# Connectivism:

# Learning Theory or Pastime of the Self-Amused?

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*Background*

It is always an honor to have one's work reviewed—even (or perhaps, especially) when it is critical in nature. Ideas, concepts, and theories are sharpened, or dulled, in the space of dialogue and scrutiny.

I recently had the pleasure of reading a critique by Pløn Verhagen (2006), Professor, Educational Design, University of Twente, of my 2004 article, "Connectivism: A Learning Theory for a Digital Age." My appreciation exists on two levels: (a) Verhagen's time in reflecting on and reacting to the article, and (b) the provision of an opportunity to further dialogue about connectivism's relation to the process of learning, development of technology, societal trends, and pedagogy and curriculum. Though this final element is particularly dry, and in today's age seems to acquire a diminishing audience, we are weary of pedagogy and curriculum before we have fully managed to effect needed change.

As I read the review, I was immediately struck by the illustration it provided of why connectivism (or pick any view of network-based learning) is so important. The review represents the limiting factors of traditional; views of learning—or, extended slightly, the very structures and spaces we use to define our schools, organizations, and society.

In the original 2004 article I stated: "The pipe is more important than the content within the pipe. Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point of application" (Conclusion section, ¶ 1). I find Verhagen's (2006) critique falls at precisely this point.

The core of what I wrote in the initial article is still valid: that learning is a network phenomenon, influenced (aided) by socialization and technology. Two years is a lifetime in the educational technology space. Two years ago, web 2.0 was just at the beginning of the hype cycle. Blogs, wikis, and RSS—now prominent terms at most educational conferences—were still the sandbox of learning technology geeks. Podcasting was not yet prominent. YouTube didn't exist. Google had not released its suite of web-based tools. Google Earth was not yet on the desktops of children and executives alike—each thrilled to view their house, school, or business in satellite images. Learning Management Systems still held the starting point of most elearning initiatives. Moodle was not yet prominent, and the term PLEs (personal learning environments) did not exist. In two years, our small space of educational technology evolved—perhaps exploded is a more accurate term.

Against this backdrop, I am unsure why Verhagen (2006) opted to complete a review on an article's content when the ensuing conversation (particularly among so called edu-bloggers) since the article (Siemens, 2004) was published says much to create a context of understanding connectivism. Understanding context is the key. Much has happened since the article was first written, which in no way devalues connectivism as a concept—rather it validates it. The theory of connectivism is no less immune to change than the underlying trends it proposes to address.

I am curious as to the approach Verhagen (2006) utilized in reviewing the article. I sense it primarily consisted of reading the article and providing a reaction based on his experience in the learning technology space. Did he search online? Did he view or listen to presentations posted on elearnspace? Did he encounter Stephen Downes' (2005) article

on Connective Knowledge? I did not receive any email or skype requests to dialogue—an opportunity I rarely resist. Diverse perspectives, current knowledge, opportunities for dialogue, and use of technology are important ways of "coming to know" in today's world.

The error made in the review is precisely the reason why we need to explore connectivism as a learning theory: static, context-less, content-centric approaches to knowing and understanding are fraught with likelihood of misunderstanding. To write a review of the American political system of 2004, and treat it as if it were today's reality, fails to acknowledge the process to which all content is subject. This is the danger of *product iconization* as offered, or explored by prominent theories of learning, thus failing to acknowledge—explicitly—that ongoing changes obsolesce current knowledge.

Hubert Dreyfus (2002), in his audio lectures exploring Heidegger's *Being and Time*, questions whether a hammer is actually a hammer in absence of nails. Context shapes the nature of knowledge and learning, requiring that we consider contextual factors when engaging in debate, dialogue, or critique. To assess a concept, in absence of the context of occurrence (why a conversation happened in the first place, as well as how it has since evolved), is to largely ignore the *process* aspect of learning and focus instead only on the *product* aspect.

Verhagen's (2006) criticisms are broadly centered on three areas:

1. Is connectivism a learning theory or a pedagogy?
2. The principles advocated by connectivism are present in other learning theories as well.
3. Can learning reside in non-human appliances?

I imagine these particular principles can be argued at length and may well reflect more of an individual's personal epistemology than a neutral discussion of learning and knowing. I have opted to broadly explore learning theories and connectivism in the balance of this paper, in order to highlight key distinctions and advance the argument of why we need a different theory of learning, and the accompanying factors influenced by learning: how we teach, how we design curriculum, the spaces and structures of learning, and the manner in which we foster and direct critical and creative thought in our redesign of education. In the process, I believe Verhagen's questions will be addressed.

My response begins with a brief exploration of our desire for externalization as expressed in language, symbols, emotions, and thought—laying a foundation of learning factors. After a quick overview of knowledge and learning, I review the principles of effective theories, change drivers, and why a new theory of learning is required.

**Connectivism: Learning Theory or Past Time of the Self-Amused?**

*"To 'know' something is to be organized in a certain way, to exhibit patterns of connectivity. To 'learn' is to acquire certain patterns"* (Downes, 2005, Section O, ¶ 2).

The spirit, or *zeitgeist*, of an era influences the structures of society: churches and religious groups, school, and government. In contrast with the educational ideals of previous cultures, our current Western world is largely dominated by a spirit of productivity, utilitarianism, and return on investment (or other metrics to justify learning and training).

In today's environment, many educational structures exist with the primary intent of preparing individuals for the workforce. Much like previous societies aligned education with the higher ideals of their era, work and employment—as cornerstones of life—drive much of today's education. The religious-based views of education have largely given way to education based on science. As a whole, our structures of learning have become more utilitarian (Postman, 1995, p. 27).

As we will explore shortly in our desire to externalize our knowledge, our goals for learning are not simply utilitarian. We may engage in formal learning activities to increase our career prospects, but for many, the bulk of learning occurs as a desire to make sense, understand, develop personally, or (for the utopian) become contributors to making a better world. Our views of learning must account for our strong urge to *make meaning*.

Bowen (1972a p. xix) presents three broad challenges to education today: adequate rationale, support, and pedagogy. Educators are seeking to create a high-calling of learning that exceeds vocational needs. The absence of a clear pedagogy, or vision of

how learning ought to be done, further complicates the potential for success. Postman (1995) noted: “There was a time when educators became famous for providing reasons for learning; now they become famous for inventing a method” (p. 26). Our educational model today is largely defined by the desire to achieve and produce in an economic system.

When compared with higher ideals of education from previous societies, this model appears shallow. Mayer (1960) listed numerous basic goals of education: health, command of processes, home membership, vocational efficiency, civic efficiency, worthy use of leisure, and ethical character (p. 12). The varied purposes of learning presented learning opportunities beyond simply work. Many of the nobler elements of learning, often found in the belief or faith domain, have yielded to the increased quest for efficiency and utilitarianism.

Postman (1995) stated, “the great narrative of science shares with the great religious narratives the idea that there is order to the universe” (p. 9). Education occurs within the prominent philosophical and societal notions of what it means “to be.” In eras of religious focus, the development of morals provided the foundation of learning. In eras defined by exploration and knowledge growth, the prominent function of education was to pry open doors of hidden knowledge. The development of the industrial era shifted the educational focus to preparing individuals to function in work environments. Career preparation, not moral or intellectual development, became the primary focus of learning. The space of shifting ideals presents challenges for society as a whole: (a) the erosion of existing structures of knowing and need for knowing, and (b) the yet to emerge characteristics of the new space are unknown, or speculative at best (p. 23).

The current internet era is at a point of substantial change. The long-established fault lines of philosophical debate are being reshaped as our means of interpreting life, learning, and reality are moving into a new dimension—the virtual world. Dede (2005, p. 9) listed tremendous physical property values assigned to online virtual spaces, with GNP of virtual games exceeding the GNP of many countries, and virtual currency trading on par with real-world currency. The internet functions according to a different sequence of rules, guidelines, codes of conduct, and points of value than does the physical world. A necessary reorganization is underway, resulting in new metaphors of learning and existence as a whole.

The eyes through which we see learning, the boundaries in which we construct learning, have been shaped and created by the great debates from previous generations. The established notions of knowledge and learning appear inadequate in a world and space subject to substantially different pressures than earlier societies. The dichotomy of qualitative versus quantitative, religion versus science, and such have been formed through the debates of philosophers, scientists, and religious people. Educators today face challenges relating to: (a) defining what learning is, (b) defining the process of learning in a digital age, (c) aligning curriculum and teaching with learning and higher level development needs of society (the quest to *become better people*), and (d) reframing the discussion to lay the foundation for transformative education—one where technology is the enabler of new means of learning, thinking, and being.

Too many educators fail to understand how technology is changing society. While hype words of web 2.0, blogs, wikis, and podcasts are easy to ignore, the change agents driving these tools are not. We communicate differently than we did even ten years ago.

We use different tools for learning; we experience knowledge in different formats and at a different pace. We are exposed to an overwhelming amount of information—requiring continually greater levels of specialization in our organizations. It is here—where knowledge growth exceeds our ability to cope—that new theories of knowledge and learning are needed. And it is in this space that a *whole development* model of learning must be created (i.e. learning beyond vocational skills, leading to the development of persons as active contributors to quality of life in society).

Instead of knowledge residing only in the mind of an individual, knowledge resides in a distributed manner across a network. Instead of approaching learning as schematic formation structures, learning is the act of recognizing patterns shaped by complex networks. The networked act of learning exists on two levels:

1. Internally as neural networks (where knowledge is distributed across our brain, not held in its entirety in one location)
2. Externally as networks we actively form (each node represents an element of specialization and the aggregate represent our ability to be aware of, learn, and adapt to the world around).

**Intermediaries and Conduits for Learning and Communication**

We are social beings. Through language, symbols, video, images, and other means, we seek to express our thoughts. Essentially, our need to derive and express meaning, gain and share knowledge, requires externalization. We externalize ourselves in order to know and be known. As we externalize, we distribute our knowledge across a network—perhaps with individuals seated around a conference, readers at a distance, or listeners to podcasts or viewers of a video clip. Most existing theories of learning assume

the opposite, stating that internalization is the key function of learning (cognitivism assumes we process information internally, constructivism asserts that we assign meaning internally—though the process of deriving meaning may be a function of a social network, i.e. the social dimension assists in learning, rather than the social dimension being the aim of learning). The externalization of our knowledge is increasingly utilized as a means of coping with information overload. The growth and complexity of knowledge requires that our capacity for learning resides in the connections we form with people and information, often mediated or facilitated with technology.

### *Language and Learning*

As with any technology, the printing press influenced the process and nature of learning. Prior to Gutenberg's invention, the written word required skill, special paper, and significant time to produce. Gutenberg opened the door for anyone to access (and own) books. Access to books was simply a conduit to the higher goal of learning and knowledge.

As a result of the increased access to codified ideas in the form of text, the learning process transitioned from the previous dialogue or vocal base (Socrates, Plato, religious leaders) to the emphasis of text. Textual representations of knowledge provide a false sense of certainty and ascribe static attributes typically not inherent in knowledge from oral traditions. When knowledge is communicated through dialogue, the progressive growth of understanding is tied to the process, not the artefact. Learning, when primarily text-based, ascribes knowledge as primary in physical objects.

The emphasis of object over process is strong within today's educational markets. Most courses and learning experiences are built around content—textbooks, videos,

magazines, articles, or other learning objects. For centuries this model was effective. The content-central view of learning loses effectiveness in environments that are rapidly changing and adapting. Text in itself is a codification of knowledge at a point in time—a snapshot. In contrast, conversation is fluid and continual.

Language, as the corner stone of conversation and dialogue, is in itself transformative. Postman (1995) asserted that we use language to transform the world, but we are then in turn transformed by our invention (p. 87). A similar concept was expressed by Alex Kozulin in his forward to Vygotsky's (1986) *Thought and Language*: "abstract categories and word meanings dominated situational experience and restructured it" (p. xl). Language is a conduit—a medium through which individuals are able to create shared meanings or interpretations of concepts.

Deriving or assigning meaning as a cognitive process has historically been detailed in two regards: (a) images, as assigned to and shaped by words, is crucial in creating meaning (Bloor, 1983, p. 7); and (b) the symbol or image is rooted in the intent of the speaker—a "conscious orientation—actively directed at its object. The symbol is 'meant' a certain way, as its correct application is governed by an 'intention'" (p. 8).

According to Wittgenstein (as cited in Bloor, 1983), the role of externalization is an attempt to replace "internal, mental constructions" (p. 10) with external and "non-mental" (p. 10) constructs. The intent of externalization is to eliminate the hidden power, or in Wittgenstein's terminology the "occult character" (p. 10) of an image, permitting greater clarity in discussions.

Wittgenstein (as cited in Bloor, 1983) explored the private and public nature of meaning, arriving at the view that the "systematic pattern of usage" (p. 19) was the

primary expression of meaning. The patterns of usage are public, not private, and internal, as mental image or act theorists detailed.

"The real source of 'life' in a word or sentence is provided, not by the individual mind, but by society" (Bloor, 1983, p. 20). "In order to prove that there is an indissoluble link between the public world and the mental life of the individual, Wittgenstein attached the idea of what he called a 'private language'" (p. 54). To elaborate on these thoughts, Wittgenstein presented right and wrong as "public standards, and their authority comes from their being collectively held". Per Bloor, Durkheim and Wittgenstein pursued a differing view of objectivity than is normally associated with learning. Their source of objectivity resides outside of the mind and in society as a whole (p. 58). The statement that there can be no private language assaults the notion of individual subjectivity (p. 60):

> The point is that even introspective discourse is a public institution which depends on conventions and hence on training. We have no immediate self-knowledge and no resources for constructing any significant account of a realm of purely private objects and experiences. (p. 64)

Vygotsky (1986), like Wittgenstein, attached a certain element of externality to thought: "The meaning of a word represents such a close amalgam of thought and language that it is hard to tell whether it is a phenomenon of speech or a phenomenon of thought" (p. 212). Vygotsky then extrapolated the thought/word connection by asserting that thoughts do not come into existence unless expressed in words (p. 218).

Vygotsky (1986) stated his interest in language as a means to ensure complete understanding of a concept:

> Psychology, which aims at a study of complex holistic systems, must replace the method of analysis into elements with the method of analysis into units.…We believe that such a unit can be found in the internal aspect of the word, in *word meaning.* (p. 5)

The interplay of language, symbols, ideas, cognition, meaning, and learning are not clearly defined. Pietroski (2004) stated the challenge:

> If theories of meaning are theories of understanding, and these turn out [to] be theories of mental faculty that associates linguistic signals with meanings in constrained ways, then we should figure out (in light of the constraints) what this faculty associates signals with.

Extended, the concerns go beyond simply determining constraints. The challenge involves acquiring a common language of meaning relating to learning and knowledge, and exploring how supporting processes (cognition and emotions) are influenced by communication models (linguistics) and the conduits that deliver information and knowledge (technology), in relation to views of learning (truth, objectivity, subjectivity, epistemology).

### *Media, Symbols, and Technology*

While not quite in alignment with Vygotsky's (1986) assertion that language gives birth to thought, Bandura (1986) stated, "power of thought resides in the human capability to represent events and their interrelatedness in symbolic form" (p. 455). Media, language, technology, and symbols are devices that enable humans the capacity to externalize the nebulous elements of private thought. The externalization of thought is an important concept to consider in light of traditional theories of learning largely emphasizing knowledge construction and cognition as primarily internal events (in the mind of individuals).

Education, as a process, has its origin in the earliest recordings of human activity. It is believed that foundational elements of communication or knowledge transmission had their origin in pictograms (Bowen, 1972a, p. 7)—the attempt of people to express thought in physical form. Pictograms developed in complexity as *determinatives* were

added to clarify ideas and eliminate ambiguity. Even in early recordings of thought and reasoning, the notion of ambiguity influenced activities of communicators. The potential that one concept may be represented, or be interpreted, in various ways is a foundational challenge that continues to drive attempts to communicate and share knowledge. Perspective and subjectivity, or at minimum interpretation, add complexity to dialogue-based processes, like learning.

The attempt to communicate also presented the continuing challenge of the imperfect nature of physical tools to express mental thought. Writing and visuals are conduits only partly able to properly reflect intended meanings and understanding held in the minds of individuals. Through symbols, we desire clarification. “The world of our experience must be enormously simplified and generalized before it is possible to make a symbolic inventory of all our experiences” (Sapir, as cited in Vygotsky, 1986).

Symbols and language have been key elements of the cycle of understanding for much of recorded history. More recently, media and technology have begun to play a central role in creating the constructs of understanding that house shared conceptions and experiences of individuals. McLuhan (1967) suggested, “societies have always been shaped more by the nature of the media by which men communicate than by the content of the communication” (p. 8). The rapid growth of social-based technology tools creates an unprecedented opportunity for anyone with a computer and internet access to play the role of journalist, artist, producer, and publisher. If media truly does shape humanity, the changed nature of dialogue and information exposure created by the internet will have greater implications to our future than the nature of the content currently being explored.

Much like tools shape potential tasks, the internet shapes opportunities for dialogue—outside of space and time—that were not available only a generation ago.

### *Cognition and Emotions*

Wittgenstein's rejection of meaning as internally-derived events opens the possibility that knowledge, learning, and other meaning-based activities are capable of being seen as "networked elements" (as cited in Bloor, 1983). Meaning that resides external to an individual—the aggregate, or at least reflection, of social processes—can be viewed as a node or element in learning and knowing structures. The importance of the shift from internal to external knowing is evident in the rise of the internet as a connected structure permitting the development of knowledge and learning, not simply data and information. The learning is the network.

Cognition is a function of the environment in which it occurs; that is it develops from social milieu (Vygotsky, 1986, p. 108). Cognition can be seen as an intricate series of interactions between external and internal elements. The environment strongly influences the nature of cognition. This element is particularly valuable in considering the design of physical and virtual spaces of learning.

While emotions have been criticized as subjective and, therefore, difficult to study or subject to reason (Lane & Nadel, 2000, p. 12), they play a central role in understanding learning and knowledge creation. Cognition, emotion, perception, and beliefs are knowledge creation and knowledge navigation enablers. Empirical processes have created significant knowledge growth and have elevated cognition above the *softer* aspects of emotion, perception, and belief (or faith). These latter elements, however, are strong contributors to the ongoing search for meaning, truth, and knowledge. Often, the

soft elements are the entities that open doors of cognition. Intuition, while not as measurable and duplicable as empirical research, still plays a substantial role in fostering learning. Both cognition and beliefs are sources of knowledge.

Reflection and metacognition (thinking about thinking) are often ignored in cognitive processes.

> When we speak of improving our mind we are usually referring to the acquisition of information or knowledge, or to the type of thoughts own should have, and not to the actual functioning of the mind. We spend little time monitoring our own thinking and comparing it with a more sophisticated ideal. (Hueuer, 1999)

This admonition is particularly relevant in exploring assumptions about religion, education, learning, language, and teaching. Achieving a stage of knowing or conceptualizing, requires the formation of boundaries in our thinking, or defined beliefs, that enable subsequent decision making. Recognizing the hidden assumptions and deeper beliefs is important in moderating extrapolations that exceed the offerings of existing data or research (Occam's razor).

### *Epistemology—What Does it Mean to Know?*

Epistemology is concerned with the "the nature of knowledge and how we come to know things" (Driscoll, 2000, p. 12). While educators may question the practicality of exploring epistemology (preferring instead to focus on the act and process of instruction and learning in classrooms), perceptions of what it means to know and valid sources of knowledge greatly influence an educator's approach to the learning process.

Major epistemological perspectives include:

1. Empiricism—the belief that knowledge is gained through senses,
2. Nativism—the belief that knowledge is innate or present in at birth,
3. Rationalism—the belief that knowledge is a function of reason. (Driscoll, 2000, p. 13)

These three structures of valid knowledge sources provide the basis for reflecting on what it means to learn or know. Educational theories and models built on these views of knowledge. Assumptions of what it means to know drives approaches to learning creation. This concept is explored in greater detail in the section on "Learning Theories."

The concept of what qualifies for appropriate descriptions of knowledge is referenced in research theory, religion, and philosophy. As an expression for *ways of being and knowing,* qualitative and quantitative models are the most prominent. Table 1 indicates the main epistemological elements contained within each theory (Glesne, 1999, p.6, and Palys, 2003, p.15).

Table 1. *Ways of Knowing*

| | Qualitative | Quantitative |
|---|---|---|
| Other terms | Interpretivist, phenomenological, inductive, constructionist, idealism | Positivism, realism, deductive, objectivism, realism |
| Emphasis | Process, perceptions, meaning | Causes, effects, inputs |
| Validity | Closeness to participants, personal involvement | Detached, objective, analytical |
| Purpose of Research | *Verstehen*—behaviour in context, understanding, interpretation | Ability to predict, causal explanations |

Ways of knowing structured in the duality of qualitative and quantitative appear incomplete. Nuances and elements exist within fields that often resist subsumption. These elements span across several domains and, given the right mix of need and climate, can develop into their own domain.

Recently, traditional views of learning have been questioned (Downes, 2005; Siemens, 2004). The limits of traditional views of knowledge are accentuated with the development of the internet. Instead of seeing knowledge as innate, a function of reasoning or experience, connectivism and connective knowledge present an alternative source of valid knowledge.

Knowledge impacted by the construct in which it occurs. Kuhn (as cited in Glesne, 1999) suggested that "data and observations are theory-led, that the theory is paradigm-led, and that paradigms are historically and culturally located" (p. 5). To present a definition of knowledge based solely on epistemology fails to account for the significant conceptual alterations that occur when enacted in a particular context, or toward a particular objective. The true value of knowledge views are realized at the point of implementation or where learning development is based on learning theories, which in turn are built on epistemological assumptions previously listed. Value is recognized in the process or outcome of the learning experience.

This provides an additional challenge to exploring knowledge, as the mindset and viewpoint, beyond simply definition and context of use, impact existing viewpoints and conceptions. Glesne (1999) cited Schwandt in presenting the interrelation of our mental constructs and our approach to new knowledge:

> Our constructions of the world, our values, and our ideas about how to inquire into those constructions, are mutually self-reinforcing. We conduct inquiry via a particular paradigm because it embodies assumptions about the world that we believe and values that we hold, and because we hold those assumptions and values we conduct inquiry according to the precepts of that paradigm. (p. 8)

The question then arises of alternative models of research and exploration. Perhaps the models used to conceptualize learning, and other knowledge-based domains like research, are too confining. Perhaps the notions of paradigm-led research are

inadequate. While knowledge definition, context, and constructs influence knowledge development, the fabricated, linear, hierarchical classification structures rob knowledge of the dynamics and life seen at the implementation level. The challenge of false constructs results in blurring an image of the whole of a space: “We parcel arts and sciences into fragments, according to the straitness of our capacities, and are not so pansosphical as *uno intuitu* to see the whole” (Burke, 2000, p. 85).

## What is Learning?

Learning, when viewed as a process, is different than learning viewed as an event. Learning viewed as structured requires a different definition than learning as an informal process. Often, attempting to define learning at best provides a glimpse into how the writer perceives learning itself—i.e., the definition of learning is a reflection of what the writer already holds to be true about learning or the perspective from which she or he sees learning.

Learning definitions differ based on the approach and intended purpose. The multi-faceted aspect of learning requires a diverse approach. For example, learning how to build an engine requires a different combination of skill and cognition than learning how to handle a conflict with a colleague. Similarly, learning how to work with a spirit of tolerance with other cultures is a different experience than learning how to write a computer program. Learning involves varying combinations of cognition, memory, emotions, beliefs, and perceptions. Motivation, task-focus, and personal gratification influence the likelihood of learning will occur, but their role is more about enabling learning, not the actual act of learning itself.

Driscoll (2000) defined learning as "a persisting change in human performance or performance potential … as a direct result of the learner's experience and interaction with the world" (p. 11). American Society for Training and Development (2006) defined learning as "gaining knowledge or skills, or developing a behavior, through study, instruction, or experience" (¶ 14). Wikipedia (2006) defined learning as:

> The process of acquiring knowledge, skills, attitudes, or values, through study, experience, or teaching, that causes a change of behavior that is persistent, measurable, and specified or allows an individual to formulate a new mental construct or revise a prior mental construct (conceptual knowledge such as attitudes or values). It is a process that depends on experience and leads to long-term changes in behavior potential. (¶ 1)

Most theorists approach learning as some type of change in performance due to acquisition of skills or knowledge. However, knowledge acquisition does not equate with learning. Completing a certain task may be a function of learning on a basic level (i.e., driving a car), but does little to address the larger, interconnected nature of learning in relation to other aspects of the learners competence, comprehension, and skills. In a society of information abundance, these definitions of learning seek to address primarily lower-level cognition and emotion. The greater need of learning is to make sense of the space in which the learner functions and the potential implications of acquired knowledge. Learning how to operate a forklift may be learning at a basic level. Skills of this level, while important, are declining in a societal context. Learning needs are currently driven by high volumes of data and information, requiring a shift to higher-level models of learning.

To address the primarily task-focused view of learning evident in current learning conceptions, Siemens (2004) defined learning as "actionable knowledge", and stated learning occurs in the space between knowledge and meaning-making on the knowledge

hierarchy. This shift in learning definition aligns more closely with the needs of knowledge workers, instead of the physical, task-based view of traditional theories.

Both cognition and beliefs are sources of knowledge. The empirical notion of knowledge—what we can see, touch, or observe—has played the dominant role in the development of research and scientific methods. The parallel developments of belief and faith as knowledge structures are often ignored established institutions. Much of what we have come to know cognitively as a society, however, has its roots in belief and faith. To discount the importance of belief is to eviscerate an important element of the process of coming to know.

Much like Tannen (1989) perceived a listener in a discussion as a co-creator of meaning (p. 12), learning itself can be viewed as a two-way experience between teacher and learner, where the listener shapes and interprets meaning. Additionally, Tannen presented the necessity of "filling in unstated information" (p. 23) during discourse. Learning is a similar pursuit. Landauer and Dumais (1997) elaborated on this concept in their statement that "people have much more knowledge than appears to be present in the information to which they have been exposed" (¶ 2).

Learning is more than the acquisition of information. Our capacity to accept new information is hindered by existing mindsets and understandings. In a sense, what we believe influences our capacity to know more. Numerous factors—internal and external to the learner—influence the likelihood of learning occurring. Stokman (2004) explored social networks as structures that influence and foster learning, concluding that mutual interdependencies influence the potential for interaction or connection forming. Similarly, learning is a multi-faceted process that functions in a milieu of different needs,

interdependent tasks, barriers, affordances, and numerous other contributors and detractors to the experience.

Bandura (1986) emphasized multiple elements in the process of interaction and learning. *Reciprocal determinism* details how "behaviour, cognitive and other personal factors, and environmental influences" (p. 23) operate in a triadic, reciprocal manner to explain human functioning. The move to numerous and integrated models of learning are more representative of the nuanced nature of learning than traditional theories. The elements of Bandura's model operate as "interacting determinants of each other" (p. 18).

## Sense and Meaning Making

Much like knowledge and learning are terms with inconsistent applications, sense and meaning making are often misunderstood due to conflicting use. According to Kurtz and Snowden (2003), people "use patterns to order the world and make sense of things in complex situations". *Sense making* is an activity closely linked to learning, but is largely internal and focused on acquiring greater levels of understandings. Learning can be a function of acquiring a new skill, belief, or attitude, while sense making is a type of learning that orders and recognizes patterns formed by existing information or knowledge. The intent of sense making is to increase the cognitive comfort of an individual by reducing confusion and chaos. This act of meaning and sense-making is the domain in which most learning occurs in an information-abundant world.

Previous conceptions of learning rested heavily on information and knowledge acquisition. The fundamental need of learning in our society has changed. Due to rapid growth of knowledge, the act of learning has shifted from acquisition to assimilation,

from understanding of individual elements to comprehending an entire space and, thereby, understanding how elements connect.

Peter Schilling (2005) suggested that patterns are constructs that influence our capacity to learn:

> So, while patterns and categories are necessary for us to sort through the information to find meaning, once we have created our categories and patterns, they can be hard to put aside. In these cases, one cannot see familiar information without the categories or meaning with which we have associated it. (¶ 8)

*Meaning making* is a close kin to sense making. While sense making attempts to organize information and knowledge to create patterns which can lead to action, meaning making is the act of determining potential outcomes, impact, or effect of the knowledge itself. To make sense then is to understand; to make meaning is to understand the implications of the sense making process. Meaning making is not a process that occurs in isolation, it depends on surrounding activity (Bloor, 1983, p. 13). Additionally, meaning is created during the act of use (p. 25), and the usage is sensitive to the context and "to the knowledge that a range of contingencies may upset its applicability in any given case" (p. 43).

Vygotsky (1986) relied on language and the internal/external domain to communicate distinctions between sense and meaning: "While meaning stands for socialized discourse, sense represents an interface between one's individual (and thus incommunicable) thinking and verbal thought comprehensible to others" (p. xxxvii). In Vygotsky's logic, word meanings are generalizations, and generalizations are acts of thinking (p. 212). It then follows that "meaning [is] a phenomenon of thinking" (Bloor, 1983, p. 6), an internal state accompanying our word usage.

## What is the Role of Theory?

*"Researchers eek out small gains of knowledge from existing "grand theories" rather than explore new areas not covered by existing theories"* (Glaser & Straus, 1967, ¶ 6).

Theory serves a dual purpose of *explaining* phenomena (or more accurately, sense and meaning making) and of providing *guidance* for decision making or action. Sutton and Shaw suggested theory is "about the connections among phenomena" (p. 378). Theory provides a link between knowledge and implementation. Karl Weick chides specific solution-focused theory formations as inappropriate, as the intent of a theory is primarily a "struggle with 'sensemaking'" (¶ 10).

Educational technology is replete with theories. Some adapted from previous models (behaviourism, cognitivism, constructivism), blended theories[1], emerging theories (connectivism), and related views of networked learning (Wikipedia, 2006). Blended and emerging theories counterbalance established theories in pursuing a theory in line with the nature of the society it purports to support. Tools change people. We adapt based on new affordances. To rely on a theory that ignores the networked nature of society, life, and learning is to largely miss the point of how fundamentally our world has changed.

## Learning Theories

Three prominent learning theories seek to provide insight into the act of learning: behaviourism, cognitivism, and constructivism. Each of these theories has numerous subsets (social cognitivism, social constructivism). Gredler (2005) listed two separate

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[1] Centre for Research On Networked Learning and Knowledge Building at Helsinki University explores socio-cognitive research of learning – and the "socially distributed nature of human cognition" – in light of technology.

theories: (a) interactionist, based on Gagné's learning conditions and Bandura's social-cognitive theory, and (b) developmental-interactionists, based on Piaget's cognitive development and Vygotsky's cultural-historical theories (p. 20). For the purposes of this paper, learning theories are cast as they link to the epistemological structures listed previously. The three dominant theories (behaviourism, cognitivism, and constructivism) are closely aligned with empiricism, nativism, and rationalism (see Table 2).

Table 2. Forms of Knowledge

| | **Objectivism** | **Pragmatism** | **Interpretivism** |
|---|---|---|---|
| Epistemology | Empiricism | Nativism | Rationalism |
| Source of knowledge | Experience | Reason and experience | Reason |
| How do we acquire knowledge? | Objective, external, sensory experience | Knowledge is interpreted, reality exists, but mediated through symbols and signs | Reality is internal and (like knowledge) is constructed through thought |
| Where does knowledge reside? | In the individual—but reflected through external, observable actions | In the individual | In the individual, in the context of environments |
| Learning theorists | Skinner, Thorndike, Pavlov, Watson | Vygotsky, Bandura, Bruner, Ausubel, Gagne | Bandura, Piaget, Bruner, Dewey |
| Learning theories | Behaviourism | Cognitivism/constructivism | Constructivism |

Note: Table adapted from: Driscoll (2000, p.17).

Behaviourists are largely concerned with the outcome, or observable elements of learning. Behaviourists see learning as a "black box" (Driscoll, 2000, p. 35). Instead of focusing on the internal mental activities, behaviourists focus on observable behaviour (Gredler, 2005, p. 28). Behaviour is managed through a process of strengthening and weakening of responses. Key theorists in behaviourism include: Pavlov, Watson, Skinner, Thorndike (Gredler, p. 29, Driscoll, p. 19).

Cognitivists, to varying degrees, have posited a structured view of learning that includes the model of a computer (input, encoding, storage, outcome), a staged process of development, and schematic views of knowledge, with learning being the act of classifying or categorizing new knowledge and experiences. Cognitivists see learning as information processing. The computer is often used as a metaphor for learning (Driscoll, 2000, p. 75). Sensory input is managed in short-term memory and coded for retrieval in long-term memory. Situated cognition, the view that thought is a function of, or adaptation to, the environment in which the thinking (or learning) occurs (p. 154), and schema theory, the view that meaningful learning (p. 116) is a process of subsumption in an internal hierarchy of concepts, are extensions of basic cognitivism. Piaget and Vygotksy are sometimes classified as cognitivits (Gredler, 2005, pp. 264 & 304; Driscoll, pp. 183 & 219). Other cognitivists include Bruner, Gagne, and Ausubel.

Constructivism is a frustratingly vague concept. The Centre for Research on Networked Learning and Knowledge Building (n.d.) suggested,

> constructive "theory" of learning, generally, has not at all become more specific or articulated or gained any increased explanatory power or unification. There has not been any progressive problem shift after the 80s but a continuation of a very general and ideologically colored discussion. (¶ 2)

Constructivists hold learning to be a process of active construction on the part of the learner. Learning occurs as the learner "attempt to make sense of their experiences" (Driscoll, p. 376). The roots of constructivism can be found in the epistemological orientation of rationalism, where knowledge representations do not need to correspond with external reality (p. 377). Adherents to constructivism borrow heavily from theorists previously mentioned: Piaget, Vygotsky, and Bruner (Dabbagh, 2005; Driscoll, 2000).

Learning theories and theorist classifications are contradictory. For example, Driscoll (2000) listed Bruner as a pragmatist/cognitivist, while Dabbagh (2005) listed him as a constructivist. New entrants into this space quickly find a convoluted mix of psychology, philosophy, and theory pop-culture. Discerning theories with underlying assumptions of learning is challenging. Particularly confusing is the theory of constructivism, which researchers tend to treat as a banner under which to fly numerous aspects and new views. It has come to mean everything, anything, and nothing. While not as acerbic, Driscoll stated, "there is no single constructivist theory of instruction. Rather, there are researchers in fields from science education to educational psychology and instructional technology who are articulating various aspects of constructivist theory" (p. 375). Additionally, it may be unclear whether constructivism is actually a theory or a philosophy (p. 395).

### *Challenges to Existing Learning Theories*

To qualify as a well-constructed theory, four elements must exist (Gredler, 2005, p. 12): (a) clear assumptions and beliefs about the object of the theory, (b) key terms are clearly defined, (c) development of principles from assumptions, and (d) explanation of "underlying psychological dynamics of events related to learning".

Instead of modeling our knowledge structures as hierarchical or flat, confined belief spaces, the view of networks enables the existence of contrasting elements selected on the intent of a particular research or learning activities. If the silos of traditional knowledge classification schemes are more fluid, perhaps the individual elements of different theories can be adopted, as required, to solve more nuances of learning problems. When the theory does not require adoption in its fullest (i.e, interpretivism or positivism), the task of seeking knowledge becomes more salient.

Wittgenstein's assertion that there can be no private language (as cited in Bloor, 1983) and Vygotsky's (1989) notion that thought requires expression are misinterpreted to place emphasis on the external environment as a mirror or reflection required for knowledge to occur, or be transmitted. While the external environment is critical, both Vygotsky and Wittgenstein mistook the environment for the space in which thought gains life, when in reality, the external environment is an additional space for knowledge, thought, expression, and reflection. As an extension of humanity, the external is in itself a space in which we exist—rather than an environment in which our words find existence. When objects and other external entities are viewed as extension of humanity, the notion of learning as a network formation process becomes more palatable. If knowledge exists in external structures of similar nature, as it exists physically within our minds (distributed, neurologically), then it is possible to ascribe knowledge and learning attributes to the distributed nature of networks formed between people.

Additional support of the concept of knowledge (and learning) existing outside of the human mind is found in vision research.

> We suggest that the objects of thought, the very things upon which mental processes directly operate, are not always inside the brain…The cognitive

> processing that gives rise to mental experience may be something whose functioning cuts across the superficial physical boundaries between brain, body, and environment. (Spivey, Richardson, & Fitneva, 2004, p. 178)

The challenge of theory comparison and analysis rests in the *point of focus.* Much like any element in society, the aspect that the viewer is focused on determines the nature of the conclusion, as well as defines the capacity to see what exists. Integrated, holistic views of theories and the particular functions they serve is often lacking.

Wittgenstein's rejection of meaning as internally-derived events (as cited in Bloor, 1983), opens the possibility that knowledge, learning, and other meaning-based activities are capable of being seen as networked elements. Meaning that resides external to an individual—the aggregate, or at least reflection, of social processes—can be viewed as a node or element in learning and knowing structures. The importance of the shift from internal to external knowing is evident in the rise of the internet as a connected structure, which permits the development of knowledge and learning—not simply data and information. The learning is the network.

One of the limiting features of much thought with regard to learning, understanding, and behaviour is the inclination to take a deliberate one-sided view of the concern. Human functioning (and the very act of cognition) is difficult to reduce to simple representations. A holistic view and model of cognition and learning is required—one which addresses emotions, thoughts, language, symbols, circumstances, morality, and environment.

Various theories present knowledge as an internal state of being in relation to knowledge as an internal or external object. Edwin Hutchins (2000) suggested that

> It does not seem possible to account for the cognitive accomplishments of our species by reference to what is inside our heads alone. One must consider the cognitive roles of the social and material world…The distributed cognition

> perspective aspires to rebuild cognitive science from the outside in,, beginning with the social and material setting of cognitive activity, so that culture, context, and history can be linked with the core concepts of cognition.

Hierarchies of knowledge have been created to demarcate elements commonly described as knowledge or information. Liebowitz (1999) cited the work of Tobin in structuring a four-tier hierarchy: data (+ relevance + purpose) = information (+ application) = knowledge (+ intuition + experience) = wisdom (p. 1-5). Wisdom is the upper echelon of most conceptions of thought and knowledge, but, as Burke (2000) noted, wisdom must be "learned more or less painfully by each individual" (p. 12). Other knowledge conceptions (Siemens, 2005) suggest the highest level in the hierarchy is meaning—the comprehension of nuances and implications of knowledge. Moving wisdom to the domain of the internal introduces similar challenges addressed by Wittgenstein (as cited in Bloor, 1983) and Vygotsky (1986), namely, how can something that is exclusively internal have life or meaning?

## Change Drivers Requiring a New Theory

*"Problems emerge when new findings are pressed into immediate service, while the academic routines on which they depend remain unchanged"* (Baumeister, 2005, Academic Teaching section, ¶ 2)

### *Understanding of Learning*

We are growing in our understanding of learning. Research in neuroscience, theories of social-based learning, and developments in learning psychology create new understanding of the act, and process, of learning. As Downes (2006) stated,

> Learning…occurs in communities, where the practice of learning is the participation in the community. A learning activity is, in essence, a *conversation* undertaken between the learner and other members of the community. This conversation, in the web 2.0 era, consists not only of words but of images, video, multimedia and more. This conversation forms a rich tapestry of resources,

> dynamic and interconnected, created not only by experts but by all members of the community, including learners. (Network Pedagogy section, ¶ 6)

### *Pace of Knowledge Growth*

Most individuals require little evidence to support the rapid growth of knowledge—they feel it in their daily lives. A University of California, Berkeley (2003) study on information growth found a 75% increase in two years. Information and knowledge are tightly linked; as information grows so does our knowledge.

### *Development of Technology (Ubiquity)*

Technology is mobile, embedded, transparent, and ubiquitous. Continual access to technology requires different vetting processes for knowledge. Consider how television news differs from video created by an amateur at the scene of an accident. Higher levels of trust are generally assigned to formal news programs. However, as exemplified by the growth of online video sites like YouTube, the personable, first-hand account of amateur video has significant appeal.

The persistent advancement of technology adds complexity to how knowledge is organized, created, and managed. Business executives are constantly connected to their office. Technical workers have mobile access to detailed database to assist with onsite work. Farmers rely on advanced soil testing in determining seeding, and then utilize GPS when planting and harvesting. Few areas of life remain unaffected.

### *Expectations of Students (Net Generation)*

When students enter educational spaces today, they do so with a different mindset from even a few years ago. Video games, mobile phones, instant messaging, and online social networking have been constant for many teenagers. Through the use of blogs and

wikis at the secondary school level, these learners are entering higher education with expectations sure to be unmet.

In *Educating the Net Generation*, Diana and James Oblinger (2004) offered a detailed overview of today's learners: digitally literate, constantly connected, socially-driven, engaged, visually-driven, and a host of additional pronounced characteristics. Simply stated, today's learners are different.

### *The Great Complexification*

Weinberger (2005) presented *complexification* as a defining aspect of knowledge today. We are now able, through an abundance of social tools, to produce and create content previously requiring a substantial investment. Broadcasting ideas—in text, audio, and video—is a fairly simple process. As a result, any issue can be explored and dissected form numerous angles. Even simple viewpoints can be complexified through the multiple viewpoints of the masses.

While blogs, wikis, podcasts, and social bookmarking are receiving much attention, the real point of interest lies not in the tools themselves, but in what the growth of the tools represents and what the tools enable. Primary affordances include: (a) two-way flow, and (b) activities reflective of networked activities of individuals

Making sense of this complex conversation requires a shift to alternative models of management. It is at this stage that technology is beginning to play its greatest role; one that will continue to grow in prominence as knowledge grows in complexity. Learning, augmented by technology, permits the assimilation and expression of knowledge elements in a manner that enables understanding not possible without technology.

*Emerging Philosophy of Knowledge, Learning, and Knowing*

Philosophies of "what it means to know" are emerging in reaction to the developments in technology and society. Stephen Downes (2005) offers a view of knowledge beyond traditional classifications as listed in Table 1.

> You probably grew up learning that there are two major types of knowledge: qualitative and quantitative… Distributed knowledge adds a third major category to this domain, knowledge that could be described as connective. A property of one entity must lead to or become a property of another entity in order for them to be considered connected; the knowledge that results from such connections is connective knowledge.

According to Downes (2005), connective knowledge networks possess four traits:

| | |
|---|---|
| *Diversity* | Is the widest possible spectrum of points of view revealed? |
| *Autonomy* | Were the individual knowers contributing to the interaction of their own accord, according to their own knowledge, values and decisions, or were they acting at the behest of some external agency seeking to magnify a certain point of view through quantity rather than reason and reflection? |
| *Interactivity* | Is the knowledge being produced the product of an interaction between the members, or is it a (mere) aggregation of the members' perspectives? |
| *Openness* | Is there a mechanism that allows a given perspective to be entered into the system, to be heard and interacted with by others? |

## What About Technology?

While still in early stages of development, technology is permitting new ways of seeing information and the impact of interactions. As discussed earlier, rapid knowledge growth requires off-loading the internal act of cognition, sense and meaning making, and filtering to a network consisting of human and technology nodes.

As a simple example, the popular tag feature of many sites (del.icio.us, digg.com, flickr), enable pattern recognition that captures the activities of thousands or millions of

individuals. As knowledge complexifies, patterns—not individual elements—become of greatest importance in gaining understanding.

## What Makes Connectivism a Theory?

Mergel (1998) cited Ertmer's and Newby's "five definitive questions … to distinguish learning theory" (Distinguishing One Learning section, ¶ 1):

1. How does learning occur?
2. What factors influence learning?
3. What is the role of memory?
4. How does transfer occur?
5. What types of learning are best explained by this theory? (¶ 2)

Table 3. *Learning Theories*

| **Property** | **Behaviourism** | **Cognitivism** | **Constructivism** | **Connectivism** |
|---|---|---|---|---|
| How does learning occur? | Black box—observable behaviour main focus | Structured, computational | Social, meaning created by each learner (personal) | Distributed within a network, social, technologically enhanced, recognizing and interpreting patterns |
| Influencing factors | Nature of reward, punishment, stimuli | Existing schema, previous experiences | Engagement, participation, social, cultural | Diversity of network |
| What is the role of memory? | Memory is the hardwiring of repeated experiences—where reward and punishment are most influential | Encoding, storage, retrieval | Prior knowledge remixed to current context | Adaptive patterns, representative of current state, existing in networks |
| How does transfer occur? | Stimulus, response | Duplicating knowledge constructs of "knower" | Socialization | Connecting to (adding) nodes |
| Types of learning best explained | Task-based learning | Reasoning, clear objectives, problem solving | Social, vague ("ill defined") | Complex learning, rapid changing core, diverse knowledge sources |

Controversy exists as to the primacy of memory in the learning process—especially when many technology tools are more effective at retrieval than we are. Memory is not as static as theorists present in views of learning. Memory involves a

*recalling* and *reconstruction*. New experiences influence existing memory. Visiting childhood homes and play areas often reveals a dramatically different space than what was remembered. Memory is perhaps most prominent in cognitivism, where input, encoding, storage (in memory), and recall (from memory) are critical in the design process.

The concept of *transfer* is loaded, with educators and cognitive scientists questioning if knowledge can be transferred or simply created, constructed, or shared. It is important to note that most learning theories overlap.

For clarification, it is important to briefly consider *connectionism* in contrast with connectivism. Connectionism is based in behaviourism (Thorndike, as cited in Kearsley, n.d.), where learning occurs as we form links between stimulus and response. Connectionism, in terms of neuro/cognitive science, is focused on neural networks—the manner in which we learn—contrasted with previous views of learning as information processing (Garson, 2002). Connectivism shares some traits of the cognitive science view of connectionism—the view that learning is a process of network formation. Connectionism is only focused with learning that happens in our heads. Connectivism is focused on the process of forming and creating meaningful networks that may include technology-mediated learning, acknowledges learning that occurs when we dialogue with others, i.e., we collect knowledge in our friends (Stephenson, n.d.) and such. Connectivism is strongly focused on the linking to knowledge sources … not simply trying to explain how knowledge is formed in our own heads.

The more rapidly knowledge develops the less likely it will be that we will possess all knowledge internally. The interplay of network, context, and other entities

(many which are external) results in a new approach or conception of learning. The active creation of our own learning networks is the actual learning, as it allows us to continue to learn and benefit from our network—compared to a course which has a set start and end date.

## Conclusion

After decades of molding existing theories to changed environments, continual revisions, in the face of dramatic change in knowledge, society, and technology, form the foundation of a needed change in how we perceive learning. Our views of learning, as the basis of a new approach to designing and fostering learning, are most useful when they are in line with the changed environment.

For many, the debate of changed modes of learning does not require an explicit statement. They sense it in their work, how they communicate, and how they learn. These individuals are not focused on what, if anything, has changed theoretically. They are asking different questions than we are attempting to answer with dated theories.

Our obligation as educators requires a solid focus on emerging trends, while not succumbing to distracting fads. Our desire to connect—to externalize—is a vital component of the learning process. Instead of merely developing learners for careers, we have an obligation to create a learning ecology where learners are able to shape their own meaning. Where we fail to react to changes, learners will pursue alternatives. The creation of a sound theory of learning provides the basis of learning and societal functioning. Knowledge growth, emerging research (in neuroscience and artificial intelligence), new philosophies of knowing, and growing complexity requiring distributed knowing and sense making are no longer sufficiently attended to by the broad

theories of learning prominent in past education. An alternative is needed. Whether connectivism plays this role is irrelevant. Of most importance is that educators are reflecting on how learning has changed and the accompanying implications to how we design the spaces and structures of learning today.

**Works Cited**

American Society for Training and Development. (2006). *Glossary.* Retrieved on November 12, 2006, from www.astd.org/astd/Resources/performance_improvement_community/Glossary.htm

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Baumeister, H-P. (n.d.). Networked learning in the knowledge economy: A systemic challenge for universities. *European Journal of Open, Distance and E-learning.* Retrieved November 12, 2006, from http://www.eurodl.org/materials/contrib/2005/Baumeister.htm

Bloor, D. (1983). *Wittgenstein: A social theory of knowledge.* London, UK: MacMillan Press.

Bowen, J. (1972a). *A history of western education* (Vol. 1). New York: Routledge.

Burke, P. (2000). *A social history of knowledge.* Malden, MA: Blackwell Publishers.

Centre for Research on Networked Learning and Knowledge Building. (n.d.). *Development of learning theories*. Retrieved November 12, 2006, from University of Helsinki, Centre for Research on Networked Learning and Knowledge Building Web site: http://www.helsinki.fi/science/networkedlearning/eng/delete.html

Dabbagh, N. (2006). *The instructional design knowledge base*. Retrieved November 12, 2006, from George Mason University, Instructional Technology Program, Nada Dabbagh's Homepage: http://classweb.gmu.edu/ndabbagh/Resources/IDKB/index.htm

Dede, C. (2005). Planning for neomillennial learning styles. *Educause Quarterly*, *28*(1). Retrieved on November, 2006, from http://www.educause.edu/pub/eq/eqm05/eqm0511.asp

Downes, S. (2005, December 12). *An introduction to connective knowledge.* Retrieved on November 12, 2006, from http://www.downes.ca/cgi-bin/page.cgi?post=33034

Downes, S. (2006). *Learning networks and connective knowledge*. Retrieved November 12, 2006, from http://it.coe.uga.edu/itforum/paper92/paper92.html

Dreyfus, H. (2002). *Lectures on Heidegger's time and being*. Retrieved November 12, 2006, from http://142.58.112.126/heidegger/

Driscoll, M. (2000). *Psychology of learning for instruction* (2nd ed.). Needham Heights, MA: Allyn & Bacon.

Garson, J. (2002) Connectionism. *Stanford Encyclopedia of Philosophy*. Retrieved November 12, 2006, from Stanford University, Center for the Study of Language and Information Web site: http://plato.stanford.edu/entries/connectionism/

Glaser, B. G., & Strauss, A. L. (1967) (Reviewed by Keith Rollag). The discovery of grounded theory: Strategies for qualitative research. Retrieved November 12, 2006, from http://faculty.babson.edu/krollag/org_site/craft_articles/glaser_strauss.html

Glesne, C. (1999). *Becoming qualitative researchers: An introduction.* New York: Longman.

Gredler, M. E. (2005). *Learning and instruction: Theory into practice* (5th ed.).Upper Saddle River, NJ: Pearson Education.

Hueuer, R. J. (1999). *Psychology of intelligence analysis.* Retrieved on November 12, 2006, from https://www.cia.gov/csi/books/19104/index.html

Hutchins, E. (2000). *Distributed cognition.* Retrieved on January 21, 2006, from http://eclectic.ss.uci.edu/~drwhite/Anthro179a/DistributedCognition.pdf

Kearsley, G. (n.d.). *Connectionism (E. Thorndike).* Retrieved November 12, 2006, from http://tip.psychology.org/thorn.html

Kurtz, C. F., & Snowden, D. J. (2003). The new dynamics of strategy: Sense-making in a complex and complicated world. *IBM Systems Journal, 42*(3), 462-483.

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 November 12, 2006 from http://lsa.colorado.edu/papers/plato/plato.annote.html

Lane, R. D., & Nadel, L. (Eds.) (2000). *Cognitive neuroscience of emotion.* New York: Oxford University Press.

Liebowitz, J. (Ed.). (1999). *Knowledge management handbook*. Boca Raton, FL: CRC Press.

Mayer, F. (1960). *A history of education thought.* Columbus, OH: Merrill Books.

McLuhan, M. (1967). *The medium is the massage: An inventory of effects*. Corte Madera, CA: Gingko Press.

Mergel, B. (1998). *Instructional design and learning theories*. Retrieved on November 12, 2006, from University of Saskatchewan, College of Education Web site: http://www.usask.ca/education/coursework/802papers/mergel/brenda.htm

Oblinger, D., & Oblinger, J. (Eds.). (2004). Educating the net generation. *Educause*. Retrieved on November 12, 2006, from http://www.educause.edu/educatingthenetgen

Palys, T. (2003). *Research decisions: Quantitative and qualitative perspectives* (3rd ed.). Scarborough, ON, Canada: Nelson.

Pietroski, P. (2004). *Character before content*. Retrieved on November 12, 2006, from University of Maryland, Workstations at Maryland Web site: http://www.wam.umd.edu/~pietro/research/papers/cbc.pdf

Postman, N. (1995). *The end of education: Redefining the value of school.* New York: Alfred A. Knoff.

Schilling, P. (2005). *Technology as epistemology*. Retrieved on November 12, 2006, from http://www.academiccommons.org/commons/essay/technology-as-epistemology

Siemens, G. (2004). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning.* Retrieved on November 12, 2006, from http://www.itdl.org/Journal/Jan_05/article01.htm

Siemens, G. (2005). *Meaning making, learning, subjectivity* Retrieved on November 12, 2006, from http://connectivism.ca/blog/2005/12/meaning_making_learning_subjec.html

Spivey, M., Richardson, D., & Fitneva, S. (2004). *Thinking outside the brain: Spatial indices to visual and linguistic information*. Retrieved November 12, 2006, from University of California, Psychology Department Web site: http://psych.ucsc.edu/eyethink/publications_assets/SpiveyRichardsonFitneva.pdf

Stephenson, K. (n.d.) (Internal Communication, no. 36) *What Knowledge Tears Apart, Networks Make Whole*. Retrieved November 12, 2006 from http://www.netform.com/html/icf.pdf

Stokman, F. N. (2004). *What binds us when with whom? Content and structure in social network analysis.* Retrieved on November 12, 2006, from http://vlado.fmf.uni-lj.si/info/sunbelt24/

Sutton, R., & Shaw, B. (1995). What theory is not. *American Science Quarterly, 40*, 371-387.

Tannen, D. (1989). *Talking voices: Repetition, dialogue, and imagery in conversational discourse.* New York: Cambridge University Press.

University of California, Berkeley. (2003). *How much information 2003.* Retrieved on November 12, 2006, from School of Information Management and Systems Web site: http://www.sims.berkeley.edu:8000/research/projects/how-much-info-2003/execsum.htm

Verhagen, P. (2006). *Connectivism: A new learning theory?* Retrieved November 12, 2006, from http://elearning.surf.nl/e-learning/english/3793

Vygotsky, L. (1986). *Thought and language.* Cambridge, MA: MIT Press.

Weick, K. E. (1989). Theory construction as disciplined imagination. *Academy of Management Review, 14*(4), 516-531. Retrieved November 12, 2006, from http://faculty.babson.edu/krollag/org_site/craft_articles/weick_theory.html

Weinberger, D. (2005, June 27). *The new shape of knowledge.* Retrieved September 1, 2006, from http://www.hyperorg.com/blogger/mtarchive/004153.html

Wikipedia (2006). *Learning.* Retrieved on March 24, 2006, from http://en.wikipedia.org/wiki/Learning

Wikipedia. (2006). *Networked learning.* Retrieved November 12, 2006, from http://en.wikipedia.org/wiki/Networked_learning