Report C: elearning literature review

Downes, Dann; Wallace, Peter; Fournier, Hélène; Pegoui, Chaouki

https://doi.org/10.4224/23002665

Learner-Centric eLearning

Report C
eLearning Literature Review

Submitted By:

Dann Downes, Peter Wallace, Hélène Fournier, Chaouki Regoui,

Version	Release date	Releaser	Major modifications
V2.1	December 3rd 2004	Peter Wallace	
V2.2	December 3rd 2004	Chaouki Regoui	Editing & styles addition

Table of Contents

Executive Summary

Introduction

The purpose of this literature review is to identify the main characteristics of a learner-centric approach to the development of e-learning tools. There are few references to learner-centered approaches to distance education (describing the shift from educators disseminating knowledge in a class room to the asynchronous self-directed character of online courses) and in the design literature concerned with user-centered design of information systems. Indeed, the learner-centric concept is yet to be coherently articulated.

In fact, adult learning is typically neither learner centered, knowledge centered, assessment centered nor community centered (Bransford, Brown and Cocking, 2003). Yet organizations are increasingly concerned with the creation of "usable knowledge" amongst their employees in the pursuit of corporate strategies and goals. Usable knowledge is not just a list of disconnected facts; it is connected and organized around concepts to specify the context in which it is applicable. The creation of usable knowledge requires considerable coordination, investment and planning.

However, it has been argued that there is a serious mismatch between the over-abundance of features in technologically mediated learning systems and the lack or total absence of explanation on the pedagogy underlying the inclusion of these tools. Also lacking are guidelines on how to design, develop, deliver, and manage pedagogically sound e-learning materials (Govindasamy 2001: 288).

This literature review will identify a number of components that would be crucial to developing such pedagogically sound and strategically significant e-learning tools.

The dominant influences on e-learning are the learning market, the available technology and the pedagogical approach (Hughes and Hay 2001). In this introductory section, we will address the learning market briefly, leaving the role of available technology and appropriate pedagogy as the focus of the rest of this document.

To understand the market potential for e-learning it can be argued that the related processes of globalization and the emergence of a knowledge economy have created a need for life-long learning. According to Cheong (2001) the breaking down of trade tariff barriers and the expansion of open market worldwide has created pressure for enterprises to constantly acquire new knowledge or know-how (339). At its simplest level, the inevitable shift from a product-based economy to a knowledge-based economy would result in an increased demand for knowledge workers who are capable of high order thinking (Govindasamy 2001: 287-88). At a more potentially profound level, knowledge is described as an economic resource that is nonexhaustible (Cheong 2001: 340). The process of acquiring new knowledge continuously is, in other words, the process of lifelong learning in order to stay competitive (Cheong 2001:340).

E-learning is an important development in technical and business training if it can achieve equivalent or comparable outcomes to traditional forms of instruction. Neuhauser (2002) compared two sections of the same course – one section was online and asynchronous; the other was face-to-face – by examining gender, age, learning preferences and styles, media familiarity, effectiveness of tasks, course effectiveness, test grades, and final grades. The two sections were taught by the same instructor and used the same instructional materials (227). The study showed that equivalent learning activities can be equally effective for online and face-to-face learners and that there was no significant difference between the effectiveness of the course as perceived by each group (230).

Benefits of e-learning: provides consistent content, it can be updated easily and quickly, it can lead to an increased retention and a stronger grasp on the subject, it can be easily managed for large groups of students (Cantoni, Cellario, & Porta 2003: 4).

At the pedagogical level, online courses can provide a risk-free simulation environment provides a forum where learners can make mistakes without directly exposing themselves, eventually receiving feedback on the consequences of their actions. This characteristic is particularly valuable when trying to learn soft skills, such as leadership and decision-making (Cantoni,, Cellario, & Porta 2003: 4).

Disadvantages and risks of e-learning: it may cost more to develop, it requires new skills in content producers, it has to clearly demonstrate a return on investment. (Cantoni, Cellario, & Porta 2003: 4). The real value of e-Learning lies not in its ability to train just anyone, anytime, anywhere, but in the ability to train the right people to gain the right skills or knowledge at the right time. Only then can e-Learning yield a justifiable return on investment (ROI) considering the costs incurred in implementing e-Learning (Govindasamy 2001: 288)

Having briefly discussed the demand for knowledge training how are we to understand the interrelationship between educational theories, systems design and the appropriate use of technology in ways that support learners? Further, how can these principles be achieved in an efficient and cost effective manner for those engaged in the construction of e-learning tools? Such an approach will address the following components:

Learners

- Adult,
- Self-directed as component of professionalism,
- Problem-solving the appropriate learning style.

Learning Environment

- Effective Design research and design principles aid learner motivation & task engagement,
- Simulation creates "authentic" experiences (real world problems),
- Collaboration reinforces knowledge acquisition.

Instruction and Learner Support

- Flexible,
- Scaffolding to support self-directed learning,
- Facilitation,
- Monitoring and appropriate feedback,
- Resource provision.

Learner and Course Evaluation

- Tied to measurable outcomes,
- Tied to organizational goals,
- Cognitive.

References:

Bransford, J. D., Brown, A. L., & Cocking, R. (2003). *How People Learn: Brain, Mind, Experience and School* (Expanded Edition ed.). Washington D.C.: National Academy Press.

Cantoni, V., Cellario, M., & Porta, M. (2003). Perspectives and challenges in e-learning: towards natural interaction paradigms. *Journal of Visual Languages & Computing, In Press, Corrected Proof.*

Cheong, C. S. (2001). E-learning--a provider's prospective. *The Internet and Higher Education, 4*(3-4), 337-352.

Govindasamy, T. (2001). Successful implementation of e-Learning: Pedagogical considerations. *The Internet and Higher Education, 4*(3-4), 287-299.

Hughes, G., & Hay, D. (2001). Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials. *British Journal of Educational Technology, 32*(5), 557-569.

Neuhauser, C. (2002). Learning Style and Effectiveness of Online and Face-to-Face. *The American Journal of Distance Education, 16*(2), 99-113.

General eLearning

Adult Learning

Who are the learners in a learner-centric model of e-Learning? They are adults with life experiences, who require motivation to learn and who pose unique educational problems because they are adults. The task of an effective e-learning system is to support the learner in her or his development of competence in a particular area of enquiry. To develop competence, students must: (a) achieve a solid foundation of factual knowledge; (b) understand facts and ideas in the context of a conceptual framework; and (c) organize knowledge in ways that facilitate retrieval and application (Bransford et al. 2003).

What are the unique characteristics of adult learning or what Knowles (1998) calls "androgogy"?

1) Adult learners are capable of self-directed learning (understood as the ways in which learners set goals, look for appropriate resources, decide on learning styles and evaluate their own progress). The ability for learners to engage with learning materials asynchronously is a defining characteristic of on-line learning.

2) Adults have higher motivation to learn when they can gain the new knowledge to help them solve important problems in their life (Huang 2002; Knowles, Holton & Swanson 1998; Garvin).

3) Metacognition plays an important role in adult learning. Metacognition simply means thinking about thinking, or understanding "how learning will be conducted, what learning will occur, and why learning is important." (Knowles et al 1998; Conrad 2002). Adult learners are more capable and more engaged when they learn how to learn. Learning "how to learn" means developing a process for solving new problems as they arise – the development of a skill set that enables the learner to be flexible, reflexive, and able to apply prior knowledge to new contexts and tasks. A metacognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them (Bransford et al. 2003). Brookfield (1995) argues that being skilled at learning will promote lifelong learning. In this way, a metacognitive approach also supports self-directed learning.

4) Adult learners show a preference for problem solving as an educational strategy, specifically involving knowledge that is presented in real-life context (Knowles et al 1998). Again, such an approach to learning makes sense when we recognize that adult learners are motivated to seek new knowledge for the practical purpose of solving problems in their professional or personal lives.

5) Adult learners come to the classroom with background knowledge and experience that reinforces their self-identity (Cromley 2000). Prior experience of the learner

impacts learning in creating individual differences, providing rich resources, creating biases and providing adults' self-identity (Knowles et al 1998). Prior subject knowledge improves the learner's ability to ask the right questions and to evaluate the results of their inquiry (McDonald, Heap and Mason 2001). Pre-existing knowledge affects the learner's ability to remember, reason, problem solve and acquire new knowledge (Cromley 2000; Bransford et al. 2003; Dalgarno 2001).

It is important to recognize that the preconceptions that adult learners bring to the educational situation are not uniformly positive. For example, learners come to the classroom with preconceptions about how the world works. "If their initial understanding is not engaged, they may fail to grasp the new concepts and information, or learn them for a test but revert to their preconceptions outside the classroom" (Bransford et al. 2003). Preexisting knowledge (in the form of entrenched models and ineffective learning, problem-solving or coping strategies) also serves as an important barrier to knowledge in adult learners (Garvin in Cromley 2000).

References:

Bransford, J. D., Brown, A. L., & Cocking, R. (2003). *How People Learn: Brain, Mind, Experience and School* (Expanded Edition ed.). Washington D.C.: National Academy Press.

Brookfield, S.B. (1995). *Becoming a Critically Reflective Teacher.* San Francisco: Jossey-Bass.

Conrad, D. (2002). Engagement, Excitement, Anxiety, and Fear: Learners' Experiences of Starting an Online Course. *The American Journal of Distance Education, 16*(4), 205-226.

Cromley, J. (2000). *Learning to Think, Learning to Learn: What the Science of Thinking and Learning Has to Offer Adult Education*: National Institute for Literacy.

Dalgarno, B. (2001). Interpretations of constructivism and consequences for Computer Assisted Learning. *British Journal of Educational Technology, 32*(2), 183-194.

Huang, H. S. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 33*(1), 27-37.

Knowles, M.S., Holton, E.F., & Swanson, R.A. (1998). *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development* (5th Edition). Houston: Gulf Publishing Company.

McDonald, J., Heap, N., & Mason, R. (2001). "Have I learnt it?" Evaluating skills for resource-based study using electronic resources. *British Journal of Educational Technology, 32*(4), 419-433.

Cognitive Psychology and Learning

Learning style can be thought of as the combination of the learner's motivation, task engagement, and information-processing habits (Aragon, Johnson and Shaik 2002: 230).

Motivational levels are maintained once the learner establishes preferred environmental and social conditions for learning (ibid: 229). The engagement level is defined as "the point of contact between the motivational condition of the learner entering the learning situation and the active processing work required by the new learning task" (Curry, 1991). Cognitive controls take place only after the learner becomes engaged in the task (Aragon, Johnson and Shaik 2002: 229).

Learning styles are varied. Gardner (1983) proposed that humans are born with at least seven intelligences which allows extraordinary flexibility in developing the competency necessary to meet the intellectual demands of their cultures. These intelligences are *verbal/linguistic, musical/rhythmic, logical/mathematical, visual/spatial, bodily-kinesthetic, interpersonal,* and *intrapersonal.* According to Gardner's Multiple Intelligence theory, these intelligences evolved for the purpose of solving problems and fashioning products necessary for human survival (Brougher 1997: 28). By participating in an environment that is nourishing for all the intelligences, adults can experience a richness and enjoyment in learning they thought they had outgrown or in many cases never experienced (Brougher 1997: 29).

Magliozzie (n.d.) describes a "new theory of learning" based on learner action and the fact that people have a short attention span (20 – 30 minutes). They key idea is that listening is less effective than solving problems in learning. Other research suggests that

problem-based learning may be particularly suited for adult learners because adults have a fully developed working memory, they are interested in contextual issues (current events, social conditions, etc.), they can distinguish reality from fantasy (in most situations). Adults have a context for meaning because they have had adult experiences of emotions like anger, guilt, etc., and have experienced social relationships. Finally, adult learners come to education having already learned to recognize and solve many problems (Cromley 2000).

Recent research has investigate the relationship between prior knowledge, a problem-solving approach to learning and the development of high technology skills. For example, McDonald, Heap and Mason (2001) investigated levels of information literacy in undergraduate and graduate students. They operationalized information literacy as comprised of four information handling skills: operation skills concerned the ability to run the physical system; navigation skills referred to the ability to run the software; investigation skills involved the ability to frame appropriate questions, conduct searches and find the appropriate information and reflection skills involve the ability to integrate the found information into project work or final reports (McDonald, Heap and Mason 2001: 420). Previous work indicates a link between these cognitive skills and subject knowledge, because students need to be able to comprehend the "framework" of the discipline so that they can form appropriate questions and evaluate the results of their searches. Thus, conclude the authors, postgraduates may be much better placed to benefit from this teaching and learning approach, because they have the necessary investigative and reflective skills (McDonald, Heap and Mason 2001: 430).

Liu (2003) explored the way students acquiring design skills for work in multimedia. The process promotes learners' active pursuit and use of knowledge and can promote the discovery of new content. The instructor took on the role of providing "scaffolding" (the support a teacher or an expert provides to a learner when she is learning a new skill so that she can achieve the goal successfully) (36). Liu found that students with a strong familiarity in the subject matter or with technology found the less structured nature of the design course satisfying. Students with less background knowledge desired more structure from the course.

It is, perhaps, unreasonable to assume that e-Learning systems can support all intelligences and all styles of learning. Indeed, by its very design, an online Internet environment will require students to utilize reflective observation (learning by watching and listening) and abstract conceptualization (learning by thinking) simply because of the way the materials are organized and presented (Aragon, Johnson and Shaik 2002: 242). Despite this fact, a study by Aragon, Johnson and Shaik (2002) found that online learning can be as effective as face-to-face learning in many respects, even though students have different learning style preferences.

References:

Aragon, S., Johnson, D., & Shaik, N. (2002). The Influence of Learning Style Preferences on Student Success in Online Versus Face-to-Face Environments. *The American Journal of Distance Education, 16*(4), 227-244.

Brougher, J. (1997). Creating a nourishing learning environment for adults using multiple intelligence theory. *Adult Learning, 8*(4), 28.

Cromley, J. (2000). *Learning to Think, Learning to Learn: What the Science of Thinking and Learning Has to Offer Adult Education*: National Institute for Literacy.

Gardner, H. (1983). *Frames of Mind: The theory of multiple intelligences*. New York: Basic Books.

Liu, M. (2003). Enhancing Learners' Cognitive Skills Through Multimedia Design. *Interactive Learning Environments, 11*(1), 23-39.

Magliozzie, T. L. (2002). *Rant and Rave: The New Theory of Learning*. Retrieved December 24, 2002, 2002, from http://cartalk.cars.com/About/Rant/r-rlast15.html, http://business.unbsj.ca/users/fleet/LCeL/general_elearning/click_clack_learning_theory.pdf

McDonald, J., Heap, N., & Mason, R. (2001). "Have I learnt it?" Evaluating skills for resource-based study using electronic resources. *British Journal of Educational Technology, 32*(4), 419-433.

Constructivist Methodologies

If learners can adapt to the learning environment it becomes important to adopt a pedagogical style inherently tailored to the requirements of adult learners. It is possible to identify three broad educational approaches: *behaviorism, socio-cultural* and *constructivism* (Conole et al., 2004:18). In effective e-learning the constructivist approach, supported by the socio-cultural approach are becoming the most fruitful strategies for designing effective e-learning situations because they focus on the learner's preference for solving problems and the fact that learning occurs socially, in particular contexts.

Constructivist psychology is based on the demise of behaviorist views in favor of cognitive views. For example, Suchman (1987) suggests that the goal oriented, plan-based models of human conduct which form the basis to HCI and cognitive science have a number of shortcomings. As Heath, Knoblauch and Luff (2000) put it, it is necessary to turn away from the experimental, the cognitive and the deterministic, to the naturalistic, the social and the contingent (304). While this sounds a bit overstated, it suggests a shift from behaviouristic approaches to learning that emphasize the repetitive conditioning of learner responses to an emphasis on the development of cognitive functions emphasizing the learner's cognitive activity and the mental models they form (Dalgarno 2001:184).

The constructivist approach to education assumes that learning is built up from the learner's perspective rather than passively received from an expert at the top (Hughes and Hay 2001: 558). This approach has influenced adult education as well as the field of usability testing. It is becoming a prominent method in the design of online courses.

According to Dalgarno, three broad principles define the constructivist view of learning.

1) **Fundamental principle** – each person forms their own representation of knowledge.

2) **Second principle** – learning occurs when the learner's exploration uncovers an inconsistency between their current knowledge representation and their experience.

3) **Third principle** – learning occurs within a social context, and that interaction between learners and their peers is a necessary part of the learning process (Dalgarno 2001: 184).

Online courses are particularly well suited to supporting the constructivist method of learning. Constructivist concept of learners carrying out realistic tasks with assistance or scaffolding to enable them to complete the larger task without need to learn all the sub-tasks involved. As a by-product the learner will learn how to complete the sub-tasks so that they may complete the larger task unassisted (Dalgarno 2001: 191).

Constructivism, applied to learning environment design, supports learners in a variety of ways. These include: the acquisition of knowledge through the internalization of interactions in the learning environment; practice of new skills in context appropriate exercises; and the realization that knowing and learning are social activities (Swan 2004: 7).

The use of constructivist methods is not universally accepted. Evidence from research on learning styles would suggest that there is no single effective method for teaching and learning since students differ in their preferences (Sahin 2003: 68). Constructivist instructional approaches are also criticized because they: are costly to develop (because they are inefficient); they require technology for their implementation; and they are very difficult to evaluate (Tam, 2000 in Sahin 2003:69).

References:

Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. *Computers & Education, 43*(1-2), 17-33.

Dalgarno, B. (2001). Interpretations of constructivism and consequences for Computer Assisted Learning. *British Journal of Educational Technology, 32*(2), 183-194.

Heath, C., Knoblauch, H., & Luff, P. (2000). Technology and social interaction: the emergence of 'workplace studies'. *British Journal of Sociology, 51*(2), 299-320.

Hughes, G., & Hay, D. (2001). Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials. *British Journal of Educational Technology, 32*(5), 557-569.

Sahin, T. (2003). Student teachers' perceptions of instructional technology: developing materials based on a constructivist approach. *British Journal of Educational Technology, 34*(1), 67-74.

Suchman, L. (1987). *Plans and Situation Actions: The Problem of Human-Machine Communication.* Cambridge: Cambridge University Press.

Swan, K. (2004). A Constructivist Model for Thinking about learning Online (paper presented at the Sloan Consortium Workshop, September, 2004).

Current eLearning Approach and Applications

Structure of Cognition

Knowledge comes coded and connected to the activity and environment in which it is developed. Knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and used. Classroom tasks, therefore, can completely fail to provide the contextual features that allow authentic activity (the application of knowledge in a real world context). At the same time, students may come to rely on features of the classroom context, in which the task is now embedded, that are wholly absent from and alien to authentic activity (Bransford et al. 2003). One approach to education that addresses the disconnect between learner requirements and the structure of the classroom learning environment is the notion of cognitive apprenticeship.

Cognitive apprenticeship methods try to enculturate students into authentic practices through activity and social interaction in a way similar to that in craft apprenticeship (Bransford et al. 2003). Cognitive Apprenticeship includes four instructional strategies:

1) Modeling – involves an expert carrying out a task so learner's can observe how tasks are performed.
2) Coaching – involves the instructor observing learners and offering suggestions as the learner performs a task.
3) Articulation – is the process of getting students to articulate their knowledge with particular emphasis on the reasoning behind it.
4) Exploration – encourages learners to engage in problem-solving (Corbett and Kearns nd: 4).

Cognitive apprenticeship supports learning in a particular domain by enabling students to acquire, develop, and use cognitive tools in authentic domain activity. Through this process, apprentices learn the culture of practice. Social interaction is a critical component of this type of situated learning. As the novice is socialized into the community of practice, she or he becomes more active and engaged within the culture and gradually assumes the role of expert (Corbett and Kearns nd: 5).

Of particular interest to developers of e-learning tools is the use of real-world simulations as a form of authentic assessment in cognitive apprenticeship. Simulations can be developed to determine the degree of transfer of classroom knowledge to typical real life situations (Corbett and Kearns nd: 7).

References:

Bransford, J. D., Brown, A. L., & Cocking, R. (2003). *How People Learn: Brain, Mind, Experience and School* (Expanded Edition ed.). Washington D.C.: National Academy Press.

Corbett, R., & Kearns, J. (2003, April 22- 24). *Implementing Activity-Based Learning.* Paper presented at the TCC 2003: Eighth Annual Teaching in the Community Colleges Online Conference.

Intellectual Capital Model

Lifelong learning is an asset to enterprises in a knowledge economy. This is, indeed one of the primary reasons to invest in e-learning. The promotion of a learning culture within an organization is intended to increase that organization's intellectual or human capital. This concept is derived from the broader notion of social capital.

Standard definitions describe human capital as the 'ability, skill and knowledge of individuals which is used to produce goods and services'. Attributes include emotional and mental health of individuals (Balatti and Falk 2001: 2).

On one hand, the term (social capital) is used to describe the resources that are made available to individuals or groups by virtue of networks and their associated norms and trust. On the other, it has been used to describe the networks themselves (Balatti and Falk 2001: 2).

Nahapiet and Ghoshal (1998, p. 243) define social capital 'as the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit'. The structural dimension of social capital refers to the 'impersonal linkages between people or units'. The relational dimension identifies the features of personal relationships, including: trust, trustworthiness, norms and sanctions, obligations and expectations, identity and identification. The cognitive dimension refers to shared language, codes, and shared narratives within the organization (Balatti and Falk 2001: 3 -4). Field and Schuller (1997, p. 17) state: Social capital...treats learning not as a matter of individual acquisition of skills and knowledge, but as a function of identifiable social relationships. It also draws attention to the role of norms and values in the motivation to learn as well as in the acquisition of skills, and the deployment of new know-how (in Balatti and Falk 2001: 3).

Learning occurs when social capital is built, that is, when the set of interactions calls upon existing knowledge and identity resources and adds to them (Balatti and Falk 2001: 4). The development of social capital involves three components: the interaction between participants, the resources potentially available to that interaction, and the desired outcomes of the interaction (Balatti and Falk 2001: 4-5).

Balatti and Falk (2001) found that most, if not all, outcomes required participants to engage in interactions that developed stores of knowledge and identity resources available to them in ways that permitted them to act differently from their norm (Balatti and Falk 2001: 15).

Content required for organizational development and knowledge transfer are unlikely to be found in the catalogs of a third party vendor. Such content needs to be developed to cater for the specific needs or needs to be customized to the language and cultural requirements of an organization (Ismail 2001: 332). Granular information is essential to the delivery of the right information, to the right person, in the right amount. It is thus important for organizations embarking on an e-learning development project to develop a strategy and systems framework prior to any technology acquisition (Ismail 2001, p.335).

References:

Balatti, J., & Falk, I. (2001, September 13 - 16, 2001). *Socioeconomic Contributions of Adult Learning to Community: A social capital perspective.* Paper presented at the Wider Benefits of Learning: Understanding and monitoring the consequences of adult learning, Lisbon, Portugal.

Ismail, J. (2001). The design of an e-learning system: Beyond the hype. *The Internet and Higher Education, 4*(3-4), 329-336.

Nahapiet, J., & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. *Academy of Management Review, 23*(2), 242 - 266.

User Design

The focus of this review is the learner in the e-learning environment. Traditionally, once facet of e-learning development that has attempted to address the learner is the field of user design. With our understanding of the motivation, cognitive styles and educational preferences of adult learners, it is possible to make the design process more robust, more comprehensive and better adapted to the needs of learners as well as the requirements of the organizations using e-learning.

Huang (2002) identifies a number of issues that are particularly important for developing online education:

1) Learner's isolation; individual learning at a distance is a basic design for online learning. Often this is assumed to be a strength of e-learning because the "user" is in control of the flow of learning. However, as we have seen, learning is a social activity and the e-learning environment must compensate in some way for the learner's isolation.

2) Learners are unable to determine the quality and authenticity of their learning. This criticism can be addressed using the pedagogical insights of constructivism and cognitive apprenticeship.

3) Instructors must notice the reality of physical distance between learners and themselves and must be prepared to change their role from consultant, guide, resource provider, etc. as the situation dictates. Learner support becomes a crucial component in effective e-learning.

4) Huang's major criticism with current practice is the fact that educators and course creators 'pre-determine' what constitutes authentic learning in their instruction. Information is not provided by real world but from developers' ideas. Simulations and collaborative settings may be effective tools for dealing with this criticism.

Such criticisms suggest a need to shift the emphasis of e-learning from the "e" (technology) to the learning. This shift will requires a closer look at content development (Hamid 2001: 313). According to Hamid (2001) the elements of e-learning content are:

- *Information architecture* – the process of translating user requirements into functional definitions.

- *User interface design(UI)* – UI is necessary because it installs in the user a sense of control. An effective UI has the following characteristics: ease of learning, efficiency of use, memorability, error frequency, and subjective satisfaction.

- *Content strategy* – content should be organized in a pyramid form with the important points highlighted and details to follow (Hamid 2001: 313 – 14).

References:

Hamid, A. A. (2001). e-Learning: Is it the "e" or the learning that matters? *The Internet and Higher Education, 4*(3-4), 311-316.

Huang, H. S. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 33*(1), 27-37.

User-centered Design

User participation in generative (early phases) can provide critical information for the development team to understand user needs and desires, but it can also be invaluable in developing ideas for product features and forms (Hanington 2003: 12).

Human-centered design includes the following elements of research:

1) User Research – early, baseline collection of information,

2) Speculative Scenarios – preliminary scenarios of use built from baseline information,

3) Pilot Testing – in-house testing of content, and research protocol,

4) Product (Document) Reviews – expert and user reviews of document,

5) Product (Document) Testing – testing of prototypes with users and experts.

Human-centered design makes use of a number of methods to achieve its goals. These can be grouped into three broad categories; traditional, adapted, and innovative methods (Hanington 2003).

Traditional Methods: are derived from traditional market reach. Techniques include surveys, interviews, questionnaires, and focus groups. Such methods are an efficient means to reach large numbers of people. If structured effectively, data can be easily compiled analyzed and visualized. However traditional human-centered design methods can be criticized because they rely on the interpretation of pre-existing information and on truthful responses from research participants.

Adapted Methods: borrow methods established from academic disciplines engaged in human research. Since the goals and purposes of academic research are slightly different from the requirements of product design, the methods must be slightly adapted. Adapted methods often use *Experiential Sampling Methods* (ESM), whereby people are paged at various times of the day to record their behavior, product use, and/or feelings. This is an example of condensing processes that may otherwise take extended amounts of time to monitor and complete.

Innovative Methods: Participants are invited to assist in research by engaging in a creative activity, the response is likely to be more favorable than when faced with a request to fill out a survey or take part in an interview. These methods are particularly appropriate during generative research, often referred to as *projective* because of their success in uncovering needs and desires that may be unknown even to the user, and that are difficult to articulate when probed for using traditional methods. Innovative methods are typically identified by their participatory nature, creative engagement and outcome, and their relatively specific application to design research (Hanington 2003: 13-15).

References:

Hannington, B. (2003). Methods in the Making: A Perspective on the State of Human Research in Design. *Design Issues, 19*(4), 9-18.

Multi-disciplinary Teams

The constructivist methodology allows benefits to accrue from multi-disciplinary teamwork in elearning design. It also corrects for weaknesses or undesirable dominating factors in the design process (Hughes and Hay 2001: 566). Concept mapping is a useful technique that makes the potential contributions of team members explicit; helps the team understand dominnat influences and blindspots of the team; helps the team reflect on how their own work can be integrated with that of the others (Hughes and Hay 2001: 558).

Concept mapping conventions include:

1) Placing concepts in boxes with directional links that show the map reader how to navigate.

2) Ensure the broadest concepts are at the top of the map with subordinate concepts at the bottom to create hierarchy.

3) Concepts are anchored in examples to ensure their meaning is clear and understood (Hughes and Hay 2001: 560).

References:

Hughes, G., & Hay, D. (2001). Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials. *British Journal of Educational Technology, 32*(5), 557-569.

Usability Testing

Users increasingly work not only with information technologies as "tools", but "inhabit" information environments in which they work, learn, and socialize (Grice and Hart-Davidson 2002: 159). The construction of effective user interfaces becomes central in creating an inhabitable environment within which learning can occur.

In the context of instructional design, instructional interface elements are those that are specifically designed to facilitate access to, and participation in, instruction and instructional support (Lohr 2000: 162). Independent of the type of media used in an instructional interface, the underlying design goal is to create easily recognizable signals, signs or cues that direct the learner to information or tools that facilitate the instructional goals of the environment (Lohr 2000: 162).

Norman asserts that to represent a rewarding experience, an effective product should: be interactive and provide feedback to users; should have specific identifiable goals; should motivate the user by communicating a continuous sensation of challenge; should provide suitable tools to accomplish specified tasks; the environment should avoid any factor of nuisance interrupting the learning stream. Moreover, the environment should be pedagogically suitable, though attractive and engaging. The user should be involved in the learning process without being overwhelmed. (Ardito et al. 2004: 80). To test these assumptions, Ardito et al. (2004) conducted a usability study of an e-learning system. A number of users complained about the lack of mechanisms to highlight both lesson structure and high priority topics. Participants also reported problems searching the educational material to study: they didn't understand how to access pages following the first one. Some participants sight got tired during prolonged interaction with the e-learning system. It should be possible to use the platform offline and the educational material should be printable (81).

To facilitate the development of effective products the design team should engage in usability testing throughout the process of product development.

Usability testing is a collection of evaluation methods based on observing how users perform tasks, and obtaining feedback from users through formal tests or compilations of user comments. It is an iterative process of collecting response data or user feedback on a product, re-designing the product in response to that feedback, and re-testing the product to examine whether changes have enhanced the usability (Kim et al. 2001: 595). Nielson (1993) suggests usability heuristics; simple and natural dialog, minimization of user memory load, consistency, feedback, clearly marked exits, shortcuts, good error messages, prevention of errors, help and documentation, and heuristic evaluation (in Lohr 2000: 164). Usability research today includes both the rigorous modeling of cognitive function and the thick ethnographic description of user behavior, both mathematical and narrative modes of analysis (Grice and Hart-Davidson 2002: 161).

The usability research community, today, understands that:

1) The context of use includes the social group
2) There are competing, but equally legitimate units of analysis
3) There is more to use than mere "use"
4) Use overlaps with use
5) Use develops over time

Among the responses to these challenges, we observe:

1) Social contexts are included in the analysis of use

2) Histories are researched and developments over time are measured

3) Units of analysis are mapped and chosen carefully to preserve a "system" view

4) A broad and detailed range of user activity is considered when data collection methods are designed.

5) Results are reported with a multidisciplinary audience of researchers, designers, and users in mind (Grice and Hart-Davidson 2002: 163).

Of particular benefit to designers of online learning materials is the fact that a usability study of a relatively small number of users could identify specific problems in interface design. It is recommended that interface problems be addressed before conducting educational studies that examine how educational software programs affect student learning (Kim et al 2001: 604).

References:

Ardito, C., Marsico, M. D., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V., et al. (2004, 2004). *Usability of E-learning tools.* Paper presented at the working conference on Advanced visual interfaces, Gallipoli, Italy.

Grice, R., & Hart-Davidson, B. (2002). Mapping the expanding landscape of usability: the case of distributed education. *ACM Journal of Computer Documentation (JCD), 26*(4), 159-167.

Lohr, L. L. (2000). Designing the instructional interface. *Computers in Human Behavior, 16*(2), 161-182.

Kim, S., Brock, D., Orkand, A., & Astion, M. (2001). Design implications from a usability study of GramStain-Tutor. *British Journal of Educational Technology, 32*(5), 595-605.

Instructional Design Challenges

The original idea of instructional design by Gagne (1985) divided ID (instructional design) into several steps:

1) Analyze the domain knowledge into a hierarchy of atoms, which are either a small piece of knowledge or a simple combination of previously specified atoms.

2) Sequence the atoms for instruction so that a combination atom is not taught until its components have been taught, and

3) Design an instructional approach for each atom in the sequence (Hakkinen 2002: 462-463).

Traditional ID methods and models have been considered to be externally directed and content driven (Hakkinen 2002: 463). For example, Govindasamy (2001) argues that e-learning content must be designed and developed in smaller manageable chunks know as learning objects (LO). Due to its smaller granularity and the way it is programmed, tagged, and stored, Los have increased share-ability and reusability (Govindasamy 2001: 292). This model is atomistic with smaller learning objects being grouped into higher level learning objects. If the learner does not achieve the minimum scores stipulated by the LO, then the learner will be directed to a more basic LO that teaches all the prerequisite knowledge required to master the current LO. Once the learner finishes the requirements of a particular learning object she or he takes a posttest that assesses the learners' mastery of the LO's knowledge. Then the learner is directed to the next LO in sequence (Govindasamy 2001: 293).

The atomistic or modular approach to content development can be an effective strategy for outsourcing content development (Talbott, Gibson and Skublics 2002).

Potential authors receive the course outline packaged with the authoring tool and a set of guidelines. The outline must include a general description and objectives of the reading material modules, assignments and chat sessions in the order in which they will be taught (Talbott, Gibson and Skublics: 219). Based on this material, they estimate and bid on a particular course. In most cases, authors are easily able to leverage their existing materials (Talbott, Gibson and Skublics: 219). By leveraging existing authoring tools, the cost savings are dramatic (Talbott, Gibson and Skublics: 220).

One problem with the modular approach to content design is the potential mismatch between the problem-solving approach to learning and the course developer's desire to leverage already existing content. In order to avoid this disconnect the main goal of designers of e-learning systems should be to understand the principles which cause cognitive effort and decision making and incorporate them into the learning environments (Cantoni, Cellario and Porta 2003: 7).

For example, it has been demonstrated that open environments have positive effects on learning outcomes among those students who have good prior knowledge and specialized expertise (see Liu 2003). Students representing a low level of achievement attain poorer outcomes in open and very unstructured environments compared to more structured environments (Hakkinen 2002: 465). Research suggests that what is presented graphically in a virtual lesson is almost always more easily remembered, regardless of the users' preferred learning style (Cantoni, Cellario and Porta 2003: 6).

Another useful content development strategy is called the Learning Design Toolkit (Conole et al. 2004). The purpose of the toolkit is to map learning theories to learning activities and associated mediating tools and resources (Conole et al. 2004: 21). Toolkits are decision-making systems based on expert models, filling a role between that of wizards and conceptual frameworks (Conole et al. 2004:22). The learning design toolkit consists of the following stages:

1) Outlining the overall learning activity and associated learning outcomes.

2) Listing potential mini-activities.

3) Outlining the contextual details in terms of resources and constraints.

4) Mapping mini-activities to potential tools and resources.

5) Selecting mini-activities and tools and resources based on their contribution to the overall pedagogic theory.

6) Planning of the actual learning activity (Conole et al. 2004: 27-28).

References:

Cantoni, V., Cellario, M., & Porta, M. (2003). Perspectives and challenges in e-learning: towards natural interaction paradigms. *Journal of Visual Languages & Computing, In Press, Corrected Proof.*

Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. *Computers & Education, 43*(1-2), 17-33.

Gagne, R.M. (1985). *The conditions of learning and theory of instruction.* (4th edition). New York: Holt, Rinehart, and Winston.

Govindasamy, T. (2001). Successful implementation of e-Learning: Pedagogical considerations. *The Internet and Higher Education, 4*(3-4), 287-299.

Hakkinen, P. (2002). Challenges for design of computer-based learning environments. *British Journal of Educational Technology, 33*(4), 461-469.

Liu, M. (2003). Enhancing Learners' Cognitive Skills Through Multimedia Design. *Interactive Learning Environments, 11*(1), 23-39.

Talbott, D., Gibson, M., & Skublics, S. (2002, 2002). *A collaborative methodology for the rapid development and delivery of online courses.* Paper presented at the 20th annual international conference on Computer documentation, Toronto, Ontario, Canada.

Collaborative and Communication Tools

Online students may expect that online courses are completely self-contained (Aragon, Johnson and Shaik 2002). Therefore, collaboration tools, support functions, online discussion groups, etc. must be incorporated into the metacognitive elements of an online course (learning objectives, and goals) so that the Learner is more inclined to make use of the added functionality of an online course as a different form of educational experience.

For an individual, social connectedness has been shown to be an important determinant of economic success and of physical and psychological well-being (Timms, Ferlander and Timms 2001: 1). In order to form a community, "virtual" or "real", participants need to share a common purpose: it is in this connection that the use of the Internet for online education may be especially relevant (Timms, Ferlander and Timms 2001:3).

Social presence has been defined as the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal relationship (Tu and McIsaac 2002: 134). Three dimensions of social presence – social context, online communication, and interactivity – have been identified as important elements in establishing a sense of community among online learners (Tu and McIsaac 2002: 131).

Kollock (1998) suggests a number of guidelines for the development of on-line communities that are derived from work on interpersonal co-operation and social dilemmas. Among the points mentioned are the importance of individuals sharing information about each other, ensuring continuity of interaction, allowing sufficient time for people to express themselves, sharing interests and having self-administered rules and sanctions (Timms, Ferlander and Timms 2001: 3).

Learning involves confrontation between alternative perspectives and experiences and space has to be allowed for participants to discover these and work through differences (Timms, Ferlander and Timms 2001: 4).

References:

Aragon, S., Johnson, D., & Shaik, N. (2002). The Influence of Learning Style Preferences on Student Success in Online Versus Face-to-Face Environments. *The American Journal of Distance Education, 16*(4), 227-244.

Kollock, P. (1998). The Economies of Online Cooperation: Gift and Public Goods in Computer Communities. *Communities in Cyberspace.* London: Routledge.

Timms, D., Ferlander, S., & Timms, L. (2001, June 10 - 13, 2001). *Building Communities: Online Education and Social Capital.* Paper presented at the EDEN 10th Anniversary Conference, Stockholm, Sweden.

Tu, C.-H., & McIssac, M. (2002). The Relationship of Social Presence and Interaction in Online Classes. *The American Journal of Distance Education, 16*(3), 131-150.

Interactive Tools

Writing may be seen as an effective learning tool provided that writing tasks are designed to promote active construction of knowledge and to encourage students to reflect on their own experiences and theorize about them(Lindblom-Ylanne and Pihlajamaki 2003: 18). Lindblom-Ylanne and Pihlajamaki (2003) investigated the use of WebCt group discussions to improve writing skills. They found that group discussions may help students to convert students' tacit knowledge to explicit knowledge and in this way enhance the writing process (Lindblom-Ylanne and Pihlajamaki 2003: 19). They further found that active use and the experienced usefulness of the WebCT were related to high essay grades. The results further showed that the fewer technical problems the students encountered related to the use of WebCT, the higher essay grades they achieved (26).

Desanctis et al. also investigated the role of online interaction tools such as chat rooms in supporting adult learners. Their approach stresses the importance of high information-carrying capacity in media for collaborative tasks; the need for high salience of others' presence in tasks that are highly interpersonally involving; and building shared mental models through dynamic, patterned discourse with others (DeSanctis et al. 2003: 566).

The authors observed Declarative and Procedural Information Exchange occurs when people seek and provide relatively objective or factual knowledge with one another. *Declarative knowledge* (discussion of fact) and *procedural knowledge* (discussion of method) often occur together as a process of knowledge swapping (DeSanctis et al. 2003: 567). They further observed that the process of developing shared mental models that enable a group to coordinate its efforts, respond to novel vents, absorb information, and detect and reduce errors emerged through a process of transactive learning. Transactive Learning is the process of sharing information about the capabilities and boundaries of knowledge that exist among members of a group in the 'groupness' of the collective as members identify their expertise, recount their successes and failures, etc. (DeSanctis et al. 2003: 567-68).

Transactive knowledge is decidedly relational and incorporates information about the persons who are interacting not just the information itself. If the gathering has defined boundaries, such as a definable start and finish and/or a fixed set of group members, exchange of transactive knowledge is easier than if the social gathering is diffused (DeSanctis et al. 2003: 568).

References:

DeSanctis, G., Fayard, A.-L., Roach, M., & Jiang, L. (2003). Learning in Online Forums. *European Management Journal, 21*(5), 565-577.

Lindblom-Ylanne, S., & Pihlajamaki, H. (2003). Can a collaborative network environment enhance essay-writing processes? *British Journal of Educational Technology, 34*(1), 17-30.

Feedback Tools

Collaborative tools are useful in cognitive apprenticeship. Salmon (2002) explored reflective practice in which individuals interpret events and then frame their interpretations into suitable actions. This process enables practitioners to be prepared for professional situations (380). According to Salmon, learners experiencedincreased confidence and motivation by posting their "point of learning" reflections in the training conferences (Salmon 2002: 386).

The role of the e-moderator is linked to the success of reflective practice. According to Salmon the moderator must be aware of several interpersonal activities; First, the contributor needs to be acknowledged, i.e., that the contributor's message has been read and appreciated by others. Second, the contributors must know that their contribution will be recorded and be available for others to read. Third, the e-moderator should be alert to opportunities to comment, at an appropriate moment, on the sufficiency of the data being presented and on the quality of the argument around it (Salmon 2002: 387).

References:

Salmon, G. (2002). Mirror, mirror, on my screen...Exploring online reflections. *British Journal of Educational Technology, 33*(4), 379-391.

Simulations and Multimedia

Simulations help people "learn while doing" by providing information coordinated with or embedded in people's activities, information in the "language" of tasks and activities [Guzdial et al, 1995]. Simulations are being used more and more because they allow companies to replicate processes that otherwise need to be witnessed on expensive hardware.

Technology can be used in Five Ways:

1) bringing existing curricula based on real-world problems into the classroom

2) providing scaffolds and tools to enhance learning

3) giving students and teachers more opportunities for feedback, reflection and revision.

4) building local and global communities that include teachers, administrators, students, etc.

5) expanding opportunities for teacher learning (Bransford et al. 2003).

Clearly, simulations vary in levels of complexity and sophistication from simple screen capture to full functional simulation. Simulations have been applied in military training, medical education, engineering, the soft skills side of management, and edutainment industries.

References:

Bransford, J. D., Brown, A. L., & Cocking, R. (2003). *How People Learn: Brain, Mind, Experience and School* (Expanded Edition ed.). Washington D.C.: National Academy Press.

Benefits and Restrictions of Multimedia

Ellis and Cohen (2001) are skeptical about the benefits of multimedia content in distance learning. They argue that while anecdotal reports tend to support the value of multimedia enhancement to learning, research that is conducted with accepted controls does not tend to indicate significant benefits. Still, the development of professional skills is achieved through experiential learning. Tasks are designed for real world relevance and for their authenticity. Problem-based learning enables students to engage in tasks that are motivating, realistic and complex.

Dalgarno (2001) suggests that simulations and microworlds are popular with constructivists for two reasons.

1. Simulations provide a realistic context for exploration and experimentation. Such processes allow the learner to construct their own mental model of the environment.

2. The interactivity quality of microworlds allows learners to experience immediate results as they create models or try out new theories (Dalgarno 2001).

According to McLoughlin and Luca (2002) technology can be used to create authentic contexts for learning, and provide resources that give students opportunities for:

- Connectivity – to connect to the world outside the classroom, to research topics that would otherwise be inaccessible, to access experts and to engage in conversation with peers;

- Computer modeling – to create simulations that assist the creation of authentic tasks and contexts for assessment; and

- Epistemological pluralism -- to express and represent ideas in many different ways (577).

Current research suggests that the interactive and entertaining qualities of games provide an excellent platform for building simulations. Games allow the learner to immerse themselves in a realistic simulation with rewards and consequences based on their actions and the opportunity to interact, compete and collaborate with other learners. "If we take the notion of game-play and we break it down into what distinguishes a good game, perhaps the single most important thing is decision-making, frequent decision-making, speed of decisions...Being forced to make those decisions increases the learning enormously" M. Prensky in (Foreman, 2004).

These processes or systems also feature complex interactions between variables.

The emphasis is put on repeated practice of a skill (reinforcement learning) so the learner builds the cognitive process to master that skill (what Aldrich calls muscle memory [Aldrich, 2003]). They allow a learner to extract his own cognitive representation of the rules underlying a given process. This cognitive process, although allowing the learner to master the skill and to reproduce it in real life (with most accuracy possible) does not imply, that the learner can explicitly explain the mechanisms driving the skill.

A simulation has to achieve the same degree of imperfection to get the learner in touch with all possible kinds of variations that the process could encounter. To implement the infinite and complex mathematical models describing these processes involves a great deal of optimization, operational research and AI techniques to dynamically generate complex situations (or states of the process object of the simulation) that depends on tens if not hundreds of varying factors. AI techniques are also sought to provide explanation of complex processes occurring allowing the learner by this feedback to adjust his cognitive models of the subject taught and therefore learn.

Simulation applications

Clearly, simulations vary in levels of complexity and sophistication from simple screen capture to full functional simulation. Simulations have been applied in military training, medical education, engineering, the soft skills side of management, and edutainment industries. Computer-based clinical simulations have a long history in medical education. Often they are used to provide practice in diagnostic skills or for evaluation. A different approach to medial education is problem-based learning which helps the student learn biomedical science as they solve problems in a small group. This provides a student-centered environment, with minimal guidance by a facilitator. One strategy is to integrate questions within a simulation which can be use in the context of collaborative problem-based discussions.

References:

Aldrich, C. (2003). "Going the "simulation way": Q& A with Clark Aldrich" in elearningpost November 2003].

Dalgarno, B. (2001). Interpretations of constructivism and consequences for Computer Assisted Learning. *British Journal of Educational Technology, 32*(2), 183-194.

Ellis, T., & Cohen, M. (2001). Integrating multimedia into a distance learning environment: Is the game worth the candle? *British Journal of Educational Technology, 32*(4), 495-497.

Foreman, J. (2004). game based learning in Educause review September-October 2004.

Granlund, R., Berglund, E., & Eriksson, H. (2000). Designing web-based simulation for learning. *Future Generation Computer System, 17*, 171-185

Kolar-Johann, W., & Bauer, P. (2003). Teaching Power Electronics in the 21st Century. *European Power Electronic and Drives Journal, 13(4)*, 43-50.

McLoughlin, C., & Luca, J. (2002). A learner-centered approach to developing team skills through web-based learning and assessment. *British Journal of Educational Technology, 33*(5), 571-582.

Technology Available

Think3's conspiracy (www.think3.com) combines the principles of gaming with learning 3D CAD software processes in an environment where people feel comfortable while they learn. According to Phipps (2003), while the training software does not cover everything one needs to know, it does provide a good first step in accelerating the learning process (Phipps, 2003).

A number of authors point to the critical aspect of timing of the availability of information. Information must be invoked from learns' memory and not only provided by the learning environment. A web-based e-learning tool for power electronics (with fourth year students) extends the content of the lesson with visual and audio-format material (Kolar-Johann & Bauer (2003). There are only a few papers that address the theory underlying interactive programs which allow the student to perform experiments via a simulator or to solve engineering problems. Simulation and interactive animation using the new e-Learning tool iPES (www.ipes.ethz.ch) interaction animation programs gives the student the opportunity to influence parameters like transistor switching states and to watch the resulting change of the current paths. Change in current paths is visualized by colored dots moving according to the direction of the current flow. Within this environment, Java-applets are capable of acting like movies demonstrating complex and/or dynamic system behavior.

The applets offer the possibility of an active manipulation of system parameters with the mouse via the graphical user interface and to study the resulting time and/or frequency behavior of the system. The associated HTML text gives hints on how to operate the system in order to understand why certain system reactions occur. This way of learning is advantageous over the classical approaches as the student is actively involved. The main idea of the practical is to simulate a typical design process of a power converter; homework includes collecting a simulation program from the internet, to perform the simulation of the system and to collect information about the used microcontroller system. The proposed e-learning tool and animation opens in combination with simulations the way to a better understanding of power electronics.

Granlund, Berglund and Eriksson (2000) report on three different simulations which offer a range of complexity and fidelity. First, the Chernobyl simulator for nuclear power plants, implemented as a Java applet. The purpose of this simulation is two fold: 1) to teach the basics of plant operation, 2) to teach rule-based modeling (Tait, 1994). There is a range of complexity and fidelity: training simulators are designed for professional operators and often include complete control-room simulators with a replica of the actual control room of the power plant in question. The Chernobyl simulator simulates only a small subset of a nuclear power plant, and it incorporates a simplified and inaccurate physics model. But even this straightforward simulation model is sufficient to make it a useful pedagogical tool.

Second, the C3 Fire micro-world provides a Java-based learning system that is a command, control and communication experimental web-based simulation environment. Configuration data define simulation properties such as the numbers of fire-fighting units; computer-simulated reconnaissance persons and actors; the actors' user interface and whether distributed to some other actor- i.e., defines to whom the actors can send e-mail.

Third, ERCIS is a Java-based group-distance exercise system simulating anti-aircraft defense. The simulation is designed as a prototype distributed-training system as a test of graphical simulation, interaction and distribution functionality in web technology from spanning from 1996 to 1977. This system served as a proof of concept showing that web-based simulation training systems could be built at that time and provides a simplification of the equipment handled by the learners, focusing on the primary components.

A variety of virtual reality (VR) technologies exist that enable users to directly interact with modeling and simulation systems in an experiential fashion; sensing a range of visual, auditory, and tactile cues and manipulating objects directly with their hands or voice; experiential computing systems are best described as a process of using a computer or interacting with a network of computers through a user interface that is experiential rather than cognitive. Experts in the field contend that in this environment, if a user has to think about the user interface, it is already in the way (Committee on Modeling and Simulation. *Modeling and simulation: linking entertainment and defense.* Retrieved online, May 2004).

Traditional military training systems are experiential computing systems applied to a training problem. People often learn more by doing and understand more by experiencing than by simple non participatory viewing or hearing information.

PCs serve as the primary point of entry to the Internet and therefore are critical to companies providing on-line entertainment, whether through so-called chat rooms or multiplayer games. Larger location-based entertainment centers, such as the flight simulator centers operated by Virtual World Entertainment and the Magic Edge, also are interested in moving away from workstation-based simulators to PC-based simulators as a means of reducing operating costs (Committee on Modeling and Simulation. *Modeling and simulation: linking entertainment and defense.* Retrieved online, May 2004).

The use of simulations in medical education focuses on the process of iterative learning through assessment, evaluation, decision making, and error correction and in creating a much stronger learning environment than passive instruction (Meller, 1997). Simulations have the advantage of allowing a student to make judgments and to make errors in this context.

Research shows that adults learn best by solving problems, which is why IBM chose to include simulations as part of its four-tier training model. In the four-tier learning model, the first tier represents information transfer, sharing best concepts, best practices and theories on a particular subject. The second tier tests for understanding and allows for the practice or application of skills and knowledge learned in tier one. The third tier is built upon collaborative learning, including an apprenticeship and mentorship model. And the fourth tier covers higher-level learning proficiencies. Through its four tiers of learning, IBM takes a blended approach and offers a rich and robust learning program for its employees Hollis, 2002).

Simulations are only part of the program, and IBM's simulations come in at the second tier, which is highly interactive and immersive. "The way we approach simulation is to meet the objectives of tier two, to give people the ability to test their understanding and competency and to allow them to practice," according to Lewis (as cited in Hollis, 2002). IBM has been designing and using simulations for more than five years. There are two types of simulations used at the company, one called QuickCase and another that is more sophisticated. QuickCase presents learners with a scenario and then lets them know whether their responses were the best or not.

Other more complex simulations in use by IBM include a coaching simulation in which the learner is immersed in a very intense situation; eight 20-minute coaching scenarios that can branch into different areas based on how the coaching is being done.

A business skills simulation created by SimuLearn walks trainees through a variety of functions, stopping them when they go wrong. It is estimated that simulations cut training time in half and at are about half as expensive (Phipps, 2003). Imparta's simulations/video integration is seamless and effective. An animated expert or mentor sits patiently in the corner offering advice dependent on user performance. Novices get more, experts less.

Ultimately though, learning initiatives and technologies need to be justified. While many organizations use e-learning, Web-based training and simulations should help save delivery and travel costs, Lewis said that it is the effectiveness of the learning approach that drives IBM's use of simulations. "It's not that IBM doesn't want to save delivery costs," she said," but the only reason why we did this was about *learning effectiveness*. It was to create a more effective learning approach." many of the managers go back to the simulations for performance support. "People go to these things to help them in their day-to-day jobs," she explained. "So they don't only use the simulator as part of a learning program, but they use the simulator as an object unto itself." (Hollis, 2002).

Example 1)

ILEs (Intelligent Learning Environments) provide environments that can monitor users while they work with the computer, help them perform their tasks and provide them with feedback in a manner that contributes to their learning process (Kabassi and Vivou 2004: 116). The two main adaptive hypermedia techniques that exist are: (i) adaptive presentation, where adaptation is performed at the content level; and (ii) adaptive navigation support, which is performed at the link level (Kabassi and Vivou 2004: 119).

In an Intelligent Learning Environment, the system constantly watches the user and when it suspects that the user is involved in a problematic situation, the ILE provides adaptive tutoring (Kabassi and Vivou 2004: 130).

This kind of system is beyond the capabilities of the LceL project. However, it might be possible to use the concepts in simulations. For example, after a learner provides a certain number of incorrect answers the learner may be directed back to the relevant information in the courseware.

Example 2)

Intelligent Tutoring Systems (ITS) are computer-based instructional systems that can specify what to teach to a particular learner, adapting instruction dynamically to the different levels of the learner (Atolagbe, Hlupic and Taylor 2001: 1605).

The generic architecture of an Intelligent Tutoring System includes the following main features:

1) an application development environment that allows interactive development of ITS components.

2) a probabilistic student model, that uses both the students' tutorial actions and their prior knowledge to assess the students' understanding.

3) an assessment module, for assessing the student learning and to identify areas where the student may require some assistance and remediation.

4) an automatic knowledge acquisition model for acquiring knowledge from user activities (Atolagbe, Hlupic and Taylor 2001: 1605-06).

In their prototype, Atolagbe, Hlupic and Taylor used the following pedagogical strategies:

1) *Learning with Scenarios*: involves demonstrating the operational activities and teaching the correct methods required to solve the problem.

2) *Learning by Doing*: coaches the student in step-by-step operations required to perform the task.

3) *Practicing with Contents Feedback*: The student performs activities without prompting by the tutor. When the tutor detects an error or misconception, he/she provides immediate remediation of the problem.

4) *Free exploration*: The learner controls the learning activities (Atolagbe, Hlupic and Taylor 2001: 1606).

Example 3)

In designing an interactive tutoring system for engineering mechanics, Soh and Gupta (2000) drew the following conclusions about the system:

- The system should be user-friendly. If the system if too complex, it will probably never be used.

- The students should be able to use the system at their own pace, i.e., they will not be forced to go through different chapters, topics, and/or problems, allowing them to proceed at their own pace and level of understanding.

- The system should be intelligent and interactive, and not merely a fancy electronic page-turner. The students should be able to solve the problems interactively, and if necessary, be guided intelligently.

- The system should be intelligent enough to mimic the actual tutoring by providing helpful hints to the students in solving the problems.

- The system should be easily portable and accessible (Soh and Gupta 2000: 167).

Example 4)

Students using a simulator are able to "stop the world" and "step outside" of the simulated process to review and understand it better (Parush, Hamm and Shtub 2002: 320). Parush, Hamm and Shtub asked the following questions:

1) Can history recording and inquiry affect the self-learning curve during the training phase with the simulator?

2) Can history recording and inquiry affect the transfer of what was learnt with the simulator? (Parush, Hamm and Shtub 2002: 321).

They found the use of history supported the building of retrieval strength…it also built storage strength which prevented or at least slowed significantly the decay of the response strength. The history mechanism enabled the building of storage strength by providing the learners with continuous access to learnt material (Parush, Hamm and Shtub 1995: 330).

References:

Atolagbe, T., Hlupic, V., & Taylor, S. J. E. (2001, 2001). *Teaching tools and methods: GeNisa: a web-based interactive learning environment for teaching simulation modelling.* Paper presented at the 33nd conference on Winter simulation, Arlington, Virginia, USA.

Hollis, E. (2002). IBM: Learning through simulations, Retrieved online, June 2004, from http://www.clomedia.com/content/templates/clo_inpractice.asp?articleid=165&zoneid=88

Kabassi, K., & Virvou, M. (2004). Personalised adult e-training on computer use based on multiple attribute decision making. *Interacting with Computers, 16*(1), 115-132.

Meller, G. A (1997). Typology of Simulators for Medical Education, in *Reprinted from: Journal of Digital Imaging.* Retrieved online May 2004, from http://www.medsim.com/profile/article1.html

Parush, A., Hamm, H., & Shtub, A. (2002). Learning histories in simulation-based teaching: the effects on self-learning and transfer. *Computers & Education, 39*(4), 319-332.

Phipps, J. L. (2003). Adding Excitement to E-Learning. *Industry Week, 252(4),* 51-52.

Soh, C. K., & Gupta, A. (2000). Intelligent Interactive Tutoring System for Engineering Mechanics. *Journal of Professional Issues in Engineering Education and Practice, 126*(4), 166-173.

Delivery and Support

Role of Instructor

Berge has argued that there are necessary conditions for successful online instruction, which he has categorized into four areas: technical, managerial, social, and pedagogical:

- The technical role requires instructors to have the necessary knowledge, skills, and comfort of the communication tools being used to facilitate the learning process.

- The managerial role includes the organizational, procedural, and administrative tasks associated with most credentialed and institutional learning environments.

- The social role includes creating a friendly and social environment necessary for ongoing and interactive communication.

The pedagogical role includes the areas of intellectual development and execution of learner tasks (Kanuka, Collett and Casswell 2002: 152).

One of the major challenges for those teaching in a distributed environment is trying to ensure that each student has opportunities for participation and that each student has an equal opportunity to participate in class discussions and to vie for the teacher's attention (Grice and Hart-Davidson 2002:164). Indeed, the lack of teacher/student interactions may be one of the major causes of unsatisfactory e-learning experiences (Chung, Severance and Chung 2003: 42).

In essence, learning involves two types of interaction: interaction with content and interpersonal interaction (with people). It becomes important to provide an environment in which both kinds of interaction can occur (Berge 1995: 1-2). Interpersonal interaction doesn't necessarily require real-time (synchronous) communication. Designers of online instruction need to be aware that the higher the content density of the materials to be learned, the more self-pacing becomes the responsibility of the learner (Berge 1995: 2).

From this perspective, the most important role of the online instructor is to model effective teaching and accept "the responsibility of keeping discussions track, contributing special knowledge and insights, weaving together various discussion threads and course components, and maintaining group harmony" (Berge 1995: 2). Because of the individuality of the learners, courses need to remain flexible and the instructor needs to support this (Berge 1995: 3).

Conrad (2002) conducted a study to determine how online students responded to the experience that could be labeled the first class: the occasion of entry into a course Web site for the first time. The author believes that the most successful and satisfying online learning occurs when adult learners are in continual and fluid exchange with each other and with the instructor. This dynamic teaching-learning reciprocity assumes levels of cognitive maturity and technical confidence over time; the building of this level of flow is a part of the online instructor's challenge (Conrad 2002: 209). Conrad used Moore's (1989) categories of interaction that occur in the teaching-learning exchange: **learner-teacher, learner-content**, and **learner-learner**. For Conrad, the learner-content interaction is by far the most important for helping learners feel initial engagement with the course (Conrad 2002: 218).

Webb, Tropper, and Fall (1995) found that engagement in highly constructive activities (i.e. – explain problems or rework) after receiving help was strongly correlated to student achievement (3). Chung, Severance and Chung (2003) developed prompts to support three activities: summarizing, explaining, and reflecting. Students in the treatment condition with the support tools more equally and effectively participated in their group projects and generated more ideas than students without support tool.

Mid-point evaluations actually allow instructors to adapt their communications style to the individual student thereby increasing the chances of course completion and improving the students overall perception of the course (Talbott, Gibson and Skublics: 222).

Moore's **theory of transactional distance** sought to isolate those elements of educational transactions that most critically influence the learners in distance education environments. The theory includes three variables. Two variables, *dialogue* (the interaction between the instructor and the learners) and *structure*, (the elements of the course design) comprise the teaching dimension. In learning environments where the learner receives directions and guidance through both a high degree of structure of the course and a high degree of interactive dialogue, then there is a low level of transactional distance (Kanuka, Collett and Casswell 2002: 153). The amount of learner autonomy is the third variable. Moore recognized that theories of distance education that only considered the variables of teaching would be incomplete (Kanuka, Collett and Casswell 2002: 154).

In summary, the pedagogical dimensions in the e-learning context are designed to support the self-directed qualities of adult learning. These are well articulated by Hamid (2001):

- *Constructivist approach* – Problem-based learning activities helps a student to (1) refine a statement of a problem, (2) contrive or develop a sense of the structure of knowledge and reasoning relevant to the problem, and (3) find the information needed to solve the problem.

- *Self-directed learning* – A course structure map that clearly outlines course competencies, self-assessments that index prior learning, and formative assessments explicitly linked to target competencies motivate learners to take responsibility for their learning.

- *Reflective approach* – an e-learning situation has all the necessary elements of reflection because: it is not constrained by class time; and the course site is a cumulative archive of all that has transpired in the class.

- *Evoke intrinsic motivation* – User frustration can be minimized through embedding support and feedback features such as chat rooms, active links, and perhaps by providing a time-management system.

- *Individual learning styles* – Effective learning occurs when the student expends a minimum of time and effort to acquire a competence he can retain and demonstrate.

- *Experiential learning* – An effective learning site is not measured by its tremendous colors and sophisticated animations but by what the learner can do with the content.

- *Learning both a private and social activity* – features such as search out, sort, and evaluate information accommodate the private side of learning. Features such as the discussion board or presentation space prompt social learning that is more collaborative.

- *Learning is not linear* – good instructional design takes the student on a spiral path through course material such that the learner cycles through the topics at an increasingly deep and detailed level (Hamid 2001: 314-15).

References:

Berge, Z. L. (1995). The Role of the Online Instructor/Facilitator.

Chung, S., Severance, C., & Chung, M.-J. (2003). Design of Support Tools for Knowledge Building in a Virtual University Course. Interactive Learning Environments, 11(1), 41-57.

Conrad, D. (2002). Engagement, Excitement, Anxiety, and Fear: Learners' Experiences of Starting an Online Course. *The American Journal of Distance Education, 16*(4), 205-226.

Grice, R., & Hart-Davidson, B. (2002). Mapping the expanding landscape of usability: the case of distributed education. *ACM Journal of Computer Documentation (JCD), 26*(4), 159-167.

Hamid, A. A. (2001). e-Learning: Is it the "e" or the learning that matters? *The Internet and Higher Education, 4*(3-4), 311-316.

Kanuka, H., Collett, D., & Caswell, C. (2002). University Instructor Perceptions of the Use of Asynchronous Text-Based Discussion in Distance Courses. *The American Journal of Distance Education, 16*(3), 151-167.

Talbott, D., Gibson, M., & Skublics, S. (2002, 2002). *A collaborative methodology for the rapid development and delivery of online courses.* Paper presented at the 20th annual international conference on Computer documentation, Toronto, Ontario, Canada.

Evaluation

The emphasis will shift from "training" to "learning" – from education in preparation for a job to education as a continuing activity within a career. The emphasis will continue to shift to "performance support" with the integration of Knowledge Management capabilities. E-learning is a vital step in the development of KMS. E-learning content will expand beyond its current concentration on IT and certification programs and will focus on meeting business needs. Internally developed content will become more important than off-the-shelf courseware as e-learning initiatives focus on the goals of the organization (Ismail 2001: 330).

To this end, training should no longer only focus on the act of training but must demonstrate a positive impact on performance or outcomes. There is a growing recognition that learning is a continuous, life-long process. Sanderson (2002) emphasizes the need for organizations to build a strategic foundation for e-learning, addressing the emerging approaches to e-learning in addition to synthesizing other learning efforts of the organization (Sanderson 2002: 18). Learning organizations concentrate on ingraining learning into the work culture. Culture-building strategies include legitimizing the learning programs so that they become part of the everyday work environment and work day. Accountability measurements for the group are based on the four criteria for business performance: cost, quality, service, and speed (Sanderson 2002: 19).

Evaluations can be carried out for the multiple constituents of an e-learning course.

Learning experience

Evaluation of the learning experience as a whole is rapid and easy to implement. It allows detection of bottlenecks that prevent the learner from engaging, completing or grabbing the most of the opportunity to learn provided by an e-learning offering. This type of evaluation is carried out around:

Human-computer interaction factors

- Interface: ease of use, effectiveness, efficiency…
- Usage: layout/navigation (design).

Support services

- Technical, delivery, registration, updates …
- Some other evaluations around the learning experience can also be carried out as a feedback measure to allow the courseware creators to adapt and enhance their offering:
- Learner behaviour and progress in course.

Content knowledge

Evaluation of the content knowledge of the course is intended for the subject matter being taught:

- Content: accuracy, clarity, completeness, timeliness (up to date).

- Content knowledge transfer to learner.

Support for knowledge

This evaluation takes into account the human tendency to perform tasks (especially cognitive ones) more effectively when socializing or involving multiple cognitive processes and modalities:

- Collaborative learning environment.
- Practice environment (simulations).
- Knowledge supporting community: mentors, peers.
- Knowledge supporting resources: knowledge bases, references…

Courseware assessments

This evaluation provides feedback to courseware developers about, the relevance, pertinence and correlation of the assessments provided by the course with the assessed knowledge to be transferred to learner:

- Clarity of assessment tools.
- Effectiveness of assessment tools for course personalization (pre and post evaluations that determine a learner's understanding of the subject).
- Coherence of the assessment tools with the knowledge taught.

Training business outcomes

This evaluation deals with the final intended goals of the training in a business environment:

- Effectiveness of training in the job setting.
- Alignment with business goals.
- Employee readiness enhancement.

The missing ingredients from most e-learning programs are clear and measurable objectives and cohesive strategies (Ismail 2001: 330).

References:

Ismail, J. (2001). The design of an e-learning system: Beyond the hype. *The Internet and Higher Education, 4*(3-4), 329-336.

Sanderson, P. E. (2002). E-Learning: strategies for delivering knowledge in the digital age. *The Internet and Higher Education, 5*(2), 185-188.

Effectiveness of Online vs. Traditional Evaluation Methods

User satisfaction assessment:

In general, the replacement of traditional face-to-face education with distance education technology should demonstrate little declin0e in student satisfaction with the quality of the educational process (Ong and Lai 2004: 9). The objections to distance education should not be based on the issues related to student satisfaction; students find distance learning as satisfactory as traditional classroom learning formats (Allen 2002: 94). In fact, Allen found evidence that distance learning offers as much academic improvement as traditional learning environments (Allen 2002: 93). In general, the student population that performed best with a digital learning course can be characterized as older, more mature and possibly more motivated. (Moyer, 200…)

However, given the need to articulate clear and measurable outcomes in the process of developing learning cultures within organizations a number of studies have explored methods of learner evaluation. Some examples follow.

Example 1)

Wang (2003) identifies e-learner satisfaction as: a summary affective response of varying intensity that follows asynchronous e-learning activities, and is stimulated by several focal aspects, such as content, user interface, learning community, customization, and learning performance (Wang 2003: 77). Wang tested two hypotheses to evaluate validity of the proposed ELS instrument: (1) A positive relationship exists between ELS score and the reuse intention of the e-learning systems; (2) A negative relationship exists between ELS score and the extent of post-usage complaint behavior (Wang 2003: 77).

Example 2)

The Input-Environment-Outcome (I-E-O) model was developed as a guiding framework for assessments in higher education (W. Astin [1993]). The premise of this model is that educational assessments are not complete unless the evaluation includes information on student inputs, the educational environment, and student outcomes. The primary purpose of the model is to control for input differences, resulting in a more accurate estimate of how environmental variables affect student outcomes (Frey 2002: 170). The outcome variable was students' satisfaction with the course.

The strongest predictor of satisfaction was students' belief regarding having a variety of ways to assess their learning. Knowing how likely students were to work with teams/groups was the second strongest predictor of student satisfaction (Frey 2002: 182). Those who felt connected or felt they 'knew' the instructor reported higher satisfaction and subsequently participated more frequently on online collaborative tools such as web message boards (Frey 2002: 183). The results suggested that student satisfaction can be attributed to what happened in the virtual classroom, and not to student characteristics (Frey 2002: 188).

Example 3)

Approaches to studying in electronically delivered courses are strongly associated with students' perceptions of the academic quality of those courses. The Course Experience Questionnaire (CEQ) and a short form of the Approaches to Studying Inventory (ASI) were administered to students in this study (Richardson and Price 2003: 45). The authors found that the different aspects of perceived academic quality fall into two subsets that exhibit different relationships with students' accounts of their study behavior. On one hand, perceptions of good materials and good tutoring are linked to high scores on meaning orientation. On the other hand, high scores on appropriate workload are linked to low scores on reproducing orientation (Richardson and Price 2003: 54-5).

Example 4)

Much, although not all, Ong and Lai (2004) investigated gender differences in attitudes towards using computers in education. They found that gender differences have effects on computer self-efficacy (CSE), perceived usefulness (PU), perceived ease of use (PEOU), and behavioral intention to use (BI) e-learning (Ong and Lai 2004: 3).

Computer self-efficacy appeared to be a significant determinant of perceived usefulness and perceived ease of use for both women and men. Users who have higher computer self-efficacy are likely to have more positive usefulness and ease of use beliefs (Ong and Lai 2004: 11). Despite women's rating of computer self-efficacy being lower than men's, their perception of computer self-efficacy was a more salient determinant affecting behavioral intention to use in addition to perceived usefulness and perceived ease of use (Ong and Lai 2004: 11).

The authors found that men's perception of perceived usefulness was more significant and more salient than women's in determining behavioral intention to use e-learning. Men's rating of perceptions with respect to computer self-efficacy, perceived usefulness, perceived ease of use, and behavioral intention to use e-learning are higher than women's. Computer self-efficacy and perceived ease of use were more salient to women. In contrast perceived usefulness was a salient factor for men (Ong and Lai 2004: 12).

Example 5)

Wu (2003) also found gender as a variable in course assessment. Wu hypothesizes that because gender is related to reading and writing skills, females may experience online discussions as more motivating and enjoyable (Wu 2003: 689). The hypotheses was tested by research:

- Students who perceive more motivation and enjoyability from online discussion will report higher perceptions of learning from online discussion.

- There will be no difference between Female and male students in perceptions of learning, motivation and enjoyability from online discussions.

The instructor will play an essential role in promoting students' motivation, enjoyability and perceptions of learning online (Wu 2003: 693).

Knowledge assessment:

Evaluation of learner achievements is time consuming and inaccurate because it is hard to measure outcomes (Huang 2002).

Recalling our earlier discussion of the three principles of constructivism (learners each form a unique representation of knowledge; learning is based on a perceived inconsistency between a learner's current knowledge representation and their experience; learning is a social process based on necessary interactions between a learner and her or his peers) we can make some claims about the role of an instructor in the delivery of constructivist education that correspond to these three factors. The role of the instructor involves: acting as a facilitator to provide experiences likely to challenge the learner's existing models; to provide exercises that will allow the learner to form knowledge models applicable to realistic tasks; to provide scaffolding to support the learner's explorations and collaboration with between the learner and her or his peers (Dalgarno 2001: 185).

Assessment is typically divided into two types, namely, the summative assessment and the formative assessment. Summative assessment is used to grade students to demonstrate students' achievement and it involves making a final judgment of the students' achievement relative to the predetermined objectives. Formative assessment is used as a diagnostic tool for students and teachers to identify and improve areas of weakness. According to Govindasamy, MCQ (multiple choice questions) are the only type of questions suitable to assess learning throughout all six levels of *Bloom's Taxonomy of Educational Objectives* (Govindasamy 2001: 295). He concludes that the time spent on mastering the art of designing multiple-choice items capable of testing higher-order thinking and skills would indeed be worth the time and effort; all the more so when considering their benefits in terms of automatic grading and speed of feedback (Govindasamy 2001: 296).

Multiple evaluation models for learning have been developed. They rely either on perceived assessments by learner or employer (qualitative), or on measurable outcomes and metrics (quantitative). The model for course development used by Innovatia has been the ILT-based ADDIE model. Similarly, the basic model for evaluation comes from the Kirkpatrick model. In particular, Innovatia has used Kirkpatrick's Level one and Level two scores as baseline evaluation data.

Kirkpatrick 4 level model

Kirkpatrick provided training professionals with a methodology to measure the effectiveness of training from a performance improvement perspective by measuring the feedback of the student or end user of the training program [Islam, 2004]. Kirkpatrick four-level model is one of the most commonly used for training and development courses. This model implements four levels, each focusing on a specific outcome:

- Level 1: Reaction, assessing learner' immediate satisfaction with the course.
- Level 2: Learning, assessing the amount of information that the learner has learned (usually pre and post tests).
- Level 3: Transfer, assessing the amount of material that the learner actually uses in their work.
- Level 4: Business Results, assessing the impact on the company or business of the training (usually measurable quantitative metrics).

One critic of this model is that the only attempt to gather the perspective of the business occurs in the fourth level of measurement where trainers attempt to show some correlation between the results of the first three measures and business impact. Knowing that according to the ASTD's state of the industry report, in 2002 only 11% of training organizations even measure to level four, business requirements are therefore rarely addressed [Islam, 2004].

Participant Perception Indicator (PPI)

The PPI is a perception based, easy to use and to interpret evaluation tool intended for courses that may have technology components or be technology enabled [Berger, 200.]. It uses a questionnaire, measuring perception of three dimensions or components of the course: knowledge, experience and confidence with a 5-point Likert scale (http://carat.umich.edu) and themes of interest to be assessed. Each theme is assessed against the three previously defined dimensions. This tool is suggested for learner profiling and clustering.

[Sonwalkar, 2002] proposes the structure of a "learning cube" to evaluate courseware based on availability of features (arranged along 3 dimensions). The pedagogical effectiveness of an online course is defined by the author as a summation of learning styles, media elements, and interactivity. He then links the availability of features to the pedagogical effectiveness of a course, the more features the more the course is supposed to be effective (probability of the pedagogical effectiveness increases as cognitive opportunity increases). The author also assumes the dimensions are equally likely and mutually exclusive (orthogonal cube). The 3 dimensions being, learning styles (apprenticeship, incidental, inductive, deductive, and discovery), media elements (text, graphics, audio, video, animation, and simulation), and interactivity (system feedback, adaptive remediation and revision, e-mail exchange, discussion groups, and bulletin boards), supposed to represent the course moving from a teacher-centric to a student-centered approach.

The intent of the methodology is to create objective criteria for evaluating the quality of online courses based on the existing elements that represent pedagogical content [Sonwalkar, 2002]:

$$PEI = \sum S_i * P_i + \sum M_j * Pj + \sum I_k * P_k \quad (0.1)$$

Where, S: learning styles, M: media, I: interactivity, P_x are respective probabilities. Furthermore, to take into account delivery factors, summative evaluation is applied in five major areas (using a Likert scale). For each of the five areas a list of factors is defined: Content factors, learning factors, delivery support factors, usability factors and technological factors.

The overall rating is achieved by incorporating the scores of both the pedagogical and delivery systems to provide a final rating:

Overall Rating = PEI x Summative Rating Score.

Figueira's global approach

To carry any evaluation, the factors influencing the effectiveness of the courseware have to be investigated and defined. Different researchers use multiple approaches. For [Figueira, 2003], e-learning integrates the three necessary components for learning: Content, strategies and tutoring. He asserts that assessing outcomes is more reliable than other types of assessment because individuals construct different mental models in accordance with their experience of the object about which they construct the mental model. Mental models are the cognitive structures built by individuals which influence the way they react to change and solve problems. Outcomes show if and how much learning has occurred, how performance has changed, and what results have been attained. This being especially evident in the business world where the emphasis for education and training is performance connected to the goals of the company. He proposes a framework, Global Approach mixing the decision-making, goal-free, and expert evaluation models, to measure the effectiveness of e-learning strategies or programmes. He lists five used approaches:

- Based on the programme goals: verification and quantification of the execution of the programme goals. This is obtained by identifying the programme goals, translating them into quantitative data, data collection from individuals and comparison of stated goals with attained goals.

- Based on the decision-making process: by tracking the scenarios in which the decision-making process occur, the decision-making models appropriate to each scenario ...

- Goal-free approach: the assessment not only of the established goals but also of all the consequences of a course.

- Based on an expert's knowledge: conducted by an individual or a team specialised in the object being evaluated, and

- Naturalistic approach: trying to respond to the most possible questions posed by all the individuals involved in the programme.

His framework draws from Bennett's system of criteria for measuring program impacts.

Evaluation metrics

The metrics are defined to account for criteria of training success as seen by both learner and employer company. These metrics are linked to the different outcomes sought from training. Therefore they can either be quantitative or qualitative.

The training metrics are evaluated or measured and compared to their target values that reaching or surpassing ensures success.

Qualitative metrics

Qualitative metrics account for subjective assessments of the training:

- Student satisfaction.
- Customer (employer) satisfaction.
- Quality of content.
- Content link to training needs.
- Courseware ease of use.
- Courseware interactivity.
- Courseware adaptation to individualized learner needs.
- Courseware adaptation to individualized learner environments.

Quantitative metrics

Quantitative metrics are measurable outcomes of the training or learning experience:

- Course completion rate.
- Drop-withdrawal-failure (DWF) rate (learners not successfully completing a course).
- Learner retention rate (learners taking a course).
- Learner grades or marks.
- Multiplicity of learning modes.
- Courseware unit cost of delivery.
- Courseware link to individual/ Enterprise Performance.
- Employer ROI: compared to training centres cost and in overall improvement in employee performance.

Employer's ROI

Evaluation in corporate training requires taking into account the financial costs of training for the employer. The way companies measure their training return on investment (ROI) ought to be integrated in the requirements when developing courseware to meet them with the training provided. An ASTD (American Society for Training & Development) study published in 2000, found a clear correlation between corporate spending on employee development and long-term financial returns. Accenture Company measured the overall effect of its development program by looking at the incremental revenues generated by each employee compared with education costs. The result was a significant ROI (both studies cited in [UkeU, 2003]).

But the ROI for an employer of any training ought to be linked to the employer's business goals and sought training outcomes. Therefore, retrieving these goals and outcomes constitutes a major prerequisite for success in corporate training. Using business performance management methodologies is a way to achieve it.

Balanced scorecard

Balanced scorecard is a new approach to strategic management that provides a clear prescription as to what companies should measure in order to 'balance' the financial perspective and feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results. Balanced scorecards let corporate staff establish strategic goals that link to specific operational measurements. The balanced scorecard suggests that we view the organization from four perspectives, and to develop metrics, collect data and analyze it relative to each of these perspectives [BSC]:

- The Learning and Growth Perspective,
- The Business Process Perspective,
- The Customer Perspective,
- The Financial Perspective.

This approach allows for metrics to be developed based on the priorities of the strategic plan, which provides the key business drivers and criteria for metrics managers most desire to watch. Decision makers examine the outcomes of various measured processes and strategies and track the results to guide the company and provide feedback. A major consideration in performance improvement involves the creation and use of performance measures or indicators. Performance measures or indicators are measurable characteristics of products, services, processes, and operations the company uses to track and improve performance. A comprehensive set of measures or indicators tied to customer and/or company performance requirements represents a clear basis for aligning all activities with the company's goals [BSC]. IBM's on demand workplace solution integrates Key performance indicators (KPIs) derived from "balanced scorecard" implementation [IBM, 2004]. The tool uses a "balanced scorecard" approach of reporting KPIs that presents key information, across a classified spectrum of controllable factors to allow examination of all key strategic indicators. The KPIs are monitored on a periodic basis by management to ensure immediate response to any condition that may affect the company's strategic goals.

A scorecard performance system usually has several common strategic themes or focus areas, each of which may contain one or more business strategies. Decomposition of business strategy into smaller components, called Objectives, may include: increased employee motivation and satisfaction, increased employee knowledge, skills and abilities etc. [Rohm, 200...].

When these strategies are decomposed into actionable goals with specific performance measures (metrics) and targets they become a benchmark that is linked to the training and the evaluation of its success.

The widespread use of BSC (60% in Fortune 500 companies and 60.000+ BSC on-line members) and its focus on (among others) the intangible assets (employees), which are viewed by executives as most strategic, makes it suitable for business side requirement collection (employer's goals and success metrics). Employers need to maximize their employees' alignment because the value of intangible assets is contextual and depends on alignment with the strategy. The alignment is created by identifying the "Strategic Job Families" needed to support each strategic process [Kaplan-Norton, 2004b].

The strategy maps of a company can also provide ground for setting relevant metrics. A strategy map is a visual framework for the corporate objectives within the four areas of BSC. Strategy maps put into focus the often-blurry line of sight between corporate strategy and what employees do every day. In the information age, businesses must increasingly create and deploy intangible assets that have become major sources of competitive advantage. Strategy maps can help a company detect major gaps in the strategies being implemented at lower levels in the organization [Kaplan-Norton, 2004a].

Six sigma

The biggest disconnect between training professionals and business professional occurs in the identification of customer (business) requirements. Six Sigma business methodology, provides a proven methodology that when applied to training programs captures the perspectives and requirements of all training stakeholders (by capturing what it calls output indicators of the process). Information from each level serves the next. Each successive level represents a more precise measure of effectiveness of training. This methodology uses a five-step methodology (DMAIC: acronym representing the five phases of the Six Sigma process) to ensure that customer/business requirements are met: [Islam, 2004]:

- Define; identify customer requirements.
- Measure: outputs of the current process are compared to the newly identified requirements.
- Analyze: statistical tools that validate why the process is not meeting customer requirements.
- Improve: solutions that ensure the process meets customer requirements are generated and,
- Control; ensure the process does not revert to the way it was previously.

Output indicators are the measurable (and prioritized) list of the critical requirements of both the business stakeholders (the voice of the business, VOB) and the end user or learner (the voice of the customer, VOC). They identify everything that must be measured about the training program, as well as the measurable targets that must be met in order for the training to make a business impact. The VOC may come from a variety of sources including phone calls, written complaints or surveys to determine what the key issues learners have around training. Corporate goals and initiatives are also looked at.

References:

Allen, M. (2002). Comparing Student Satisfaction With Distance Education to Traditional Classrooms in Higher Education: A Meta-Analysis. *The American Journal of Distance Education, 16*(2), 83-97.

Berger (200). "Finding out how they learn: Quick and Effective Assessment of Students and Programs", presentation by Carl Berger University of Michigan

Dalgarno, B. (2001). Interpretations of constructivism and consequences for Computer Assisted Learning. *British Journal of Educational Technology, 32*(2), 183-194.

Figueira (2003). Evaluating the Effectiveness of E-Learning Strategies for Small and Medium Enterprises" by Eduardo Figueira in European Seminars - Exploring models and partnerships for eLearning in SMEs, February 2003.

Frey, B. (2002). Evaluation of Student Satisfaction: Determining the Impact of a Web-Based Environment by Controlling for Student Characteristics. *The American Journal of Distance Education, 16*(3), 169-189.

Govindasamy, T. (2001). Successful implementation of e-Learning: Pedagogical considerations. *The Internet and Higher Education, 4*(3-4), 287-299.

Huang, H. S. (2002). Toward constructivism for adult learners in online learning environments. *British Journal of Educational Technology, 33*(1), 27-37.

Kaplan-Norton, (2004). "Having Trouble with Your Strategy? Then Map It" by Robert S. Kaplan and David P. Norton, in Harvard business review, March 31, 2004.

Ong, C.-S., & Lai, J.-Y. (2004). Gender differences in perceptions and relationships among dominants of e-learning acceptance. *Computers in Human Behavior, In Press, Corrected Proof.*

Richardson, J., & Price, L. (2003). Approaches to studying and perceptions of academic quality in electronically delivered courses. *British Journal of Educational Technology, 34*(1), 45-56.

Rohm (200…). " " by Howard Rohm in Perform magazine volume 2, issue 2.

[Sonwalkar, 2002]: "A new methodology for evaluation: The pedagogical rating of online courses" by Nishikant Sonwalkar in Syllabus Magazine, January 1st 2002.

Wu, D., & Hiltz, S. R. (2003). *Online Discussions and Perceived Learning.* Paper presented at the Ninth Americans Conference on Information Systems.

Wang, Y.-S. (2003). Assessment of learner satisfaction with asynchronous electronic learning systems. *Information & Management, 41*(1), 75-86.

Conclusion

Learner centricity can be defined from two different perspectives: from the learner (intrinsic) and from the client (extrinsic). Therefore, a learner-centric approach must consider learning style, media literacy, media access and the motivation of learners. However, the approach must also account for the execution of key strategic processes, rapid deployment, the alignment of employees/training with strategy and Return on Investment. These external factors can be considered the learning context (i.e. pressures/constraints from the client's perspective).

Learner-centric must consider: learner style, learning context (i.e., pressures/ constraints from client centered perspective)

Learner (intrinsic)	**Client** (extrinsic)
Learning style	**Execu. of key strategic processes,**
	Rapid deployment
Media literacy	
	Alignment of employees with strategy
Media access	
Motivation	**ROI**

The key to implementing a learner-centric process is to offer multiple paths to achieving outcomes. The design of the learning path must be tied to learning style which, in turn, is tied to assessment. Upon setting the benchmark of the minimum transfer of knowledge required for a training course, the design team must work to offer multiple paths to the same knowledge, thus enhancing knowledge transfer. In order to create a learning culture, learners must develop their own cognitive maps/schemas.

Multiple paths to achieving outcomes
How to account for multiple paths?
Still in transition from physical to virtual learning contexts

Learning paths **Learning styles**	Design of learning path tied to learning style to assessment, 'minimum transfer of knowledge' **+ offer of multiple path to same to same knowledge, to enhance knowledge transfer.**

Work Cited

Aldrich, C. (2003). "Going the "simulation way": Q& A with Clark Aldrich" in elearningpost November 2003].

Allen, M. (2002). Comparing Student Satisfaction With Distance Education to Traditional Classrooms in Higher Education: A Meta-Analysis. The American Journal of Distance Education, 16(2), 83-97.

Anido, L., Rodriguez, J., Caeiro, M., & Santos, J. M. (2003). High-level brokerage services for the e-learning domain. Computer Standards & Interfaces, 25(4), 303-327.

Aragon, S., Johnson, D., & Shaik, N. (2002). The Influence of Learning Style Preferences on Student Success in Online Versus Face-to-Face Environments. The American Journal of Distance Education, 16(4), 227-244.

Ardito, C., Marsico, M. D., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V., et al. (2004, 2004). Usability of E-learning tools. Paper presented at the working conference on Advanced visual interfaces, Gallipoli, Italy.

Atolagbe, T., Hlupic, V., & Taylor, S. J. E. (2001, 2001). Teaching tools and methods: GeNisa: a web-based interactive learning environment for teaching simulation modeling. Paper presented at the 33rd conference on Winter simulation, Arlington, Virginia, USA.

Balatti, J., & Falk, I. (2001, September 13 - 16, 2001). Socioeconomic Contributions of Adult Learning to Community: A social capital perspective. Paper presented at the Wider Benefits of Learning: Understanding and monitoring the consequences of adult learning, Lisbon, Portugal.

Berge, Z. L. (1995). The Role of the Online Instructor/Facilitator.

Bonk, C., Olson, T., Wisher, R., & Orvis, K. (2002, August 14-16, 2002). Blended Web Learning: Advantages, Disadvantages, Issues, and Considerations. Paper presented at the 18th Annual Conference on Distance Teaching and Learning, Madison, Wisconsin.

Bransford, J. D., Brown, A. L., & Cocking, R.R. (2003). How People Learn: Brain, Mind, Experience and School. (Washington D.C.: National Academy Press).

Brookfield, S.B. (1995). Becoming a Critically Reflective Teacher. San Francisco: Jossey-Bass.

Brougher, J. (1997). Creating a nourishing learning environment for adults using multiple intelligence theory. Adult Learning, 8(4), 28.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. Educational Researcher, 18(1), 32-42.

Cantoni, V., Cellario, M., & Porta, M. (2003). Perspectives and challenges in e-learning: towards natural interaction paradigms. Journal of Visual Languages & Computing, In Press, Corrected Proof.

Cheong, C. S. (2001). E-learning--a provider's prospective. The Internet and Higher Education, 4(3-4), 337-352.

Chung, S., Severance, C., & Chung, M.-J. (2003). Design of Support Tools for Knowledge Building in a Virtual University Course. Interactive Learning Environments, 11(1), 41-57.

Cloete, E. (2001). Electronic education system model. Computers & Education, 36(2), 171-182.

Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. Computers & Education, 43(1-2), 17-33.

Conrad, D. (2002). Engagement, Excitement, Anxiety, and Fear: Learners' Experiences of Starting an Online Course. The American Journal of Distance Education, 16(4), 205-226.

Corbett, R., & Kearns, J. (2003, April 22- 24). Implementing Activity-Based Learning. Paper presented at the TCC 2003: Eighth Annual Teaching in the Community Colleges Online Conference.

Cromley, J. (2000). Learning to Think, Learning to Learn: What the Science of Thinking and Learning Has to Offer Adult Education: National Institute for Literacy.

Dalgarno, B. (2001). Interpretations of constructivism and consequences for Computer Assisted Learning. British Journal of Educational Technology, 32(2), 183-194.

Davies, L., & Hassan, W. S. (2001). On mediation in virtual learning environments. The Internet and Higher Education, 4(3-4), 255 - 269.

Derntl, M., & Motschnig-Pitri, R. (2004). Patterns for Blended, Person-Centered Learning: Strategy, Concepts, Experiences, and Evaluation. Paper presented at the 2004 ACM symposium on Applied computing, Nicosia, Cyprus.

DeSanctis, G., Fayard, A.-L., Roach, M., & Jiang, L. (2003). Learning in Online Forums. European Management Journal, 21(5), 565-577.

DeVries, J., & Tella, S. (1998). The Role of Distance Education Instructor: Attitudes, Skills, and Strategies. Media Education Publication, 8, 10.

Edvinsson, L., & Sullivan, P. (1996). Developing a model for managing intellectual capital. European Management Journal, 14(4), 356-364.

Ellis, T., & Cohen, M. (2001). Integrating multimedia into a distance learning environment: Is the game worth the candle? British Journal of Educational Technology, 32(4), 495-497.

Figueira (2003). Evaluating the Effectiveness of E-Learning Strategies for Small and Medium Enterprises" by Eduardo Figueira in European Seminars - Exploring models and partnerships for eLearning in SMEs, February 2003.

Foreman, J.(2004). game based learning in Educause review September-October 2004.

Forman, D., Nyatanga, L., & Rich, T. (2002). E-learning and educational diversity. Nurse Education Today, 22(1), 76-82.

Frey, B. (2002). Evaluation of Student Satisfaction: Determining the Impact of a Web-Based Environment by Controlling for Student Characteristics. The American Journal of Distance Education, 16(3), 169-189.

Gagne, R.M. (1985). The conditions of learning and theory of instruction. (4th edition). New York: Holt, Rinehart, and Winston.

Gardner, H. (1983). Frames of Mind: The theory of multiple intelligences. New York: Basic Books.

Govindasamy, T. (2001). Successful implementation of e-Learning: Pedagogical considerations. The Internet and Higher Education, 4(3-4), 287-299.

Granlund, R., Berglund, E., & Eriksson, H. (2000). Designing web-based simulation for learning. Future Generation Computer System, 17, 171-185

Grice, R., & Hart-Davidson, B. (2002). Mapping the expanding landscape of usability: the case of distributed education. ACM Journal of Computer Documentation (JCD), 26(4), 159-167.

Hakkinen, P. (2002). Challenges for design of computer-based learning environments. British Journal of Educational Technology, 33(4), 461-469.

Hamid, A. A. (2001). e-Learning: Is it the "e" or the learning that matters? The Internet and Higher Education, 4(3-4), 311-316.

Han, D., & Han, I. (2004). Prioritization and selection of intellectual capital measurement indicators using analytic hierarchy process for the mobile telecommunications industry. Expert Systems with Applications, 26(4), 519-527.

Hannington, B. (2003). Methods in the Making: A Perspective on the State of Human Research in Design. Design Issues, 19(4), 9-18.

Heath, C., Knoblauch, H., & Luff, P. (2000). Technology and social interaction: the emergence of 'workplace studies'. British Journal of Sociology, 51(2), 299-320.

Huang, C. (2003). Changing learning with new interactive and media-rich instruction environments: virtual labs case study report. Computerized Medical Imaging and Graphics, 27(2-3), 157-164.

Huang, H. S. (2002). Toward constructivism for adult learners in online learning environments. British Journal of Educational Technology, 33(1), 27-37.

Hughes, G., & Hay, D. (2001). Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials. British Journal of Educational Technology, 32(5), 557-569.

Ismail, J. (2001). The design of an e-learning system: Beyond the hype. The Internet and Higher Education, 4(3-4), 329-336.

Kabassi, K., & Virvou, M. (2004). Personalised adult e-training on computer use based on multiple attribute decision making. Interacting with Computers, 16(1), 115-132.

Kanuka, H., Collett, D., & Caswell, C. (2002). University Instructor Perceptions of the Use of Asynchronous Text-Based Discussion in Distance Courses. The American Journal of Distance Education, 16(3), 151-167.

Kaplan-Norton, (2004). "Having Trouble with Your Strategy? Then Map It" by Robert S. Kaplan and David P. Norton, in Harvard business review, March 31, 2004.

Kim, S., Brock, D., Orkand, A., & Astion, M. (2001). Design implications from a usability study of GramStain-Tutor. British Journal of Educational Technology, 32(5), 595-605.

Knowles, M.S., Holton, E.F., & Swanson, R.A. (1998). The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development (5th Edition). Houston: Gulf Publishing Company.

Kolar-Johann, W., & Bauer, P. (2003). Teaching Power Electronics in the 21st Century. European Power Electronic and Drives Journal, 13(4), 43-50.

Kollock, P. (1998). The Economies of Online Cooperation: Gift and Public Goods in Computer Communities. Communities in Cyberspace. London: Routledge.

Lindblom-Ylanne, S., & Pihlajamaki, H. (2003). Can a collaborative network environment enhance essay-writing processes? British Journal of Educational Technology, 34(1), 17-30.

Liu, M. (2003). Enhancing Learners' Cognitive Skills Through Multimedia Design. Interactive Learning Environments, 11(1), 23-39.

Lohr, L. L. (2000). Designing the instructional interface. Computers in Human Behavior, 16(2), 161-182.

Low, A. L. Y., Low, K. L. T., & Koo, V. C. (2003). Multimedia learning systems: a future interactive educational tool. The Internet and Higher Education, 6(1), 25-40.

Lupo, D., & Erlich, Z. (2001). Computer literacy and applications via distance e-learning. Computers & Education, 36(4), 333-345.

Magliozzie, T. L. (2002). Rant and Rave: The New Theory of Learning. Retrieved December 24, 2002, 2002, from http://cartalk.cars.com/About/Rant/r-rlast15.html

Martinez, R.-A., Milans del Bosch, M., Henar Perez Herrero, M., & Sampedro Nuno, A. Psychopedagogical components and processes in e-learning. Lessons from an unsuccessful on-line course. Computers in Human Behavior, In Press, Corrected Proof.

McDonald, J., Heap, N., & Mason, R. (2001). "Have I learnt it?" Evaluating skills for resource-based study using electronic resources. British Journal of Educational Technology, 32(4), 419-433.

McLoughlin, C., & Luca, J. (2002). A learner-centered approach to developing team skills through web-based learning and assessment. British Journal of Educational Technology, 33(5), 571-582.

Nahapiet, J., & Ghoshal, S. (1998). Social Capital, Intellectual Capital, and the Organizational Advantage. Academy of Management Review, 23(2), 242 - 266.

Neuhauser, C. (2002). Learning Style and Effectiveness of Online and Face-to-Face. The American Journal of Distance Education, 16(2), 99-113.

Ong, C.-S., & Lai, J.-Y. (2004). Gender differences in perceptions and relationships among dominants of e-learning acceptance. Computers in Human Behavior, In Press, Corrected Proof.

Ong, C.-S., Lai, J.-Y., & Wang, Y.-S. (2004). Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies. Information & Management, 41(6), 795-804.

Parush, A., Hamm, H., & Shtub, A. (2002). Learning histories in simulation-based teaching: the effects on self-learning and transfer. Computers & Education, 39(4), 319-332.

Pond, W. K. (2001). Twenty-first century education and training: Implications for quality assurance. The Internet and Higher Education, 4(3-4), 185-192.

Richardson, J., & Price, L. (2003). Approaches to studying and perceptions of academic quality in electronically delivered courses. British Journal of Educational Technology, 34(1), 45-56.

Rohm (200…). " " by Howard Rohm in Perform magazine volume 2, issue 2.

Roschelle, J. (1995). Learning in Interactive Environments: Prior Knowledge and New Experience. In Public Institutions for Personal Learning: Establishing a Research Agenda (pp. 29): The American Association of Museums.

Rovai, A. P. (2002). Sense of community, perceived cognitive learning, and persistence in asynchronous learning networks. The Internet and Higher Education, 5(4), 319-332.

Sahin, T. (2003). Student teachers' perceptions of instructional technology: developing materials based on a constructivist approach. British Journal of Educational Technology, 34(1), 67-74.

Salmon, G. (2002). Mirror, mirror, on my screen...Exploring online reflections. British Journal of Educational Technology, 33(4), 379-391.

Sanderson, P. E. (2002). E-Learning: strategies for delivering knowledge in the digital age. The Internet and Higher Education, 5(2), 185-188.

Schank, R. C. (2002). Designing world class e-learning : how IBM, GE, Harvard Business School, and Columbia University are succeeding at e-learning. New York: McGraw-Hill.

Shin, D., Yoon, E. S., Lee, K. Y., & Lee, E. S. (2002). A web-based, interactive virtual laboratory system for unit operations and process systems engineering education: issues, design and implementation. Computers & Chemical Engineering, 26(2), 319-330.

Soh, C. K., & Gupta, A. (2000). Intelligent Interactive Tutoring System for Engineering Mechanics. Journal of Professional Issues in Engineering Education and Practice, 126(4), 166-173.

Sonwalkar, N. (2002). "A new methodology for evaluation: The pedagogical rating of online courses" in Syllabus Magazine, January 1st 2002.

Suchman, L. (1987). Plans and Situation Actions: The Problem of Human-Machine Communication. Cambridge: Cambridge University Press.

Talbott, D., Gibson, M., & Skublics, S. (2002, 2002). A collaborative methodology for the rapid development and delivery of online courses. Paper presented at the 20th annual international conference on Computer documentation, Toronto, Ontario, Canada.

Timms, D., Ferlander, S., & Timms, L. (2001, June 10 - 13, 2001). Building Communities: Online Education and Social Capital. Paper presented at the EDEN 10th Anniversary Conference, Stockholm, Sweden.

Tu, C.-H., & McIssac, M. (2002). The Relationship of Social Presence and Interaction in Online Classes. The American Journal of Distance Education, 16(3), 131-150.

Wang, Y.-S. (2003). Assessment of learner satisfaction with asynchronous electronic learning systems. Information & Management, 41(1), 75-86.

Welle-Strand, A., & Thune, T. (2003). E-learning policies, practices and challenges in two Norwegian organizations. Evaluation and Program Planning, 26(2), 185-192.

Wen, M. L., Tsai, C.-C., Lin, H.-M., & Chuang, S.-C. (2004). Cognitive-metacognitive and content-technical aspects of constructivist Internet-based learning environments: a LISREL analysis. Computers & Education, 43(3), 237-248.

Wilkinson, A., Forbes, A., Bloomfield, J., & Fincham Gee, C. (2004). An exploration of four web-based open and flexible learning modules in post-registration nurse education. International Journal of Nursing Studies, 41(4), 411-424.

Wu, D., & Hiltz, S. R. (2003). Online Discussions and Perceived Learning. Paper presented at the Ninth Americans Conference on Information Systems.

Yagodzinski, E. (2003). Web-Based Training: Creating e-Learning Experiences: Margaret Driscoll; Jossey-Bass/Pfeiffer, San Francisco, 2002, 352 pages, ISBN 0787956198, US$45.00. The Internet and Higher Education, 6(2), 207-210.