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Technology for Teaching and Learning: Moodle as a Tool for Higher Education

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Many Canadian Educational Psychology classes currently emphasize and model constructivist teaching practices in addition to integrating the notion of connectivity and Web 2.0 into educational theory. This study examines 'Moodle[1]' as a technological tool to further enhance participation and performance in addition to the regularly used 'semiotic tools' and social-dialogical activities found in a teacher education program. Similarly, discourse and narrative are described as a mode of thinking, as a structure for organizing our knowledge, and as a vehicle in the process technology and higher education. How can a program of learning be assisted with structuring the delivery and organization of knowledge?

The implementation of constructivist[2] notions of theory into practice has been attempted in many learning environments, and most recently in technology and higher education (Doolittle, 1999; Roth & Lee, 2007). Vygotsky's cultural-historical theory of psychological development informed the foundation of sociocultural theory and constructivist practices of teaching and learning (Kozulin, 1998; Lave & Wenger, 1991; Vygotsky, 1978; Wells, 1999; Wenger, 1998; Wertsch, 1998).

Educational Psychology is a compulsory course for all teacher education candidates at my university. Many Canadian teacher education programs currently emphasize and model constructivist teaching practices based on the theory that learning involves active, cognitive processes that are adaptive, subjective, and involve both sociocultural and individual processes (Doolittle, 1999). Teacher candidates today are required to teach in the Canadian public school system that has a preponderance of Web 2.0 learners. Teachers are required to integrate the notion of connectivity and Web 2.0 into their educational practices. It is necessary that they understand and adapt their teaching methods to address these students (Levin, Arafeh, Lenhart, & Raine, 2002; Salaway, Borreson, & Nelson, 2008).

Web 2.0 Learners

Prensky (2001) was one of the first to identify the change in thinking patterns of today's students – K through university – who represent the first generations to grow up with new digital technologies. According to his research, they have spent their entire lives surrounded by and using computers, video games, digital music players, video cams, cell phones, and all the other tools of the digital age including computer games, E-mail, the Internet, texting, and instant messaging-- all of which are integral parts of their lives. These students can be called Digital Natives, that is, native speakers of the digital language of computers, video games and the Internet. Digital immigrants are those who were not born into this era, who may have adopted these technologies but are not native speakers (Prensky, 2001). This has led to one of the most talked about problems with education today, that is our Digital Immigrant instructors, "who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language" (Prensky, 2001,p. 2). In order to address this, Digital Native methodologies need to be constructed for all subjects, at all levels, using our students to guide us (Prensky, 2007).

All this exposure and previous experience, Prensky (2001) surmises, has caused Digital Natives' brains to develop to a physiologically different degree. As a result of repeated experiences some areas of the brain are larger and more highly developed, and others are less so.

For example, thinking skills enhanced by repeated exposure to computer games and other digital media include reading visual images as representations of three-dimensional space (representational competence), multidimensional visual-spatial skills, mental maps, "mental paper folding" (i.e. picturing the results of various origami-like folds in your mind without actually doing them), "inductive discovery" (i.e. making observations, formulating hypotheses and figuring out the rules governing the behavior of a dynamic representation), "attentional deployment" (such as monitoring multiple locations simultaneously), and responding faster to expected and unexpected stimuli (Prensky, 2001, p.4).

These notions of "pruning" and "brain plasticity" are also supported by researchers (Kolb, Gibb, & Robinson, 2003; Seely-Brown, 2002). Moreover, Small & Vorgan (2008) surmise that youth are predominantly using their temporal lobes while interacting with digital media and may not be establishing vital connections in their frontal lobes, where reasoning and social abilities are established. Nevertheless, the intensity and

combination of these cognitive skills have caused the old educational paradigm to be obsolete (Prensky, 2001). Twenty-first century teachers have developed into the role of challenger, observer, guide, and coach to their students. In doing so, they maintain intellectual rigor but with the collaboration of their students in defining the goals that are worthwhile, allowing them to arrive at the destination at their own speed and choice of "vehicle" (Prensky, 2007).

Continuing with the philosophy of "teach less / learn more," Tapscott (2009) advocates for similar teaching strategies to address the Millennials' unique learning needs. These include: a) a learning environment that is student focused, customized, and collaborative, b) learning experiences that emphasize student co-creation and reduced lecturing, c) student empowerment and choice, d) a focus on life-long learning, not teaching to the test, e) technology as a tool to get to know each student, f) educational programs designed according to the eight norms of the "Net Generation" (Tapscott, 2009, p. 148). Moreover, he describes the Net Generation as the children of the Boomer generation aged 11-31 who have grown-up digital. Tapscott (2009) posits that there are eight norms, or clusters of attitudes and behaviors, that define this generation and are central to understanding how their needs are changing the process of education and work environments. These norms include: freedom, customization, scrutinizers of information, integrity, collaboration/relationships, entertainment/motivation, speed, and innovation. The Net Generation adapts technology to suit their individual needs [adapters], while other generations are considered "users" of the technology that is presented to them [adopters].

Web 1.0/Web 2.0 Continuum

The term "Web 2.0" reflects a shift in leading-edge applications on the World Wide Web, a shift from the presentation of material by website providers (Web 1.0) to the active co-construction of resources by communities of contributors with interactive media. Whereas the twentieth-century web revolved around developer-created material (e.g., informational websites) generated mainly by a small fraction of the Internet's users, Web 2.0 tools (e.g., Wikipedia) help large numbers of people build online communities for creativity, collaboration, and sharing. And with web application programming interfaces, community-builders do not need specialized technical expertise to create new media/information (Dede, 2008).

Students raised in a Web 2.0 world view knowledge and its acquisition differently. It is thought that many schools and parents do not address their preferences for learning and are proponents of emphasizing 20th century learning epistemologies (Bauerlein, 2008; Owston, 1997). Some researchers, who are digital immigrants, question whether we should be adapting school time to Web 2.0 learning environments since students are already immersed in so much screen-time (Birkerts, 1994; McKibben, 1992; Postman, 1993). What long-term implications does this have for learning, development, and schooling? Moreover, how many students in Canadian public schools and universities are really digital natives? What factors influence this distinction?

Interestingly, precise distinctions are difficult to ascertain between Web 1.0 and Web 2.0 because in reality these technologies develop over time, with hybrid versions in place, a "work in progress" as they are used and adapted by users in multiple contexts, schooling being just one.

Technology as a Tool for Learning

The following are assumptions for designing contemporary pedagogical practices infused with constructivist theory in classrooms that view: (1) learning as a process of construction so there will be multiple constructions/perspectives, (2) learning in contexts that are relevant to the learner, (3) learning mediated by tools (technology) and signs (semiotic tools), and (4) learning as a social-dialogical activity (Duffy & Cunningham, 1996; Vygotsky, 1978). As well, "it seems typical of apprenticeship that apprentices learn mostly in relation with other apprentices" (Lave & Wenger, 1991, p.93). This is in keeping with Digital Natives' philosophy of learning, that is "search for meaning through discussion" (Prensky, 2007, p. 2).

Doolittle (1999) proposes that contemporary pedagogy can be translated into the virtual medium, and that this interface can meet constructivist tenets while providing relevant learning opportunities. A learning management system (LMS) is needed to bridge constructivist theory with pedagogical recommendations. Moodle can provide a unique opportunity for students to engage in social negotiation and mediation in the form of asynchronous (e-mail, threaded discussions) and synchronous (simulations, web-based data collection, and ill-structured problem solving) technology. These online communications allow for social negotiation and mediation to occur across both time and distance (Doolittle, 1999). Moreover, formative feedback can be provided to students by their peers, as well as by the professor, in order to alter subsequent instruction. Social negotiation and feedback can encourage students to be more involved and more persistent relative to the educational environment. In addition, this format encourages instructors to take on a facilitating role and encourage the use of diverse resources and multiple perspectives (Doolittle, 1999).

With a change in pedagogical practices infused with technology, new taxonomies should inform the development of instructional strategies and assessments that encourage many "types (styles) of learners" such as active, strategic, intentional, conversational, reflective, and "ampliative" that is, learners who generate assumptions, attributes, and implications of what they learn (Jonassen & Tessmer, 1997). Therefore, learners are multidimensional participants in a sociocultural process of making "knowing how we know" the ultimate accomplishment.

Conceptual Framework

Sociocultural Approach

Vygotsky's cultural-historical theory of psychological development informed the foundation of sociocultural theory and constructivist practices of teaching and learning. Major contributions of Vygotsky's theory include the "role of culture in learning and development, recognition of the psychological functions, and the importance of social action during learning" (Gredler, 2001, p.271). More specifically, this theory establishes the sociocultural setting as the basis for development and learning. Therefore, learner characteristics, cognitive processes, and the context for learning are all viewed from the same perspective (Gredler, 2001; 2007).

Methodology

A study examining the usefulness of Moodle as a technological tool was implemented in an Educational Psychology course, where Vygotsky is viewed as one of the earliest Constructivists. The study examined Moodle as a tool that enhances participation and performance, used in addition to the regularly used "semiotic tools" and social-dialogical activities found in a teacher education program. Similarly, discourse and narrative are described as a mode of thinking, as a structure for organizing our knowledge, and as a vehicle in the process technology and higher education. How can a program of learning be assisted with structuring the delivery and organizing of knowledge with a LMS? The following research questions guide this study:

1. To what extent are teacher education students Web 2.0 learners?
2. How do teacher education students use technology? Are they users or adapters?
3. What are teacher education students' perspectives regarding technology as a learning tool?
4. What are teacher education students' perspectives regarding Moodle as a LMS?

Within my post-graduate B.Ed. program, technology is embedded in classes and expected in activities and assignments. Moodle was used as a platform to deliver and organize learning activities and resources, a space to meet virtually, to collaborate on assignments, and to enhance participation and familiarity with the material and readings. To bridge the digital divide, Moodle allowed those students who need speed and collaboration to work at their own pace, as Tapscott (2009) suggests. In addition, reading on the computer screen, manipulating data/text on wiki-spaces and discussion-boards can be orchestrated remotely at the student's convenience. Moreover, those who prefer or who do not have broadband access at home can download and print readings, and can choose to meet in person to work collaboratively with their classmates.

Data Collection

Sixty-two students out of a potential pool of 90 were purposively sampled, at the beginning of the semester with follow-up data collection after the semester. The response rate was 69%. Sixteen semi open-ended questions were asked relating to the B.Ed. students' technology use to ascertain the usefulness of technology-literacy taught in the program and the effectiveness of Moodle as a LMS. This naturalistic inquiry produced thick descriptive data that offers insight into the students' perspectives of technology and learning.

During the analysis phase, the data was constantly compared to uncover emerging themes and patterns. A beginning list of factors was created to tie research questions directly to the data. Factors were redefined and added when they did not fit. Computer assisted reading, highlighting, grouping of data, and frequency counts were used to analyze themes that emerged, to verify the researcher's semantic analysis, and to initiate the interpretation of the students' perceptions.

Key Findings

The descriptive narrative data explicated the students' perceptions of technology use and yielded many interesting findings. This section will highlight key findings related to the four research questions.

To What Extent are Teacher Education Students Web 2.0 Learners?

The response rate for participation was 69%. As described previously, the students were asked a series of questions related to technology use and how they learn. From this data, they were then described as a digital native or digital immigrant according to the eight norms or clusters of attitudes/behaviors as proposed by

Table 1
Digital Natives *(n=9)*

Participant Number	Sex	Undergraduate Degree	Age
4	Female	English/French	22
6	Female	English	23
10	Female	Mathematics	22
15	Male	Mathematics	21
17	Female	English	27
18	Female	History	23
24	Female	English	24
39	Male	Mathematics	32
55	Female	Physical Education/Kinesiology	23

Tapscott (2009). Only nine out of the sixty-two participants could be characterized as digital natives. While many of the other participants used some aspect of digital technology/media daily, only these nine were totally *immersed* in the digital world since public school (see Table 1).

Of the fifteen percent of the participants who were considered digital natives, only two were male. Regarding the age of the participants, the mean was 24 years. This certainly is in keeping with Prensky (2001) and Tapscott's (2009) notion of Digital natives' age range (11-31), but this is only part of the story. Fifty-three of the sixty-two participants were within this Digital Native age range (11-31) but only nine (or 15%) were actually categorized as Digital Natives. What factors have led to this disparity? Further examination of the data will help illuminate many of these influences.

How Do Teacher Education Students Use Technology? Are they Users or Adapters?

Of the nine Digital Natives, five could be considered adapters; that is, they adapt technology to suit their individual needs. Only two of the sixty-two participants stated they were non-users of technology; the other 97% reported being users in varying degrees. Moreover, prior to their participation in the B.Ed. program, 28% of the participants described embracing technology.

One of the "adapters" stated when asked if peers used technology the same way: "Simply put, they do not. I am a technophile and it shows. Having worked for Compaq/HP for a few years, friends and family call me for technical support on a regular basis" (no. 39). On the other end of the continuum, this non-user explained:

> I am sure there are peers who use technology more than me but I am just as sure that there are those who don't use it either. I would bet that almost all of my children's peers use technology as that is the age they are growing up in. If I need something on the computer and I am stuck, my children will find it or fix it for me. My children are much more comfortable on the computer than I am (no. 23).

In the middle of the "pack" there are students who have recognized there has been a change in learning. One participant posited:

> I believe that at 32 years of age I am very close to the transition to our technology-based world. My friends who are slightly older than me tend to be a little less comfortable with new technologies, while those that are younger seem to be more at ease. Now being back in university with fellow students only a few years removed from High School, I can clearly see how much more comfortable they are with the gadgets and programs. I really didn't feel old until I came to [the B.Ed. program] (no. 36).

Finally, a digital native describes her computer usage:

> I use my computer for pretty much everything, more specifically, information, creation, and communication. It is not unusual to find my husband and I at home in the same room quietly on our separate computers. I call it "dueling laptops" and it is very strange to our families, but very normal to us. The Internet is our great oracle that decides what to wear in the morning. It tells me whether or not those boots I want are actually as cute and as water resistant as they say they are. It allows me to make decisions based on many factors. It informs me of possible opportunities and allows me to be an anonymous voyeur and exhibitionist from the privacy of my home. The Internet is my main source of entertainment, research, news, correspondence, gossip, trends—

> you name it. I can find anything on the Internet. I grew up in a family and a group of friends who are really engaged with technology (no. 24).

What are Teacher Education Students' Perspectives Regarding Technology as a Learning Tool?

Only two of the participants reported being non-users and were critical of technology as a learning tool. The other 97% of participants identified technology as very positive learning tools if used appropriately. One participant explained:

> Students benefit from information that is conveyed using visuals, connections, repetitions, discussion, choice, applicability. The use of technological tools such as SMART Boards benefits the teacher and students. It's visual, it provided access to so many amazing resources, and it's interactive. However, the use of technology is no substitute for good teaching and critical thinking (no. 1).

Every participant, even the two non-users spoke of wanting to learn how to use the SMART Boards more effectively. SMART Boards were seen as resource for both teachers and students. This digital immigrant explicates how her learning experiences have changed:

> It is difficult to comment on how *technology* has changed my learning experiences. My learning experiences have certainly changed since public school, yet there are numerous factors contributing to this change. Certainly, the accessibility of information due to high-speed Internet has had a drastic impact on my learning experience since high school. Because of the readiness of information, I feel that I am spending much less time finding my research material, and also less time with an individual piece of research. I also find that today my learning comes from a multiplicity of sources, rather than from a few, because of the accessibility of information. This quick and fragmented approach to accessing information also contributes to my learning that occurs outside of the classroom. Throughout my teenage years, I feel that my learning was more focused, coming from one or a few sources. Today, I have so many areas of interest and know a little bit about each area. I believe this is because I have acquired a thirst to know about everything, but it is also a result of the accessibility of information. I now feel that it is possible to learn almost anything, anytime, and independently (no. 31).

Structuring course information that can be accessible at any time and allows students to work on their own and collaboratively is challenging. Learning is increasingly individualistic; that is, students want it personalized to their needs, desires, and schedules with one-to-one flexible learning.

What are Teacher Education Students' Perspectives Regarding Moodle as a LMS?

Only a small percentage (23%) of participants thought Moodle was a great way to structure a course in reality. While many thought it was a great idea, as many public schools are beginning to implement its use at the high school level, its use was fraught with many logistical problems. My Educational Psychology courses were the first at the university to use Moodle as a main platform with 90 students, in addition to the high extent of user traffic, as the only way to access readings, virtual space to meet, and collaborative assignments. All of this usage caused server crashes when many students and groups attempted to complete assignments the night before a due date. In addition, students chose their own groups and did not consider the range of technological abilities, the attitudes towards technology use, the work ethic, schedules of members, and members' access to computer/Internet equipment at home. As it turned out, many students living twenty minutes outside of the city limits did not have access to broadband Internet. Based on the students' perspectives, this hindered their participation and learning.

Broadband Internet

Lack of access to reliable broadband Internet (BBI) was an emergent factor discussed by many students as a constraint. When BBI was available consistently, it was considered an affordance, a benefit to learning. One digital native spoke of her earlier experiences with computers and Internet as positively contributing to her learning. She explained:

> Technology, especially the use of computers, has greatly enhanced my learning. I experienced a slightly different approach to learning than most while I was progressing through school as I was exposed to the use of computer technology early in my education. I attended Harry Miller Middle School, an 'early adopters' school that began integrating technology when I was in grade 6. We were taught how and given the opportunity to use computers in all subjects for various projects and assignments. It was a very hands-on approach. I consider myself very lucky to have had this experience. The use of computer technology has been a huge help through university as I am able to create presentations, conduct research and edit

> assignments in a timely fashion. It has helped foster my overall learning in general. I strongly believe that computers are a technology that is a wonderful tool in education today (no. 4).

Very few participants were this lucky, to be an early adopter. Not only was the next participant disadvantaged during her public school experience, she was still disadvantaged during the B.Ed. program and Moodle use. She stated:

> The biggest change has been the Internet access. At home, there is still no high-speed access available and therefore that was quite limiting on what you could do on the Internet. Furthermore, when I was in public school, there was no such thing as a SMART board and generally overhead projectors were as exciting as it got. We did have a technology class but it was also quite limited compared to all the technology that I am learning in Educational Technology (no. 34).

Another Digital Immigrant commented on his learning experiences related to technology. He posited:

> I wouldn't have thought that technology had affected my learning so much from public school, but looking back, when I graduated from high school ten years ago, I didn't even have an e-mail account, or even a home computer that could access the Internet. It wasn't until I was at [university] as an undergrad that I really spent much time online at all. Along with e-mail, came Internet research, both academic and otherwise. I would say that this had probably the greatest impact on my learning because I didn't have to spend hours searching through hardbound texts, skimming indexes, flipping pages, and reading paragraph after paragraph (if not page after page) just to determine whether the material was relevant or not. Technology has made learning more time-efficient and less frustrating, but at the same time, technology has made me lazy and dependent on the technology (no. 40).

To summarize the participants' perspectives in this preliminary study, 86% of the participants in this study were of the Net Generation age group [11-31] but only 15% could be categorized as Digital Natives or having Net Generation behaviors and attitudes. Access to technology and BBI appears to be related to urban vs. rural schools, funding of school districts, and to some extent socioeconomic status and privilege. Moodle's effectiveness as a platform for learning appears to be inconclusive, in this particular program/institution, at this time due to unforeseen circumstances.

Discussion

First as a cautionary point, especially related to the theoretical underpinnings of constructivist approaches to teaching and learning, we must examine the contexts of participants' prior experiences, as well as examine the assumptions of the literature reviewed before implementing program change. Not all students 11-31 years of age are digital natives. In fact, only a small percentage could be considered "full-members" of this category in my very competitive B.Ed. Program. Students who are "very good" at 20th century school are admitted to the program. It should be of no surprise if Web 2.0 epistemologies (e.g., Moodle) are for the most part considered foreign and unwelcome by some.

Secondly, it appears that both Prensky's Digital Natives/Immigrants, and Tapscott's Net Generation present Web 1.0 and Web 2.0 as polar opposites. In reality, it is a process of negotiating the tension between philosophy and reality—of bridging the learning needs and preferences of digital natives and immigrants—where few learners are purely one or the other, in all circumstances.

Leu, O'Byrne, Zawilinski, McVerry, and Everett-Cacopardo (2009) suggest that this divide could be better addressed by first viewing the issue as one of technology-as-literacy, another symbol system to be mastered, instead of technology being taught as a stand-alone subject or add on—one that can be seen as an "extra" to be "covered" when there is adequate time. More specifically the learning challenges of today can be addressed by promoting the following:

1. Technology standards could become integrated with subject area standards.
2. Instruction in Internet use could be integrated into each subject area.
3. Every classroom teacher/professor could be responsible for teaching online information and communication use.
4. Online information and communication skills could be included in subject area assessments.

While all of these recommendations would not be that difficult to implement, it must be remembered that institutions of learning often have a traditional resistance to technological change (Demetriadis, et al., 2003; McKibben 1992; Traxler, 2007).

In Canada where the preponderance of its population exists along the US/Canada border (Custred, 2008), there are many provinces that have rural areas lacking in educational services and opportunities, the foremost being access to broadband Internet (Lie, 2003). There is a lack of equitable integration of technology and Internet in schools, households, communities, and work places (Bussiere & Gluszynski,

2004; Veenhof, Clermont, & Sciada, 2005). This lack of opportunity and prior experience hinders the cognitive development of students from grade school to the workplace as explicated by the participants in this study (Lie, 2003). Extending BBI to rural schools and communities is a concrete and essential objective for provinces, one that is supported frequently in research literature (Ally, 2005; 2009; Gregson & Jordaan, 2009; Wishart, 2009). Further research is warranted to tease out the essential educational services in both public and higher education, and how lack of access to technology exacerbates all the other 'isms' to further entrench the rich/poor divide.

Notes:

[1] Moodle is a software program for electronic or "e-learning," a category of programs that are variously identified as "Course Management Systems" (CMS), "Learning Management Systems" (LMS), or "Virtual Learning Environments" (VLE). Many of the mechanics of classroom operation—such as assignments, scheduling, and quizzes—can be easily set up through simple resource-based "courses." Moodle also has a broad variety of additional modular features and a relatively quick learning curve, helping educators easily and effectively develop full online classes, either in advance or as the course is being taught. This versatility allows Moodle to be used in a variety of ways depending on the needs and capabilities of the classroom and program of study: from simple classroom management to pure e-learning--or a "blended" combination of the two, with e-learning content and utilities extending on-site classroom learning (Pieri & Diamantini, 2009).

The system allows professors to use a course at the same time they are developing it, and then re-use and improve it each year. Often classrooms start using a single feature such as a calendar or assignment drop box and then expand as professors explore additional features. Moodle has also been built to support a 'social constructivist pedagogy,' which is based on the active contribution and collaboration of the students. In addition to the traditional lesson, calendaring, assignment, and quiz capabilities associated with online learning, Moodle incorporates a variety of modules that support this approach, including wikis, forums, and chat. The development community continues to add Moodle program features, and as well some Moodle users share courses as open content.

[2] Constructivism: The theory of constructivism "acknowledges the learner's active role in the personal creation of knowledge, the importance of experience (both individual and social) in this knowledge creation process, and the realization that the knowledge created will vary in its degree of validity as an accurate representation of reality. These four fundamental tenets provide the foundation for basic principles of the teaching, learning, and knowing process as described by constructivism"(Doolitttle, 1999, p.1). Moreover, these tenets may be emphasized differently, resulting in various "degrees" or "types" of constructivism.

[3] This article is based on a conference presentation-Wood, S.L. (2009, July). *Higher education and the changing media environment: Enhanced participation and performance*. Paper presented at 'Improving University Teaching, 34th International Conference', Simon Fraser University, Vancouver, BC.

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References

Ally, M. (2009). *Mobile learning: Transforming the delivery of education & training*. AU Press.

Ally, M. (2005). *Use of mobile devices in distance education*. Paper presentated at mLearn 2005, Cape Town, South Africa.

Bauerlein, M. (2008). *The dumbest generation.* New York, NY: Penguin.

Birkerts, S. (1994). *The Gutenberg elegies: The fate of reading in an electronic age*. UK: Faber & Faber.

Bussière, P., & Gluszynski, T. (2004). *The Impact of computer use on reading achievement of 15-year-olds*. Learning Policy Directorate, Strategic Policy and Planning Branch, Human Resources and Skills Development Canada.

Custred, G. (2008). Security threats on America's borders. In Alexander Moens (Ed.), *Immigration policy and the terrorist threat in Canada and the United States* (pp. 96). Fraser Institute.

Dede, C. (2008). A seismic shift in epistemology. *EDUCAUSE Review*, 80-81. Retrieved from http://net.educause.edu/ir/library/pdf/ERM0837.pdf

Demetriadis, S., Barbas. A., Molohides, A., Palalgeorgiou, G., Psillos, D.,… Vlahavas, L. (2003). Cultures in negotiation: Teachers' acceptance/resistance attitudes considering the infusion of technology into schools. *Computers and Education, 41*(1), 19-37.

Doolittle, P. (1999). *Constructivism and online education*. Virginia Polytechnic Institute & State University. Retrieved from http://edpsychserver.ed.vt.edu/tohe/text/doo2.pdf.

Gredler, M. (2001). *Learning and instruction: Theory into practice*. NJ: Prentice Hall.

Gredler, M. (2007). Of kings and cabbages. *Review of Educational Research, 77*(2), 232-248.

Gregson, J., & Jordaan, D. (2009). Exploring the challenges and opportunities of m-learning: Within an international distance education programme. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education & training* (pp. 215-246). AU Press.

Kolb, B., Gibb, R., & Robinson, T. (2003). Brain plasticity and behavior. *Current Directions in Psychological Science, 12*(1), 3-15.

Kozulin, A. (1998). *Psychological tools: A sociocultural approach to education*. Boston, MA: Harvard University Press.

Lave J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York, NY: Cambridge University Press.

Leu, D., O'Byrne, W., Zawilinski, L., McVerry, J., & Everett-Cacopardo, H. (2009). Expanding the new literacies conversation. *Educational Researcher, 38*(4) 264-269.

Levin, D., Arafeh, S., Lenhart, A., & Raine, L. (2002). *The digital disconnect: The widening gap between Internet-savvy students and their schools.* Washington, DC: Pew Internet and American Life Project.

Lie, E. (2003). *Promoting broadband: The case of Canada.* International Telecommunications Union.

McKibben, B. (1992). *The age of missing information*. New York, NY: Plume Book.

Owston, R. (1997). The world wide web: A technology to enhance teaching and learning? *Educational Researcher, 26*(2), 27-33.

Pieri, M., & Diamantini, D. (2009). From e-learning to mobile learning: new opportunities. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education & training* (pp. 183-194). AU Press.

Postman, N. (1993). *Technopoly: The surrender of culture to technology*. New York, NY: Vintage Books.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 1-6.

Prensky, M. (2007). Changing paradigms: From being taught to learning on your own with guidance. *Educational Technology,* July/August.

Roth, W. M., & Lee, Y. J. (2007). Vygotsky's neglected legacy: Cultural-historical activity theory. *Review of Educational Research, 77*(2), 186-232.

Salaway, G., Borreson, J., & Neslon, M. (2008). *The ECAR study of undergraduate students and information technology, 8.* Boulder, CO: EDUCAUSE.

SMART Technologies. (2008). *Notebook software training for SMART Board users: Level 2 learner workbook.*

Tapscott, D. (2009). *Grown up digital*. Toronto, ON: McGraw Hill.

Traxler, J. (2007). Current state of mobile learning. *International Review on Research in Open and Distance learning, 8*(2), 1-10.

Veenhof, B., Clermont, G., & Sciada, G. (2005). *Literacy and digital technologies: Linkages and outcomes.* Research paper no. 56F004MIE, Ottawa, ON: Statistics Canada.

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

Wells, G. (1999). *Dialogic inquiry: Towards a sociocultural practice and theory of educatio*n. Toronto, ON: Cambridge University Press.

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

Wertsch, J. (1998). *Mind as action*. New York, NY: Oxford University Press.

Wishart, J. (2009). Use of mobile technology for teacher training. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education & training* (pp. 265-278). AU Press.

Appendix 1

List of Semi-Open Ended Questions:
1. How do you like to learn?
2. How do you like to study?
3. How many computers do you own?
4. How do you use the computer?
5. How do you use the Internet?
6. How do you use the telephone/cell phone?
7. How do you use the library
8. How do you use the television?
9. What technology/programs/software do you use?
10. How has technology changed your learning experiences in public school to university?
11. How do you socialize?
12. How would you like to see your learning environment change?
13. How would you like to see the school you teach at [internship etc.] change?
14. What technologies do you hope to use as a teacher?
15. What technologies would you like to learn to use?
16. Do peers of a ‘similar age’ use technology the same was as you?