Information and Communications Technology (ICT) and Education

Saïd Assar

ICT and Education

Author Contact Information

Saïd Assar, PhD
Telecom Ecole de Management, Institut Mines-Telecom
9, rue C. Fourier, 91011 Evry, France
said.assar@telecom-em.eu
+33(0)160764488
+33(0)160764493

Abstract

As Information and communication technologies gradually permeate daily life, they are profoundly changing the way education is conceived and delivered. Teachers play a key role in this transformation process; their believes, pedagogical practices and teaching skills are continuously challenged. ICT integration in the educational process can significantly enhance traditional courses, and Internet based education, i.e. e-learning, is becoming a serious alternative to traditional, face-to-face courses. To be used as a lever for pedagogical innovation and institutional transformation, teacher ICT competencies need to go beyond skills in ICT use per se, and enclose contextual knowledge about technology, pedagogy and content. On the other hand, learners' engagement with ICT in education depends on their expectations and conceptions of learning and required assessment. Learner experience with ICT in education is linked to his perception of systems' ease of use and usefulness in achieving learning goals. Adaptive learning systems open new potentialities for a personalized instruction which is tailored to learner's characteristics. At the edge of a new era, schools, colleges and higher education struggle to seize opportunities and overcome obstacles.

Keywords

Technology based education, technology based learning, e-learning, online learning, online education, digital media in education, ICT and pedagogy, ICT and teacher, education reform, education transformation

Introduction

Education is existential for human societies; it is a fundamental leverage for social preservation and economic growth. For centuries, the way education is performed remained the same: the teacher talks and acts, while pupils listen, watch and write. Printing machines made textbooks widely available and knowledge rapidly spread; educational institutions appeared and developed all over the world. However, the way education was performed did not change so much and remained teacher centered. With the emergence of new technological devices for handling picture and sound, new possibilities for knowledge transmission emerged. Instead of handmade drawings, photos could be used to present study subjects, for example, in biology or physics courses. Using audio recordings, pupils learning foreign languages could at their convenience listen to native speakers and practice their lessons. With animated pictures and movies, a chemistry course could be illustrated with the visual transcription of a complex experiment. Television took education a step further as lectures and seminars could be broadcasted. The *Gyan Darshan* educational TV channel in India, for example, aired on a large scale programs originating from institutions all over the country for the benefits of millions of Indian students (Rani, 2006). However, it is the raise of computers and personal computers (PC) – combined with the rapid expansion of Internet – that opened a wide area of new applications and usages in education.

Fast development in Information and Communication Technologies (ICT) is shaping a new world in which education at all levels can no longer be assimilated to a group of learners in a classroom listening and watching a teacher with a textbook following a fixed curriculum. With ICT, learning is shifting from teacher-centered to learner-centered and can potentially be undertaken anytime and

anywhere, from classrooms to homes and offices. E-learning refers to learning via the Internet; it provides learners with a flexible and personalized way to learn (Zhang & Nunamaker, 2003). It offers learning-on-demand opportunities and can significantly contribute to reduce teaching and learning costs. E-learning is the enabler for a massive transformation in the education world; new teaching and learning opportunities are continuously challenging traditional schools, colleges and higher education (Oliver, 2002)(Collins & Halverson, 2009). However, effective and innovative use and integration of ICT in education is a complex and multi-facetted problem. Complexity lies in the intertwining of technology, pedagogy, user adoption and institutional policies (John & Sutherland, 2004). ICT encompass many different things, and can address multitude challenges; in fact, to teach and to learn with ICT remains partially understood, and all its benefits are still not fully exploited (Cuban, 2003)(Kirkwood, 2009). Furthermore, from primary schools to higher education, scientific evidence is still insufficiently available about the effectiveness of ICT integration in education (U.S. Dept. of Education, 2010).

Digital resources for education

There are three general and complementary categories of ICT artifacts to be used in teaching:

- The first category is stand-alone digital components to be used to support learning inside a course for didactic and/or assessment purposes. Called also Digital Learning Material (DLM) or Learning Objects (Polsani, 2006), it include video clips (e.g., a YouTube fragment), illustrations (e.g., photos and drawings), simulations (e.g., simulation of an organizational process or an electronic circuit), and interactive assessment resources (e.g. quiz) (Kreijns, Van Acker, Vermeulen, & Van Buuren, 2013).
- The second category includes general tools for communication and information diffusion such as RSS (Really Simple Syndication), blogs, chat and voice over IP, peer to peer file sharing, Wikis, web conferencing and social networks. These tools were not specifically designed for teaching; however, they can support teaching purpose by providing communication facilities in pedagogical scenarios.
- The third category resembles software systems to run a course. Called also Learning (or Course) Management System (LMS or CMS), these complex tools are educational software packages for online course administration and delivery (Morgan, 2003). Their main functions include course content organization and presentation, students recording and tracking, class activities management, teachers and learners' communication, student assessment tools and grade books tools. Other terms used to denote such systems are Web-Based Learning Systems (WBLS), Virtual Learning Environments (VLE) or, more simply, learning platforms. Blackboard and Moodle are common examples of learning platforms in higher education (see Web references).

Simple learning objects (e.g. a video sequence or a quiz) can be composed into more complex educational resources and made available on their own in the form of a CD-ROM or interactively online. They can also be part of complex software application dedicated to providing learners with specific assistance while learning particular subject, e.g. mathematics (c.f. article 92027 – Computer-assisted Instruction). For primary and secondary school, simple and composite learning objects are a common way to integrate ICT in teaching. In higher education, this approach is particularly common as well: learning objects are integrated in face-to-face lectures; they can also be part of courses provided online through a learning platform. Learning platforms can be used either for blended learning where face-to-face alternates with and complements online teaching, or for fully online learning where no face-to-face occurs (i.e. virtual learning). In both cases, different communication and information diffusion tools (e.g. blog, wiki) can be used in combination with the learning platform.

Teachers and ICT

Teachers are critical change agents at the academic work floor; they are the instrument by which changes in education will become true. In an extensive literature review, Mumtaz (2000) summarized what influence teachers' attitude towards technology use in school: available and easy to use digital resources, incentives to change and support from colleagues and school managers, clear and understandable school and national polices, and background in formal computer training. A worldwide educational survey at primary and secondary education confirmed these early indications. Pelgrum (2001) assessed ICT integration in teaching and ranked three factors as most significant barriers: (i) computers insufficiently available, (ii) teachers' lacking of ICT knowledge and skills, and (iii) difficulties in integrating ICT in instruction in a relevant manner. Furthermore, teachers tend to ignore the full potential of ICT to power learning environment. For example, in the Netherlands, a survey in the highest grade primary schools found that 60 to 80% of teachers in the sample never used CD-ROM encyclopedias and information search on the Web (Smeets, 2005). In another survey, in higher educational institutions, 51% of teachers considered that the quality of students' learning in their course did not improve using Internet; and 27% think that e-learning environments have no added value for their course (Mahdizadeh, Biemans, & Mulder, 2008, p. 148).

Nonetheless, teachers' adoption of ICT use in teaching cannot be restricted to merely technology-related factors: "integration of educational computer use in professional competencies of teachers implies a more complex approach" (Tondeur, Hermans, Van Braak, & Valcke, 2008) (p.2542). Beyond factors related to technology resource and education management, teachers' beliefs about teaching and learning with ICT are essential and need to be fully taken into account (Mumtaz, 2000)(Cloke & Sharif, 2001). Teachers' beliefs are understandings, premises, or propositions felt to be true about education purpose and educational process. They are rooted in teachers' perception of their role and mission as knowledge owners and knowledge transmitters (Tondeur et al., 2008). Established typologies distinguish between ''traditionalistic" or behaviorist, teacher-centered, and more ''progressive" or constructivist, student-centered beliefs (Tondeur et al., 2008, p. 2544*).* These two types are not exclusive; research in the last decades on the dimensionality of educational beliefs has acknowledged a multidimensional vision of the belief system. For example, (Tondeur et al., 2008) found that most frequent adoption of all types of computer uses is amid teachers with relatively high constructivist beliefs and also high traditionalist beliefs.

To make teachers adopt a more constructivist perspective, they primarily need to gain a broader and deeper understanding of what is expected from ICT integration in class. They also need to acquire higher self confidence through improving their ICT self-efficacy and their awareness of ICT potential. Furthermore, encouraging teachers' experimental behavior and training them with pedagogy-oriented ICT skills can be strong determinants of ICT adoption in teaching (Kreijns et al., 2013). In fact, the knowledge and skills that teachers need to acquire will differ depending on the content that is taught and the pedagogical goal. This can vary from improving learning effectiveness in school subjects to promoting the development of specific skills such as lifelong learning and learning to learn.

Pedagogical issues

ICT alone does not improve teaching; rather it is the ways in which ICT is incorporated into the various learning activities that is of crucial importance (John & Sutherland, 2004). This will depend on the teacher and on his pedagogical approach in presenting content knowledge. Shulman (1987, p.8) defines Pedagogical Content Knowledge as "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented and adapted to the diverse interests and abilities of learners, and presented for instruction". The challenge with ICT lies in exploiting its vast possibilities to incorporate adequate digital resources – created from scratch or reused from existing material – into his teaching process in order to support the pedagogical content knowledge he intends to present. Learning theories can be helpful in guiding this process to build ICT based curriculums (Ally, 2008).

To illustrate the contribution of learning theories in shaping ICT usage, Mödritscher (2006) conducted an experiment in which he designed a virtual course (i.e. fully online) according to three well known theories: behaviorism, cognitivism, and constructivism (c.f. article 92036 – Learning Theories and Educational Paradigms). These three courses had identical knowledge goal and content, but pedagogically, were developed differently. The first (i.e. behaviorism) was structured as three modules provided sequentially to the students, and the learning process was assessed by typical behaviorist elements like multiple choice questions. The second (i.e. cognitivism) course was organized in two phases: first, three groups of four students each worked on the course's objectives; second, the groups (dispatched differently) had to restructure the result of the first phase and synthesize the content in a Wiki environment. Assessment was done by grading the result of each phase based on quality and quantity. The third course (i.e. constructivism) was organized in such a manner to lead students to build the knowledge content collectively. The four groups were given all material, and the task was to create a document for mediating the course's learning objectives to colleagues. The three members of each group had then to compare the works of the other groups and evaluate them. Results showed that each of the three courses varied in various aspects such as learners' and teacher's effort and effectiveness. The behaviorist and constructivist approaches showed better results in teaching effectiveness and earned better rating from students. Furthermore, best efficiency in knowledge transfer was obtained through those tasks that students had to complete on their own (Mödritscher, 2006).

Beyond pedagogical approaches to ICT integration in teaching, there is a serious issue that arises: is it teaching "with ICT" or teaching "about ICT"? When teaching, for example, a basic statistical technique using a spreadsheet (e.g. Excel), there is always a risk that the focus is on the tool and not on the subject. According to Selinger (2001), we need to teach ICT skills in ways that "enable students to perceive the benefits and potential of using computers to support their work" (p.144). Because it is difficult to teach ICT tools without their usage contexts, both should be taught simultaneously: the content material with the help of ICT (e.g. accounting), and effective ICT skills (e.g. how to use Excel). However, among teachers, ICT integration in teaching practices is still difficult to understand. For example, in a survey among primary school teachers in Belgium, Tondeur, Van Braak, & Valcke (2007) found that, although the governmental ICT curriculum centers on the integrated use of ICT within the learning and teaching process, "teachers in primary education still stress to a large extent technical ICT skills" (p. 972). Teachers need to better understand how ICT can be integrated in teaching, and what kind of skills they require (c.f. article 92085– Teacher Education).

A framework for teacher knowledge

The Technology, Pedagogy, and Content Knowledge (TPACK) framework is a proposal to develop teacher knowledge in the ICT based education era (Harris, Mishra, & Koehler, 2009). It is intended to help teachers successfully integrate technology into their teaching practice. It is based on a recurring observation: "different disciplines have differing organizational frameworks, established practices, ways of acknowledging evidence and proof, and approaches for developing knowledge" (Harris et al., 2009, p.395). It claims that it is insufficient to expose teachers to particular technological tools and resources and their possible curriculum-based educational use. There are complex relationships among content, pedagogy, technology, and context that teachers need to understand and conceptualize in order to put these technological resources into practice. The TPACK framework emphasizes "the connections among technologies, curriculum content, and specific pedagogical approaches"; it is expected to demonstrate "how teachers' understandings of technology, pedagogy, and content can interact with one another to produce effective discipline-based teaching with educational technologies" (Harris et al., 2009, p.396).

Activity types are the building concept in the TPACK framework. An activity type is a content oriented teaching pattern which conceptualize notions of pedagogical content knowledge mentioned before (Shulman, 1986)(Shulman, 1987). It acknowledges the need for particular

pedagogical techniques when teaching a particular content. It is a structured representation of pedagogical techniques that can be associated with classroom activities, interactions and recognizable material for a particular content. For example, one of the first proposals of such teaching pattern mentioned in educational literature is Mehan (1979) I-R-E sequence: teacher Initiation, student Reply, teacher Evaluation (cited in Harris et al., 2009, p. 404). Other well known pedagogical techniques, such as "to have a discussing", "to brainstorm an issue" or "to make an experiment", can be further refined in order to form activity types. However, because of the interdependency between pedagogy and content, an activity type has to be defined in the context of a specific teaching domain. "To make an experiment", for example, would be defined differently depending on the content: in a chemistry course, it would mean going to the lab and manipulating material and measurement tools; in a foreign language course, it would mean composing linguistic constructs and evaluating them.

Concretely, for a given content, the TPACK framework gradually and incrementally matches relevant activity types with adequate technological resources (see Web references). For example, in the mathematics domain, a typical interpretation activity type is to "develop an argument". Candidate technologies to support this activity would be concept mapping software, presentation software, and specialized word processing tools (Grandgenett, Harris, & Hofer, 2011, p. 3). Another possible activity in teaching mathematics is to "describe an object or concept mathematically"; candidate technologies would be specialized tools such as Logo graphics, engineering visualization software, or Mathematica software package (ibid, p.4).

Learners and ICT

Learner acceptance is a key issue when using ICT in education. It will depend on two sets of intertwined factors: the first concerns ICT role in the educational process and how it contributes – directly or indirectly – to better performance, the second relates to learner's own experience while using ICT for educational purposes. For example, when instructors make available to students recorded lectures as audio and video podcasts to download, learners' attitudes and opinions will depend primarily on the extent to which this facility can contribute to successful grading in the course. In turn, this will depend on podcasts' content, and how it complements – or supplements – face to face lectures. Beyond traditional lectures, availability as podcasts of short revision summaries were, for example, highly appreciated by students (Copley, 2007). On the other hand, learners' attitudes will also depend on their experience in downloading, storing and using the audio and video digital files. File size, file format, text size and video resolution play then a key role; in addition, the ease of use and flexibility of podcasts will contribute to learner satisfaction.

Let's illustrate how multiple factors intertwine in shaping learners' perception according to educational contexts and scenarios. Kay & Knaack (2008) report a large survey to better understand how teachers and students perceive learning objects is secondary schools. Although students were less positive than teachers, they rated positively visual support, ease of use and animation with learning objects; they also felt better engaged with the course. Negative remarks mentioned inadequate level of details in certain graphics and the use of different wording and explanation methods than those used in class. Kirkwood (2008) investigated how undergraduate learners use online resources. He finds that most learners use the internet for "personal, domestic, social and employment purposes as well as for educational goals" (p. 381), but seeking information resources is most frequent when it is directly useful for their ongoing studies, particularly in relation with assessment. He insists however on the importance of adequate ICT literacy in terms of copyright and plagiarism issues, identifiers and passwords management and protection against malicious software.

Nonetheless, it is the student's perception of distance education through the Internet (i.e. e-learning) that received highest attention. Researcher regularly investigates the extent to which e-learning is appropriate for all students and is an effective manner to provide education. In 2004, Allen et al. analyzed previous empirical studies; results showed that distance learning slightly outperformed face to face classes on the basis of performance (i.e. ability to master content and

skills). Highest improvement was for teaching specific contents, e.g. foreign languages (ibid, p. 413). Concannon, Flynn, & Campbell (2005) surveyed students in an undergraduate blended course – lectures and laboratory sessions were supplemented with online course content. They found that e-learning adoption depended on the learner's general attitude and skills with computers, awareness of online resources availability, peer influence and instructor support. Complaints concerned difficulties in navigating through the resources and technical problems in accessing the platform. Hence, authors issue some tips to ease students' use of learning platforms: email notification when new material is online (students often did not notice that new material was published on the platform), high quality tutorials on how to use the system and feedback on students' questions along with comments. Globally, although students "experienced a real improvement in the quality of their education experience" (p.511) and considered ICT as a valuable support to the learning process, 81% of them claimed "traditional lectures and tutorial groups result in more effective student learning than a pure e-learning environment" (p. 508). A more fine grained study of students' perception of e-learning showed that students favored face-to-face learning over online learning when confronted with acquisition of certain specific knowledge and skills, e.g., "conceptual knowledge in the subject matter, skills in the practical application of one's knowledge, knowledge and skills in using scientific work routines, or in communication" (Paechter & Maier, 2010, p. 296). Another recent study found comparable results when analyzing students' attendance (Larkin, 2010): "contrary to popular belief, Generation Y students in general, do not aspire to replace lectures with downloadable, online versions" (p. 238); in fact, they "valued the opportunity for interactive learning provided by face to face teaching" (ibid, p. 238).

Indeed, the actual tendency is to align learner's adoption models with general models of technology adoption, i.e. TAM (Technology Adoption Model)(Lee, Kozar, & Larsen, 2003). Hence, perceived system quality, e.g. platform ease of use and learner's interface user-friendliness, is the first global factor that directly impacts learners' adoption (Chang & Tung, 2008)(Shee & Wang, 2008). The second factor measures the global usefulness of technology based educational process for attaining learners' goals. Paechter, Maier, & Macher (2010) found "achievement goals proved to be more important than other course characteristics, e.g., the design of the learning material or the user friendliness of the learning platform" (p. 227). Thus, they suggest that instructors should increase learners' motivation by adapting instruction accordingly, e.g., clarifying learning objectives, providing self-tests to assess progress all along the course.

To conclude this section, it is worthwhile to mention adaptation and personalization techniques. As learning is a complex and sophisticated process in which individual traits and characteristics can interfere, adaptive learning systems seek to adjust the content, the appearance or the process to learner's knowledge level, goals and other characteristics (Papanikolaou, Grigoriadou, Magoulas, & Kornilakis, 2002). The aspiration is to break the "one size fits all" educational paradigm and to provide personalized content, to protect learner from cognitive overload and disorientation, and to better assist him through the learning process. The basic ideas behind such approaches is to classify learner according to a certain user model, and then match learner profile with adequate content, representation or process (De Bra, Kay, & Weibelzahl, 2009). A basic and widely known user model is prior knowledge: students are grouped into groups that have similar ability and knowledge. Adaptation (i.e. automatic personalization) in such case is relatively straightforward: a quiz or a test determines learner level, and accordingly, directs him to specific learning material. However, most of existing research on adaptive learning is devoted to model learner according to his learning preferences, i.e. learning style. Learning style is the person's preferred way to learn and the way he/she learns best. More complex definitions include cognitive characteristics, in addition to affective and psychological behaviors (c.f. article 92008 – Cognitive Styles and Learning Styles). Adequately tailoring learning material in with student learner style is a complex and open problem, and actual results seem – for the moment – contradictory and controversial (Brown, Brailsford, Fisher, & Moore, 2009). However, it is widely acknowledged that

personalization and adaptability in technology-enhanced learning will have enormous potential for improving the user experience.

Conclusion

ICT is with no doubt profoundly transforming education. In order to fully benefit from this ongoing revolution, academics need to re-assess their own beliefs and pedagogical practices concerning teaching and assessment and their potential impact on learners' experiences. Both teachers and learners need to understand how ICT should be integrated in education, why e-learning activities are to be undertaken, and what expected rewards can be derived. ICT literacy for education, i.e. necessary ICT skills and knowledge for educational purposes, at individual and organizational levels, is the foundation for modern societies to reinvent teaching and learning at the age of technology.

List of Relevant Websites

General information

ICT and education, World Bank, http://www.worldbank.org/
ICT in education, UNESCO, http://www.unesco.org/new/en/unesco/themes/icts/

Digital learning resources

MIT OpenCourseWare, USA, http://ocw.mit.edu
MERLOT (Multimedia Educational Resource for Learning and Online Teaching), USA, http://www.merlot.org/merlot/
LORDEC (Learning Object Research, Development and Evaluation Collaboratory), Canada, http://www.education.uoit.ca/lordec/
National Digital Learning Resource Network, Australia, http://www.ndlrn.edu.au/

Course Management Systems

Blackboard, Course Management System, http://www.blackboard.com/
Moodle, Course Management System (open source), http://moodle.org/

TPACK framework

About TPACK, http://tpack.org/
Learning Activity Types Wiki, http://activitytypes.wmwikis.net/

Virtual schools and universities

Coursera, USA, http://www.coursera.org
Academic Earth, USA, http://www.academicearth.org/
The Open University Learning Space, UK, http://openlearn.open.ac.uk/
Indira Ghandi National Open University (IGNOU), India, http://www.ignouonline.ac.in/

References

Allen, M., Mabry, E., Mattrey, M., Bourhis, J., Titsworth, S., & Burrell, N. (2004). Evaluating the Effectiveness of Distance Learning: A Comparison Using Meta-Analysis. *Journal of Communication*, *54*(3), 402‑420.

Ally, M. (2008). Foundations of educational theory for Online Learning. In T. Anderson (éd.), *Theory and practice of online learning (2nd edition)* (p. 15‑44). Athabasca University Press.

Brown, E. J., Brailsford, T. J., Fisher, T., & Moore, A. (2009). Evaluating Learning Style Personalization in Adaptive Systems: Quantitative Methods and Approaches. *IEEE Transactions on Learning Technologies*, *2*(1), 10 ‑22.

Chang, S.-C., & Tung, F.-C. (2008). An empirical investigation of students' behavioural intentions to use the online learning course websites. *British Journal of Educational Technology*, *39*(1), 71–83.

Cloke, C., & Sharif, S. (2001). Why use information and communications technology? Some theoretical and practical issues. *Journal of Information Techology for Teacher Education*, *10*(1-2), 7‑18.

Collins, A., & Halverson, R. R. (2009). *Rethinking Education in the Age of Technology: The Digital Revolution and Schooling in America*. New York: Teachers' College Press.

Concannon, F., Flynn, A., & Campbell, M. (2005). What campus-based students think about the quality and benefits of e-learning. *British Journal of Educational Technology*, *36*(3), 501–512.

Copley, J. (2007). Audio and video podcasts of lectures for campus-based students: production and evaluation of student use. *Innovations in Education and Teaching International*, *44*(4), 387‑399.

Cuban, L. (2003). *Oversold and Underused: Computers in the Classroom*. Harvard University Press.

De Bra, P., Kay, J., & Weibelzahl, S. (2009). Introduction to the Special Issue on Personalization. *IEEE Transactions on Learning Technologies*, *2*(1), 1‑2.

Grandgenett, N., Harris, J., & Hofer, M. (2011). Mathematics learning activity types. College of William and Mary, School of Education, Learning Activity Types Wiki. Retrieved from http://activitytypes.wmwikis.net/Mathematics

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393–416.

John, P. D., & Sutherland, R. (2004). Teaching and learning with ICT: new technology, new pedagogy? *Education, Communication & Information*, *4*(1), 101‑107.

Kay, R. h., & Knaack, L. (2008). An examination of the impact of learning objects in secondary school. *Journal of Computer Assisted Learning*, *24*(6), 447–461.

Kirkwood, A. (2008). Getting it from the Web: why and how online resources are used by independent undergraduate learners. *Journal of Computer Assisted Learning*, *24*(5), 372–382.

Kirkwood, A. (2009). E-learning: you don't always get what you hope for. *Technology, Pedagogy and Education*, *18*(2), 107‑121.

Kreijns, K., Van Acker, F., Vermeulen, M., & Van Buuren, H. (2013). What stimulates teachers to integrate ICT in their pedagogical practices? The use of digital learning materials in education. *Computers in Human Behavior*, *29*(1), 217‑225.

Larkin, H. E. (2010). « But they won't come to lectures… » The impact of audio recorded lectures on student experience and attendance. *Australasian Journal of Educational Technology*, *26*(2), 238–249.

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The Technology Acceptance Model: Past, Present, and Future. *Communications of the AIS*, *12*(1), 53.

Mahdizadeh, H., Biemans, H., & Mulder, M. (2008). Determining factors of the use of e-learning environments by university teachers. *Computers & Education*, *51*(1), 142‑154.

Mehan, H. (1979). *Learning lessons: Social organization in the classroom*. Harvard University Press Cambridge, MA. Retrieved from http://www.getcited.org/pub/101876806

Mödritscher, F. (2006). E-learning theories in practice: A comparison of three methods. *Journal of Universal Science and Technology of Learning*, 3–18.

Morgan, G. (2003). *Faculty Use of Course Management Systems, Vol.2* (p. 94). EDUCASUE Center for Applied Research. Retrieved from http://www.educause.edu/ir/library/pdf/ers0302/rs/ers0302w.pdf

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Techology for Teacher Education*, *9*(3), 319‑342.

Oliver, R. (2002). The role of ICT in higher education for the 21st century: ICT as a change agent for education. HE21 Conference, Curtin University of Technology, Sarawak Campus, Miri, Malaysia.

Paechter, M., & Maier, B. (2010). Online or face-to-face? Students' experiences and preferences in e-learning. *The Internet and Higher Education*, *13*(4), 292‑297.

Paechter, M., Maier, B., & Macher, D. (2010). Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction. *Computers & Education*, *54*(1), 222‑229.

Papanikolaou, K. A., Grigoriadou, M., Magoulas, G. D., & Kornilakis, H. (2002). Towards new forms of knowledge communication: the adaptive dimension of a web-based learning environment. *Computers & Education*, *39*(4), 333‑360.

Pelgrum, W. . (2001). Obstacles to the integration of ICT in education: results from a worldwide educational assessment. *Computers & Education*, *37*(2), 163‑178.

Polsani, P. R. (2006). Use and abuse of reusable learning objects. *Journal of Digital information*, *3*(4).

Rani, N. U. (2006). *Educational Television in India: Challenges and Issues*. Discovery Publishing House, New Delhi, India.

Selinger, M. (2001). Learning information and communications technology skills and the subject context of the learning. *Journal of Information Techology for Teacher Education*, *10*(1-2), 143‑156.

Shee, D. Y., & Wang, Y. S. (2008). Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its applications. *Computers & Education*, *50*(3), 894–905.

Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher*, *15*(2), 4.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard educational review*, *57*(1), 1–23.

Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers & Education*, *44*(3), 343‑355.

Tondeur, J., Hermans, R., Van Braak, J., & Valcke, M. (2008). Exploring the link between teachers' educational belief profiles and different types of computer use in the classroom. *Computers in Human Behavior*, *24*(6), 2541‑2553.

Tondeur, J., Van Braak, J., & Valcke, M. (2007). Curricula and the use of ICT in education: Two worlds apart? *British Journal of Educational Technology*, *38*(6), 962–976.

U.S. Dept. of Education. (2010). *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington, D.C.,.

Zhang, D., & Nunamaker, J. F. (2003). Powering E-Learning In the New Millennium: An Overview of E-Learning and Enabling Technology. *Information Systems Frontiers*, *5*(2), 207‑218.