

Review

The effects of information and communication technologies (ICTs) on higher education: From objectivism to social constructivism

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Higher education has been on the rollercoaster for the last couple of decades with the advent of the first personal computer in the 1980s and then the internet in the 1990s and not only explicitly in terms of using innovative digital gadgets, but also implicitly in perceptions about and approaches to e-Learning from behaviourism through cognitive to social constructivism or more specifically, from transmitted knowledge to negotiated and then harvested knowledge. The journey reflects the emancipation of learners from bonded (teacher-led) learning to independent and self-reigned knowledge-acquisition. This paper is a short discourse on the theoretical voyage of pedagogy and learning in higher education institutions (HEIs) from the introduction of traditional 'technology-based-instruction' to modern 'network based' 'web-enhanced e-courses' in collaborative and socially active learning environments operating with 'social-software-tools' of blogging and social-book marking.

Key words: Objectivism, behaviourism, constructivism, cognitive-constructivism, social-constructivism, transmitted, negotiated, harvested-knowledge, e-learning, blended, virtual.

INTRODUCTION

Educational technologies are pushing academicians to construct alternative theories for learning (Oliver, 2002). The paradigm shift in higher education institutions (HEIs) refers not only to the departure from the traditional pedagogy, learning and education-management to modern; it also characterizes the changes within the e-Learning environments for teaching, learning and administrative purposes (Young, 2003; Baumeister, 2006; Ezziane, 2007). This dimension of paradigm shift is described in terms of the progress from old-ICTs to new-ICTs in three stages of traditional e-Learning, blended e-Learning and contemporary virtual e-Learning (Hameed, 2007). The technological advancements in e-Learning are linked with the theories of learning like behaviourism, objectivism, constructivism and cognitive and social constructivism (Wikipedia, 2008; Hashim et al., 2010).

Objectivism believes that everything related to learning is predictable therefore; one learning-model fits all. Likewise, behaviourism gives priority to the stimulus response relationship in learning and underplays cognitive role therefore sees the learning environment as in objectivism (Young, 2003). This is exactly like behaviour of scientific management where worker is taken as a part of a big machine called organization (Macleod, 2005).

Constructivism advocates that reality does not exist out there objectively rather it is constructed by the human beings subjectively. It is not predictable in total rather most of it depends on the human interaction with the situation resulting into human perception (giving meaning), which in turn draws the picture/image of reality (Alam, 2009). The moves towards constructivism in higher education have been pushed by the emergence of universal connectivity through ICTs (Wims and Lawler, 2007), which enabled the masses to globally communicate and most importantly access to the world knowledge resources through the advent of internet after

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1990s. Given the access to broader sources of knowledge, contemporary theory suggests that collaborative learning is the most effective means of facilitating teaching and learning in digital environments (Phillips et al., 2008).

Social constructivism is gaining foothold in higher education around the world because teaching and learning can now easily be undertaken as a social and community activity (Bondarouk, 2006) thereby propagating collective learning (social) along with individual (cognitive) with the help of traditional e-mail/chatting and modern wikis, blogs, vblogs, RSS feeds and the list continues (Klamma et al., 2007). For example, RSS is a format used to publish frequently updated works like blog-entries, new headlines, audio and video (Wikipedia, 2009).

PARADIGM SHIFTS IN HIGHER EDUCATION

The e-Learning in HEIs is going through a paradigm shift wherein teachers and students have departed from passive mode to open independent learning environment (Young, 2003; Baumeister, 2006). ICT is not neutral rather it borrows ideas from the concepts like "globalization of the economy, the new information society, the end of national policy and the advent of world government (Sasseville, 2004)." e-Learning developers have to go beyond the paradigms of their own discipline and they need to seek interdisciplinary exchange with all the university stakeholders (Ehlers, 2005).

One can see that technology paradigm shifts have changed not only the computing practices but also the perceptions of society about technology (Ezziane, 2007). In this techno-economic paradigm, the user is increasingly seen as the origin of innovation (COST Action 298, 2007). At the broader level, the paradigm shifts in e-Learning are characterized by objectivism, constructivism and social constructivism indicating different levels of "eMaturity (Moolman and Blignaut, 2008)" and progress in scholarship.

Objectivism/behaviourism

Traditional-computer-based learning is built around the realist/objectivist theories of knowledge, which assume that reading, watching videos or operating the digital gadgets refers to "active learning (Young, 2003)." In objectivist mode, learning occurs through the "instructor presenting the learner with the required stimuli along with the required behavioural responses within an effective reinforcement regime. The degree of learning is assessed through observable measures such as tests, assignments and examinations (Ward et al., 2006)." As a psychological theory, behaviourism emerged as a reaction to theories of mind in the late 19th century,

suggesting that mental processes cannot be understood without objective scientific methods like observational and quantifiable investigation as in the stimulus-response experiments (Ward et al., 2006). The objectivist teaching gives complete control of materials to the teacher who manages the pace and direction of learning thereby making learning a sequential process where there is a single reality about which the "learners display an understanding through declarative, procedural and conditional knowledge (Phillips et al., 2008)."

Traditional e-Learning aims at promoting technical rationality grounded in objectivism (Young, 2003). Under this, paradigm knowledge is seen as a repertoire of actions elicited in response to specific environmental stimuli and does not exist in any sense outside this. In terms of knowledge delivery this often implies question and answer exercises with gradual increases in difficulty and frequent feedback, mainly positive and encouraging (Ward et al., 2006).

Constructivism

The constructivist theories of learning dominate today and propagate that learning is achieved by the active construction of knowledge supported by various perspectives within meaningful contexts and social interactions (Oliver, 2002). These environments create engaging and content-relevant experiences by utilizing ICTs and resources to support unique learning goals and knowledge construction (Young, 2003). The constructivists believe that there is no single version of reality, rather a multitude of realities situated within each learner. As such, learning is dependent upon the "learner's ability to analyze, synthesize and evaluate information to create meaningful, personalized knowledge (Phillips et al., 2008)."

With the emergence of collaborative technologies, it has been recognized that behaviourist models do not fit with contemporary teaching and learning environments, therefore current research is focusing "to develop models of constructivist computer-based instructional development (Young, 2003)." Constructivists contend that ICTs should not be guided by a technologically deterministic approach rather in the context of social, cultural, political and economic dimensions of using technology (Macleod, 2005). The effectiveness of the behavioural approach is questionable in areas that require comprehension, creativity and 'gray' answers (Ward et al., 2006).

The strengths of constructivism lie in its emphasis on learning as a process of personal understanding and the development of meaning where learning is viewed as the construction of meaning rather than as the memorization of facts. Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their student centered environments based on their context (Oliver, 2002). Given, that knowledge is

constantly advancing; the design and development principles need to be aligned with teacher and students emerging requirements. The current trend in e-Learning is to provide cognitive tools, which can be adapted for intellectual partnerships among teachers and students and facilitate critical thinking and higher-order learning (Young, 2003).

Cognitive constructivism

The cognitive constructivism gives priority to the cognitive powers of an individual. For example, the 'learning-style' of every learner indicates his/her cognitive trends. The developers of e-Learning face the challenges of producing systems, which accommodate individual differences such as nationality, gender and cognitive learning, style (Graff et al., 2001). The ICTs can play a supplemental as well as central role in learning by providing digital cognitive or adaptive tools or systems to support constructivist learning (Sirkemaa, 2001). The design of computer-based learning environments has undergone a paradigm shift, moving students away from instruction that was considered to promote technical rationality grounded in objectivism, to the application of computers to create cognitive tools utilized in constructivist environments (Young, 2003). Consequently in terms of instruction while there is still a requirement for memorizing and behavioural activities, there is a great emphasis on the instructor encouraging the student to appraise their own beliefs, challenge them in the light of new evidence and acquire new theories of the world which better fit the facts presented (Ward et al., 2006).

Since students vary in their cognitive or learning styles, they also benefit from those teaching techniques that appeal to their individual styles (Cagiltay et al., 2006). Similarly, the rapid development of digital technologies in the emerging information society forces the individuals to command and employ cognitive skills in teaching and learning process (Aviram and Eshet-Alkalai, 2006). Thus cognitive learning is a product of the learners creating and testing their own hypotheses about the world realities, where data are processed according to the learners' learning-style, preferences and "a dynamic process of personal trial and error (Ward et al., 2006)" through the active engagement of the learner and cognitive participation of teacher (Ezziane, 2007).

Social constructivism

In contrast to cognitive-constructivism, 'social constructivism' emphasizes 'collective-Learning' where the role of teachers, parents, peers and other community members in helping learners becomes prominent. Social constructivists emphasize that learning is active, contextual and social; therefore the best method is 'group-learning' where teacher is a facilitator and guide

(Tinio, 2002). Social constructivists explain the technology-adoption as a process of involving social groups into the innovation process where learning takes place on the learners' experiences, knowledge, habits and preferences (Bondarouk, 2006). In contrast to traditional classrooms where teachers used a linear model and one-way communication, the modern learning is becoming more personalized, student-centric, nonlinear and learner-directed (Cagiltay et al., 2006).

While cognitive constructivists believe that learning takes place through interaction with environmental stimuli alone, social constructivists argue that culture also influences the design and development of the learning models (Ward et al., 2006). It is necessary to move e-Learning beyond learning management systems and engage students in an active use of the web as a resource for their self-governed, problem-based and collaborative activities like using social software (Dalsgaard, 2006). The concept of social constructivism has been around since 1990s when research started on the interpretivism in the design and development of computer-based information systems (Bondarouk, 2006).

Furthermore, researchers argue that human-computer interaction (HCI) is social (users treat computers as other human beings) and not para-social (users covertly interact with imagined others through the computer terminals as they do with the characters in mass media). Very few studies have investigated the student-computer interaction (SCI) and very little is known about the social aspects of SCI (Deaudelin et al., 2003). This is a variant on constructivism founded on the premise that learning could not be separated from its social context therefore, while cognitive constructivists theorized that learning took place through interaction with environmental stimuli alone, but social constructivists felt that culture and language heavily influence the way the learners update their world models (Ward et al., 2006).

Along the continuum of objectivist/realist to constructivist modes of pedagogy, learners find changing learning environments. Under behaviourist model, students have to depend on teachers only. There is one-way communication and actions of teachers rather than their interaction with the students (Young, 2003). On the other extreme of social constructivist learning environments, learners follow self-designed, self-controlled and socially collaborative learning-tracks (Phillips et al., 2008). The middle stages of this continuum are characterized by a mix of both the absolute positions. Teachers still plays the dominant role but student is given the liberty to apply his/her cognitive powers to construct knowledge along with learning from teacher. Figure 1 gives a picture of this evolution and learning environments for the learners.

FROM TRANSMITTED TO HARVESTED KNOWLEDGE

The journey from behaviourism to constructivism also

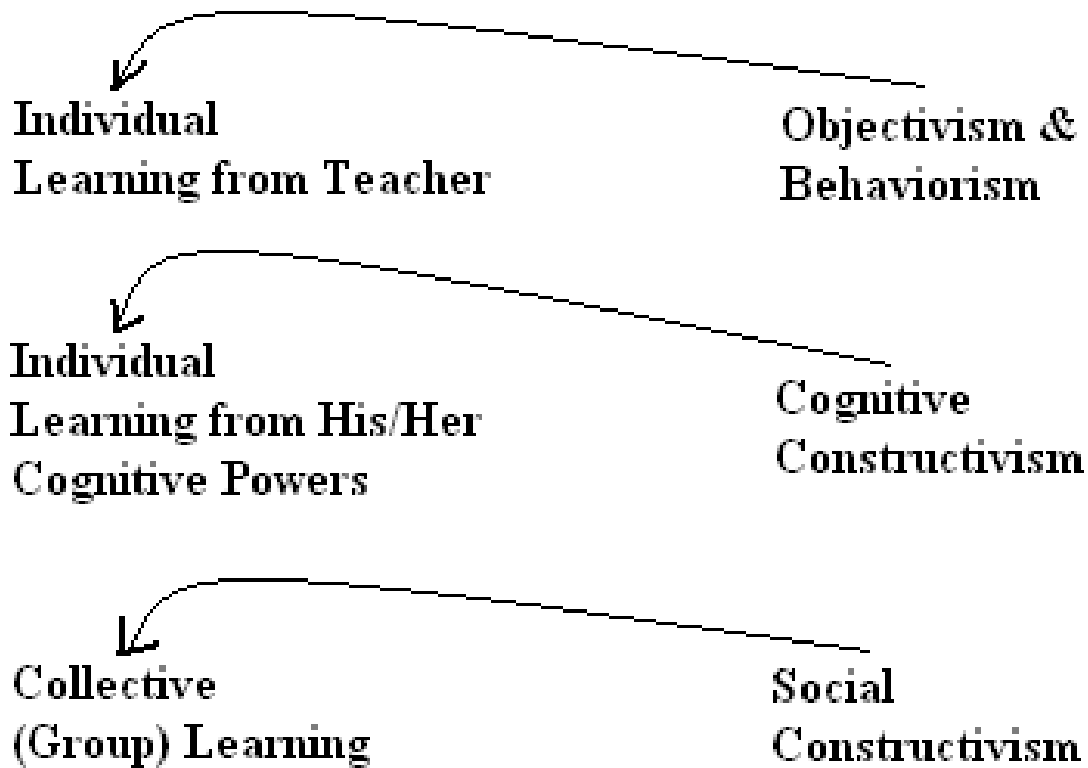


Figure 1. Learning under different paradigms/theories.

characterizes the change in the way students acquire knowledge and skills. Objectivism transmits knowledge from teacher to student; cognitive constructivism gives negotiated knowledge, while social constructivism provides an environment where learners harvest knowledge through self-controlled learning platform (Gray et al., 2003). E-Learning encompasses a continuum of integrated educational technologies. At one end are applications like PowerPoint, which have little impact on learning and teaching strategies or the organization.

At the other end are virtual learning environments (VLEs) and managed learning environments (MLEs), which can have significant impact upon learning and teaching strategies and upon the organization (Sife et al., 2007).

Transmitted knowledge (traditional/objectivist)

Traditional e-Learning programs are “didactic in approach - a form of transmitted knowledge (Gray et al., 2003)” with “passive acceptance of well-cooked teacher’s knowledge (Hvorecký et al., 2005)” where teachers used “a linear model (Cagiltay et al., 2006).” Transmission refers to one-way communication such as, radio transmission. Radio-listeners are on the receiving-end

with the broadcaster in full control of whatever is transmitted. Similarly, those learning environments where there is teacher-led pedagogy, the students are the listeners and have to capitalize on whatever is transmitted because teacher has absolute control of the learning dynamics with a sequential process of transmitting knowledge (Phillips et al., 2008).

Negotiated knowledge (blended - objectivist + constructivist)

The research tells us that by the 1990s, e-Learning began to be supplemented by new media, particularly e-Mail and discussion groups/forums. For example, the existing e-Learning models of course ware were accompanied by a discussion forum where participants could read and post messages to involve in mutual support and debate – a kind of “negotiated knowledge (Gray et al., 2003).” Given the reported failure of traditional e-Learning, constructivist thinking emerged (Young, 2003). In constructivist thinking, knowledge is created through active and collaborative involvement of the students where there is ‘negotiation’ on the content and context of knowledge thereby every individual creates or constructs his/her own knowledge-cache and integrate it with prior

experience (Blázquez et al., 2006). There are four main mechanisms to motivate and encourage student participation in e-Learning environments, including personal access, personal reputation, social altruism and negotiated tangible rewards (Klamma et al., 2007).

Harvested knowledge (social constructivist)

Soon after 1990s, Lemke (1993) predicted that “very soon all the libraries of the world will be one virtual library, all the databases on every subject will be available through a common interface and they will contain not just numbers and texts, but every visual and auditory form of information.” The contemporary e-Learning environments are loaded with very powerful digital models and devices particularly, the internet, which has revolutionized the way people, used to interact, exchange messages, teaches and learns. The web is increasingly equipped with millions of web-pages, site archives, portals, databases and much more for ascertaining a kind of “harvested-knowledge” where learners can learn by themselves by constructing or harvesting knowledge (Gray et al., 2003). At the moment, e-Learning is facilitated by web technologies and delivered through end-user computing, which creates interconnectivity between teachers, students and information thereby creating opportunities for social learning approaches (Hvorecký et al., 2005).

In recent years, it has been recognized that e-Learning is not merely another medium for the transmission of knowledge but that it changes the relationship between the teacher or trainer and learner. It requires new skills, competencies and attitudes amongst those planners, managers, teachers and trainers who are going to design and develop materials and support learners online (Gray et al., 2003). Social software tools like blogs, wikis, and social-bookmarking etc offer fields of knowledge to harvest according to the requirements of the users (teachers and learners) (Dalsgaard, 2006; Klamma et al., 2007). Because of the internet, learners have access to virtually unlimited information. Web-based learning is worldwide accessible, low in maintenance, secure, platform-independent, current and accommodates various learning styles because now e-Learning can be delivered to the learners easily, in an individualized manner (Manochehr, 2007).

DISCUSSION

The transition from objectivism to constructivism is multidimensional in the sense that departures have to happen: from transmitted to harvested knowledge, traditional e-Learning to virtual learning and old technologies to new gadgets (Gray et al., 2003; Cagiltay et al., 2006). As illustrated in Figure 2, the transitions

happening in the e-Learning applications of HEIs is passing through three broader phases:

1. Traditional e-Learning: Using old technologies (that is, e-mail) to acquire transmitted knowledge through objectivist and behaviourist modes of pedagogy and learning with one-way communication from teacher to student (Phillips et al., 2008);
2. Blended e-Learning: Most of the institutions particularly in developing countries are passing through the midphase of blended e-Learning with a mix of both the old and new technologies (that is, chatting and discussion forums/groups). Both one-way and two-way communication becomes prevalent;
3. Virtual learning: When there is high level of collaboration between all the stakeholders. There is group learning but in a highly individualized teaching and learning environments. Through personalization and integration technologies, every individual user can customize the technologies with one-to-many and manyto- many communication links, which are active and alive 24/7 (Mejias, 2006).

Different countries are passing through different phases of this transformation. Similarly, within each country different educational sectors (primary, secondary, and higher education) are experiencing different phases too. Furthermore, within each educational sector, every HEI is catching up with the transition very differently from other fellow institutions. The story does not end here. Every individual user of e-Learning tools is passing through different phases as compared to his/her colleagues. These differences between countries, sectors, institution and individual users stem from the contextual variations of these entities (Sanyal, 2001). There is a diversity of ICT resources, management support, technical support, professionalism, digital literacy of developers and users. At the same time, demographic attributes (age, gender, education) of the university-constituents (teachers, students and administrators) (Juniu, 2005) play decisive role in assisting or resisting the evolution from old technologies to new technologies thereby moving away from objectivist education to socially constructive way of e-Teaching, e-Learning and e-Education (Thomas and Allen, 2006; Abrami et al., 2006).

Taken together, it has been recognized that behaviourist models do not fit with a constructivist approach and constructivist theory that focuses on the design environment and places less emphasis on instructional sequence is often more challenging to practice in computer-based learning environments (Young, 2003). There is no doubt that ICTs are seen as central to education in the 21st century (Knight et al., 2006) but learning cannot be managed rather facilitated (Dalsgaard, 2006). Thus, the design for e-Training and e-Learning should be based on the constructivist theory where knowledge is acquired through the active

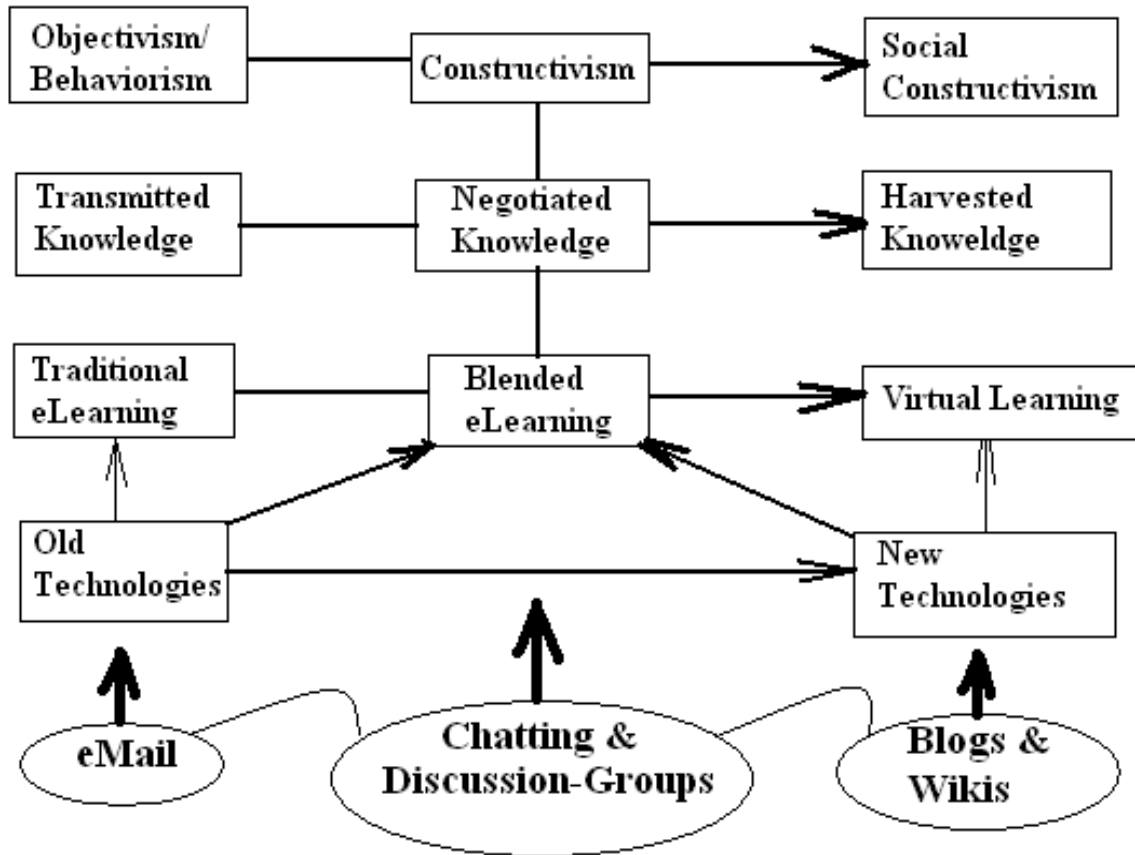


Figure 2. Transitions from constructivism to social constructivism.

involvement of students where there is collaboration and negotiation on meaning (Blázquez et al., 2006). As such, constructivist learning depends 'upon learner's ability to analyze, synthesize and evaluate information to create meaningful, personalized knowledge (Phillips et al., 2008)."

CONCLUSIONS

Though, teachers still believe that what really defines them is the ability to establish a bond between teacher and student; teaching is, first and foremost, the ability to use that bond to create a positive and productive way of learning. Human relations still remain at the core of their craft (Sasseville, 2004). However, e-Learning is bringing the shifts from linear to hypermedia learning, from instruction to construction and discovery, from teacher entered to learner-centered education, from absorbing material to learning how to navigate and how to learn, from school to life long learning (LLL), from one-size-fitsall to customized learning, from learning as torture to learning as fun and from the teacher as transmitter to the teacher as facilitator (Dinevski and Kokol, 2005).

However, those who are responsible for designing and

leading the courses, have not made the pedagogical shift and are not yet ready to implement current pedagogies where students will be more active and the role of the teacher will become that of a facilitator rather than a transmitter of information (Allan, 2007). There is a decisive shift from computer-based instruction where students learn from technology, to the application of cognitive tools and constructivist environments where students learn with the technology (Young, 2003) however, "there is lack of a clear educational concept, e.g. based on social constructivism (Valcke, 2004)." The researchers assert that critical thinking skills and strong constructivist pedagogies must always be the prerequisites for using computers for instruction (Juniu, 2005) but this requires wider research about teaching practices, user attributes and development of e-Learning environments (Phillips et al., 2008).

Experience testifies that traditional e-Learning models have failed to bridge the gap between theory and practice (Young, 2003) therefore, software developers have to go beyond the paradigms of their own discipline when designing the learning software by using interdisciplinary collaboration with teachers and learners (Ehlers, 2005). Instruction is becoming more personalized: learner entered, non-linear and self-directed. Social constructivist

pedagogical approaches “pose strong arguments against the structured knowledge consumption approach (Cagiltay et al., 2006).” Social software supports social constructivist e-Learning by providing personal tools and social networks to engage the students (Dalsgaard, 2006).

REFERENCES

- Abrami PC, Bernard RM, Wade A, Schmid RF, Borokhovski E, Tamim R, Surkes MA, Lowerison G, Zhang D, Nicolaidou I, Newman S, Wozney I, Peretiatkovic A (2006). A Review of e-Learning in Canada: A Rough Sketch of the Evidence, Gaps and Promising Directions. *Can. J. Learn. Technol.*, 32(3), Fall/Autumn. Retrieved May 14, 2007, from <http://www.cjlt.ca/>.
- Alam, GM (2009). The role of science and technology education at network age population for sustainable development of Bangladesh through human resource advancement. *Sci. Res. Essays*, 4(11): 1260-1270.
- Allan MK (2007). Millennial teachers: Student teachers as users of Information and Communication: A New Zealand case study. *Int. J. Educ. Dev. using ICT*, 3(2). Retrieved May 11, 2007, from <http://ijedict.dec.uwi.edu/>.
- Aviram A, Eshet-Alkalai Y (2006). Towards a Theory of Digital Literacy: Three Scenarios for the Next Steps. *Eur. J. Open, Distance and E-Learning*, Retrieved May 11, 2007, from <http://www.eurodl.org/>.
- Baumeister H (2006). Networked Learning in the Knowledge Economy - Systemic Challenge for Universities. *Eur. J. Open, Distance and E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Blázquez FE, Díaz LA (2006). A Training Proposal for e-Learning Teachers. *Eur. J. Open, Distance E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Bondarouk TV (2006). Action-oriented group learning in the implementation of information technologies: results from three case studies. *Eur. J. Info. Syst.*, 15: 42-53. Retrieved April 10, 2007, from <http://www.palgrave-journals.com/ejis/>.
- Cagiltay NE, Yildirim S, Aksu M (2006). Students' Preferences on Web-Based Instruction: linear or non-linear. *J. Edu. Technol. Soc.*, 9(3): 122-136. Retrieved April 10, 2007, from <http://www.ask4research.info/>.
- COST Action 298 (2007). The good, the bad and the unexpected: The user and the future of information and communication technologies. A transdisciplinary conference organized by COST Action 298. Moscow, Russian Federation. 23rd-25th May 2007. Retrieved April 5, 2007, from http://www.nord-internet-solidaire.org/IMG/doc/Call_for_papers_20071.doc.
- Dalsgaard C (2006). Social software: E-Learning beyond learning management systems. *Eur. J. Open, Distance and E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Deaudelin C, Dussault M, Brodeur M (2003). Human-Computer Interaction: A Review of the Research on its Affective and Social Aspects. *Canadian J. Learn. Technol.*, 29(1), winter. Retrieved May 14, 2007, from <http://www.cjlt.ca/>.
- Dinevski D, Kokol DP (2005). ICT and Lifelong Learning. *Eur. J. Open, Distance E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Ehlers U (2005). Quality in e-Learning from a learner's perspective. *Eur. J. Open, Distance E-Learn*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- E-Learning (2009). Wikipedia Retrieved February 10, 2009, from <http://www.Wikipedia.org/>.
- Ezziane Z (2007) Information Technology Literacy: Implications on Teaching and Learning. *J. Educ. Technol. Soc.*, 10(3): 175-191. Retrieved April 10, 2007, from <http://www.ask4research.info/>.
- Graff M, Davies J, McNorton M (2001). Cognitive Style and Cross Cultural Differences in Internet Use and Computer Attitudes. *Eur. J. Open, Distance E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Gray DE, Ryan M, Coulon A (2003). The Training of Teachers and Trainers: Innovative Practices, Skills and Competencies in the use of eLearning. *Eur. J. Open, Distance E-Learn*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Hameed T (2007). ICT as an enabler of socio-economic development. Retrieved June, 24 2007, from <http://www.itu.int/osg/spu/digitalbridges/materials/hameed-paper.pdf>.
- Hashim F, Alam GM, Siraj S (2010) Information and communication technology for participatory based decision-making-E-management for administrative efficiency in Higher Education. *Int. J. Phys. Sci.*, 5(4): 383-392.
- Hvorecký J, Manažmentu VS, Cesta P (2005). Can E-Learning break the Digital Divide? *Eur. J. Open, Distance E-Learn*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Juniu S (2005). Digital Democracy in Higher Education Bridging the Digital Divide. *Innov. J. Online Educ.*, 2(1), October/November. Retrieved April 10, 2007, from <http://Innovateonline.info>.
- Klamma R, Chatti MA, Duval E, Hummel H, Hvannberg EH, Kravcik M, Law E, Naeve A, Scott P (2007). Social Software for Life-long Learning. *J. Educ. Technol. Soc.*, 10(3): 72-83. Retrieved June 24, 2007, from <http://www.ask4research.info/>.
- Knight C, Knight BA, Teghe D (2006). Releasing the pedagogical power of information and communication technology for learners: A case study. *Int. J. Educ. Dev. using ICT*, 2(2). Retrieved May 11, 2007, from <http://ijedict.dec.uwi.edu/>.
- Lemke JL (1993). Hypermedia and higher education. *Interpers. Comput. Technol. (eJournal)*, 1(2), April. Retrieved April 10, 2007, from <http://www.helsinki.fi/science/optek/1993/n2/lemke.txt>.
- Macleod H (2005). What role can educational multimedia play in narrowing the digital divide? *Int. J. Educ. Dev. using ICT*, 1(4). Retrieved May 11, 2007, from <http://ijedict.dec.uwi.edu/>.
- Manochehr N (2007). The Influence of Learning Styles on Learners in E-Learning Environments: An Empirical Study. *Computers in Higher Education and Economics Review*, 18. Retrieved April 10, 2007, from <http://www.economicsnetwork.ac.uk/cheer.htm>.
- Mejias U (2006). Teaching Social Software with Social Software. *Innov. J. Online Educ.*, 2(5), June/July. Retrieved April 10, 2007, from <http://Innovateonline.info>.
- Moolman HB, Blignaut S (2008). Get set! e-Ready, ... e-Learn! The e-Readiness of Warehouse Workers. *J. Educ. Technol. Soc.*, 11 (1): 168-182. <http://www.ask4research.info/> accessed April 10, 2007.
- Oliver R (2002). The role of ICT in higher education for the 21st century: ICT as a change agent for education. Retrieved April 14, 2007 from <http://elrond.scam.ecu.edu.au/oliver/2002/he21.pdf>.
- Phillips P, Wells J, Ice P, Curtis R, Kennedy R (2008). A Case Study of the Relationship Between Socio-Epistemological Teaching Orientations and Instructor Perceptions of Pedagogy in Online Environments. *Elect. J. Integ. Technol. Educ.*, 6: 3-27. Retrieved April 10, 2007, from <http://ejite.isu.edu/> 6 (1).
- Sanyal BC (2001). New functions of higher education and ICT to achieve education for all. Expert Roundtable on University and Technology-for-Literacy/Basic Education Partnership in Developing Countries. Paris, 10 to 12 Sep, 2001. International Institute for Educational Planning, UNESCO. Retrieved April 10, 2007, from <http://www.literacyonline.org/products/ili/pdf/UTLPSanyal.pdf>.
- Sasseville B (2004). Integrating Information and Communication Technology in the Classroom: A Comparative Discourse Analysis. *Can. J. Learn. Technol.*, 30(2), spring. Retrieved May 14, 2007, from <http://www.cjlt.ca/>.
- Sife AS, Lwoga ET, Sanga C (2007). New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *Int. J. Educ. Dev. using ICT*, 3(1). Retrieved July 21, from <http://ijedict.dec.uwi.edu/>.
- Sirkemaa S (2001). Information technology in developing a metalearning environment. *Eur. J. Open, Distance E-Learning*. Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Thomas T, Allen A (2006). Gender Differences in Students' Perceptions of Information Technology as a Career. *J. Inf. Technol. Educ.*, 5. Retrieved July 14, 2007, from <http://jite.org/documents/> 5.
- Tinio VL (2002). ICT in education. Presented by UNDP for the benefit of participants to the World Summit on the Information Society. UNDP's regional project, the Asia-Pacific Development Information Program (APDIP), in association with the secretariat of the Association of

- Southeast Asian Nations (ASEAN). Retrieved July 14, 2007 from <http://www.apdip.net/publications/iespprimers/eprimer-edu.pdf>.
- Valcke M (2004). ICT in higher education: An uncomfortable zone for institutes and their policies. In R. Atkinson, C. McBeath, D. Jonas-Dwyer and R. Phillips (Eds), *Beyond the comfort zone: Proceedings of the 21st ASCILITE Conference*, pp. 20-35. Perth, 5-8 December. Retrieved April 10, 2007, from <http://www.ascilite.org.au/conferences/perth04/procs/valckekeynote.html>.
- Ward T, Monaghan K, Villing R (2006). MyVLE: A case study in building a universal telematic education environment for a small university. *Eur. J. Open, Distance E-learn.* Retrieved April 10, 2007, from <http://www.eurodl.org/>.
- Wims P, Lawler M (2007). Investing in ICTs in educational institutions in developing countries: An evaluation of their impact in Kenya. *Int. J. Educ. Dev. using ICT*, 3(1). Retrieved July 21, 2007, from <http://ijedict.dec.uwi.edu/>.
- Young LD (2003). *Bridging Theory and Practice: Developing Guidelines to Facilitate the Design of Computer-based Learning Environments.* *Canadian J. Learn. Technol.* 29(3), Fall/Autumn. Retrieved May 14, 2007, from <http://www.cjlt.ca/>.