatingResearchers/educating_researchers.pdf

[125] Randolph, J. J. (2008). Multidisciplinary methods in educational technology research and development. Retrieved February 1, 2009, from http://www.archive.org/details/MultidisciplinaryMethodsInEducationalTechnologyResearchAndDevelopment

[126] Anderson, T. (2007). Research models for Connectivist Learning. Presented to Online Connectivism Conference, University of Manitoba. Retrieved February 20, 2009, from http://ltc.umanitoba.ca/wiki/Anderson

[127] Anderson, T. (2005). Design-based research and its application to a call center innovation in distance education. Canadian Journal of Learning and Technology, 31(2), 69-84.

[128] DBR use in education provided by Terry Anderson in personal correspondence, March 3, 2009.

[129] Amiel, T., & Reeves, T. C. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. Educational Technology & Society, 7(4), 167-175.

[130] Buell, T., & Anderson, T. (2006). Toward a Pan-Canadian e-learning research agenda. Available from http://scope.bccampus.ca/file.php/56/Background_Reading/Pan_Canadian_E-Learning_Research_Agenda.pdf

[131] Conole, G. (2008). International perspectives on e-learning: Mapping strategy to practice. Retrieved February 20, 2009, from http://scope.bccampus.ca/file.php/56/Background_Reading/conole_international_perspectives_elearning.pdf

[132] National Science Foundation. (2007). Changing US Output of Scientific Articles: 1998-2003. Retrieved on February 20, 2009 from http://www.nsf.gov/statistics/nsf07320/