

Pedagogical Models for E-Learning: A Theory-Based Design Framework

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This paper presents a theory-based design framework for E-Learning that emphasizes the transformative interaction between pedagogical models, instructional strategies, and learning technologies. I argue that situated or distributed cognition is an appropriate foundational knowledge perspective from which to derive pedagogical models and constructs for E-Learning and offers a theory-into-practice framework that characterizes the instructional implications of situated cognition and guides the design of E-Learning. Specific examples of how to apply this framework in E-Learning contexts are provided.

Keywords: E-Learning, Distributed Cognition, and Pedagogy

Recent advances in Internet and Web-based technologies have redefined the boundaries and pedagogies of distance learning by stretching its scope and deepening its interconnectedness (Dabbagh & Bannan-Ritland, 2005). New learning interactions that were not perceived possible before can now be facilitated, such as the coupling of experts from around the world with novices, the instantaneous access to global resources, the opportunity to publish to a world audience, the opportunity to take virtual field trips, the opportunity to communicate with a diverse audience, and the ability to share and compare information, negotiate meaning and co-construct knowledge. Such activities emphasize learning as a function of interactions with others and with the shared tools of the community prompting (a) the emergence of pedagogical constructs and models such as distributed learning, open/flexible learning, asynchronous learning networks, knowledge building communities, and communities of practice, and (b) the reconceptualization of distance learning as the deliberate organization and coordination of distributed forms of interaction and learning activities to achieve a shared goal. This paper describes such models and their theoretical grounding and instructional implications for E-Learning contexts, and presents a theory-based design framework for E-Learning that capitalizes

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on the interaction between pedagogical models, instructional strategies, and learning technologies to facilitate meaningful learning and knowledge building.

GROUNDING ASSUMPTIONS FOR E-LEARNING

E-Learning, like all instructional technology delivery environments, must be rooted in epistemological frameworks to be effective for teaching and learning. Bednar, Cunningham, Duffy, and Perry (1991) pointed out the importance of linking theory to practice in the design and development of any instructional system and emphasized "... effective design is possible only if the developer has a reflexive awareness of the theoretical basis underlying the design" (p.90). In their view, theoretical constructs emerge from our assumptions or perspectives on knowledge. The implications of a particular perspective on constructing knowledge are significant in the application of theory and design associated with a specific instructional delivery mechanism. Hannafin, Hannafin, Land & Oliver (1997) expand on this by suggests that clarifying the foundations and assumptions of different perspectives on learning and aligning theoretical approaches and methods of instruction through *grounded design* helps to validate instructional applications based in different perspectives. In order to better understand how grounded design can lead to effective and meaningful E-Learning, a review of the different perspectives or views on cognition and knowledge is in order. These perspectives include: the cognitive information processing view or "mind as a computer metaphor", the parallel distributed processing view or "mind as a brain metaphor", and the distributed or situated cognition view or "mind as a rhizome metaphor" (Duffy & Cunningham, 1996).

COGNITIVE INFORMATION PROCESSING VIEW

In this view, the mind manipulates symbols in the same manner that a computer manipulates data. Hence, "the human learner is conceived to be a processor of information in much the same way a computer is" (Driscoll, 1994, p.68). This analogy has emerged as part of the Cognitive Information Processing (CIP) perspective, which has roots in behaviorist and cognitivist views on learning. Behaviorists utilize the input - output events of a computer system to explain how environmental stimuli become inputs in a learning cycle and behaviors (or responses) become outputs, and cognitivists adding the *black box* as the intervening and impacting variable between input and output to explain the *information processing system* of the learner. Implicit in this knowledge acquisition model is the principle that information undergoes a series of transformations in the mind in a serial manner until it can be permanently stored in long-term memory in packets of knowledge that have a fixed structure. Resulting from this view is the specification of instructional and learning strategies that assist the learner in processing information in discrete and linear events that align with internal cognitive processes such as selective attention, encoding, retention, and retrieval. Additional implications for instruction include provision for organized instruction, arrangement of extensive and variable practice, and enhancing learner's self control of information processing (Driscoll, 2000).

PARALLEL DISTRIBUTED PROCESSING VIEW

In this view, also known as connectionism, long-term memory is perceived as a dynamic structure (or network) that represents knowledge in patterns or connections with multiple pathways instead of fixed schemata such as concept nodes and propositions

(Driscoll, 2000; Duffy & Cunningham, 1996). Information processing is understood as a process of activating these patterns, in parallel, to accommodate new information by strengthening the most relevant pattern in the knowledge structure based on the goals of the learner at the time of learning. Knowledge (or cognition) is thought of as “stretched over” or distributed across the whole network structure of long-term memory (much like a neural network hence the mind as a brain analogy) and not residing in fixed loci in our brains (Salomon, 1993). Therefore, a fundamental distinction between Parallel Distributed Processing (PDP) and CIP is that knowledge is stored in an active connectionist representation versus a static and localized representation, and that information processing occurs in parallel instead of a serial manner, activating knowledge patterns simultaneously and adjusting them as a function of new information to resolve cognitive dissonance. PDP does not attempt to describe cognition at a behavioral level since the knowledge network is an interrelated structure of interactions and not a propositional structure. As described by Spiro, Feltovich, Jacobson, and Coulson (1987, p. 181), “highly compartmentalized knowledge representations are replaced with structures characterized by a high degree of interconnectedness.” This non-linear, fluid and dynamic view of information processing which views knowledge as “a function of distributed connection strengths and network activation” (Duffy & Cunningham, 1996, p. 177) paves the way to the consideration of several constructivist learning theories in which E-Learning can be grounded.

SITUATED COGNITION VIEW

The situated cognition view bears some resemblance to the PDP model but has additional characteristics that distinguish it from both PDP and CIP. These include (1) the concept that knowledge extends beyond the individual, and (2) the emphasis on perception (how individuals perceive the situation or the environment) rather than memory (how individuals retrieve knowledge). Nardi (1996) explains that situated or distributed cognition is concerned with knowledge representations inside and outside the mind and the transformations these structures go through, suggesting that knowledge representations are dynamic, constantly evolving and changing, and subject to infinite juxtapositions, similar to a rhizome (hence the mind as a rhizome metaphor). Situated cognition suggests that rather than thinking of cognition as an isolated event that takes place inside one’s head, cognition is looked at as a distributed phenomenon that is more global in nature—one that goes beyond the boundaries of a person to include environment, artifacts, social interactions, and culture (Hutchins & Hollan, 1999; Rogers, 1997). Another main emphasis of distributed cognition is on understanding the coordination among individuals and artifacts (how individuals align and share within a distributed process), for example, how two programmers coordinate the task of doing software maintenance among themselves.

The idea that cognition or intelligence is distributed suggests that learning spaces are becoming more dynamic and complex and that individuals learn from activity and the tools supporting such activity to extend their cognitive potential (Oubenaissa, Giardina, & Bhattacharya, 2002). Distributed cognition does share its roots with other cognitive theories in that it seeks to understand how cognitive systems are organized and considers cognitive processes to be those involved with memory, decision-making, reasoning, problem solving, learning, and so on. However, the distinguishing principle between distributed cognition and other cognitive learning theories or views is that distributed cognition looks for cognitive processes wherever they may happen, based on the functional relationship of elements that participate together in the process. Knowledge in this view is perceived as belonging to, and distributed in, communities of practice or

“environments of participation” in which the learner practices the patterns of inquiry and learning, and the use of shared resources is part of the preparation for membership in a particular community (Firdyiwiek, 1999). Distributed cognition acknowledges “an object has a certain kind of intelligence or the context has a certain kind of knowledge” allowing learners or members of a community of practice to complete their tasks more easily (Dede, 2002).

For example, the navigational system goal of a U.S. Navy amphibious transport helicopter would be to successfully steer the ship into a harbor. Since this system is not relative to a single person but to a distributed collection of interacting people and artifacts (tools) that form a single cognitive system. This system can only be understood when one understands “as a unity, the contributions of the individual agents in the system and the coordination among the agents to enact the goal” (Nardi, 1996, p. 77), which in this case, is to achieve a successful and safe entry into the harbor. A main principle of distributed or situated cognition therefore is to understand the coordination among individuals and artifacts (how individuals align and interact within a distributed process) in a system or community.

In educational settings, these distributed forms of interaction are manifested in learner-instructor, learner-content, and learner-learner interactions (Moore & Kearsley, 1995). These types of interactions are perceived as necessary in enhancing social learning skills such as communication or group-process skills. They are also perceived as tools or activities that promote higher-order thinking and sustain motivation in distance education settings (Navarro & Shoemaker, 2000). In E-Learning contexts, distributed forms of interaction can take place in knowledge networks, virtual classrooms, and asynchronous learning networks where groups of learners or professionals with a common goal congregate to share information and resources, ask questions, solve problems, and achieve goals, and in doing so, collectively build new knowledge and evolve the practices of their community. These knowledge networks are made possible by Internet and Web-based technologies, which as described at the beginning of this paper, are fundamentally responsible for increasing the interconnectedness and scope of interactions and activities in distance learning and providing a global perspective on a particular area of study.

The situated cognition view is consistent with the epistemological assumptions of constructivism, which stipulate that meaning is a function of how the individual creates meaning from his or her experiences and actions (Jonassen, 1991). Constructivism views the learner as an active participant in the instructional experience, developing knowledge through a process of perception and meaning making. Situations, activities, and social interactions are constantly challenging the learner’s understandings resulting in new meanings. Therefore, the context or the activity, which frames the knowledge, is of equal importance to the learner as the knowledge itself. Knowledge or cognition in the constructivist view is perceived as indexed or linked to the experiences in which it was learned, resulting in multiple representations and infinite juxtapositions. Rather than acquiring concepts as abstract, self-contained entities, the idea is to acquire useful knowledge through understanding of how knowledge is used by a group of practitioners or members of a community. Table 1 summarizes the assumptions of each of the views on cognition discussed above and their implications for instruction.

Resulting from the situated cognition and the constructivist views of learning is the specification of pedagogical models and strategies that allocate control of the sequence of instruction to learners (Coleman, Perry, & Schwen, 1997), and task the learner with creating, elaborating, or otherwise constructing representations of individual meaning (Hannafin, 1992). Examples of pedagogical models that exemplify these instructional characteristics in E-Learning contexts include: open or flexible learning, distributed

learning, learning communities, communities of practice, and knowledge building communities. Each of these models is described below.

Table 1. *Views on Cognition and Knowledge and their Characteristics*

<i>Views on Cognition and Knowledge</i>	<i>CIP View</i>	<i>PDP View</i>	<i>Situated Cognition View</i>
<i>Learning is defined as a process of ...</i>	Cognitive operations that help learners encode information into long-term memory, & retrieve information in response to external cues	Activating & reconstructing relevant schema for understanding new knowledge based on perception of context	Constructing meaning from activity & experience
<i>Epistemological Orientation</i>	Objectivism: reality is independent from & outside the knower; knowledge is equated with truth	Pragmatism: knowledge should reflect reality to the extent possible, however what works is often accepted as viable	Constructivism: truth is viable, therefore knowledge depends on the knower's frame of reference
<i>How is knowledge acquired? Through what processes?</i>	Memory processes (e.g., sensory input, pattern recognition, rehearsal, chunking, encoding, retrieval)	Accretion, tuning, restructuring	Through mediated forms of interaction & enculturation into a community of practice
<i>What is the role of the learner?</i>	Uses learning strategies to facilitate encoding	Actively organizes past experience to interpret new content	Actively negotiating own perception with external world; primary meaning maker; takes ownership of learning
<i>What is the role of the instructor?</i>	Supports learners' use of learning strategies	Identifies misconceptions in learners schema; provides opportunities for restructuring	Facilitator, guide, coach, mentor; creator of scaffolds for learning; creator of a resource-rich learning environment
<i>What are the implications on instruction?</i>	Provide organized instruction, Arrange extensive and variable practice, and Enhance learner's self control of information processing Gagne's events of instruction	Identify existing mental models, track development of learners' mental models, Provide conceptual models to make instructional materials meaningful	Open-ended learning environments that support multiple perspectives, discovery, inquiry-based, and experiential learning, social interactions, role-playing, debates, and authentic contexts Examples include: communities of practice, cognitive apprenticeship, anchored instruction, microworlds, simulations, case-based learning, and problem-based learning

PEDAGOGICAL MODELS FOR E-LEARNING

OPEN LEARNING

Open or flexible learning is a new approach to describing distance education where the emphasis shifts from delivering a pre-established curriculum to focusing on

individual and local needs and requirements, and creating open learning places based on the here and now (Edwards, 1995). Key principles of open learning are student-centeredness and a focus on learning rather than teaching (The Open University, 2002). Open learning provides students with flexibility and choice in meeting their educational goals. It can include a variety of non-traditional learning opportunities, such as: short courses, night courses, workshops, seminars, conferences, certificate programs, customized training packages, and degree-credit and non-credit distance education courses (University of Guelph Office of Open Learning, 2003). Examples of open or flexible learning environments that rely on the use of Internet and Web-based communications technologies include knowledge networks, knowledge portals, asynchronous learning networks, virtual classrooms, and telelearning.

DISTRIBUTED LEARNING

Distributed learning is described as education delivered anytime, anywhere, to multiple locations, using one or more technologies or none at all (Jones Knowledge, 2000). When telecommunications media is utilized, distributed learning refers to off-site learning environments where learners complete courses and programs at home or work by communicating with faculty and other students through e-mail, electronic forums, videoconferences, and other forms of computer-mediated communication and Internet and Web-based technologies.

According to The California State University Center for Distributed Learning (2003), distributed learning supports a “pull” model of education in which students engage in learning activities at their own pace and at a self-selected time, in contrast to the traditional “push” model of education where students have to synchronize their needs and schedules to the delivery model of the institution. From a pedagogical standpoint, distributed learning environments “result in a diffuse sense of cognition – where what is known lies in the interaction between individuals and artifacts, such as computers and other technological devices” (Pea, 1990; Perkins, 1990; Salomon, 1990, cited in Bronack & Riedl, 1998, p. 3).

LEARNING COMMUNITIES

Learning communities are groups of people who support each other in their learning agendas, working together on projects, learning from one another as well as from their environment and engaging in a collective socio-cultural experience where participation is transformed into a new experience or new learning (Rogoff, 1994; Wilson & Ryder, 1998). Learning communities represent an intentional restructuring of students' time, credit and learning experiences around an interdisciplinary theme to foster more explicit intellectual and emotional connections between students, between students and their faculty, and between disciplines (MacGregor, Smith, Tinto, & Levine, 1999). Learning communities act as academic and social support structures that allow students to learn in more authentic and challenging ways. They are considered informal learning environments, moving the emphasis from teaching to learning. Communities of practice and knowledge building communities are synonymous constructs however, the term learning communities may be perceived as a broader or more loosely defined term that encompasses any social network or infrastructure that brings people together to share and pursue knowledge.

COMMUNITIES OF PRACTICE

Communities of practice are “groups of people informally bound together by shared expertise and passion for a joint enterprise” (Wenger & Snyder, 2000, p. 139). The construct has become popular in the business community and in organizations that focus on knowledge as an intellectual capital. Communities of practice are different from formal work groups or project teams in that they are defined by knowledge rather than task, and members are self-selecting rather than assigned by a higher authority (Allee, 2000). Additionally, what holds a community of practice together over time is its members’ interest in maintaining the group and not project deadlines or job requirements. Over time, the activity and actions of the individuals engaged in the enterprise give rise to new and specific practices and processes that are shared by all members of the community. When the common purpose is learning, communities of practice can be described as “shared environments that permit sustained exploration by students and teachers enabling them to understand the kinds of problems and opportunities that experts in various areas encounter and the knowledge that these experts use as tools” (CTGV, 1992, p. 79).

KNOWLEDGE BUILDING COMMUNITIES

Knowledge building communities are learning communities in which communication is perceived as transformative (resulting in a new experience or learning) through knowledge sharing and generation. Participants in a knowledge building community “share a common goal of building meaningful knowledge representations through activities, projects and discussion” and the instructor or tutor “is an active, learning participant in the community” (Selinger & Pearson, 1999, p. 41). A common goal of knowledge building communities is to advance and share the knowledge of the collective. Research teams in the scientific disciplines provide a prototypical example although knowledge building communities can also exist in other forms such as film societies or industrial firms. What is defining about a knowledge building community is a commitment among its members to invest its resources in the collective pursuit of understanding (Hewitt, Brett, Scardamalia, Frecker, & Webb, 1995).

The emergence of these models has prompted the reconceptualization of distance learning as the deliberate organization and coordination of distributed forms of interaction and learning activities to achieve a shared goal. Specifically, E-Learning can be defined as an open and distributed learning environment that utilizes pedagogical tools, enabled by Internet and Web-based technologies, to facilitate learning and knowledge building through meaningful action and interaction.

In addition to this definition, the following attributes apply: (1) globalization and learning as a social process are inherent and enabled through telecommunications technology; (2) the concept of a learning group is fundamental in achieving and sustaining learning; (3) the concept of distance is relatively unimportant or blurred, and is not limited to the physical separation of the learner and the instructor; (4) teaching and learning events are distributed over time and place occurring synchronously and/or asynchronously; (5) learners are engaged in multiple forms of interaction: learner-learner, learner-group, learner-content, and learner-instructor; and (6) internet and Web-based technologies are utilized to support the teaching and learning process and to facilitate learning and knowledge building through meaningful action and interaction.

THEORY-BASED DESIGN FRAMEWORK FOR E-LEARNING

In addition to the above attributes, this definition of E-Learning stipulates that there are three key components working collectively to foster meaningful learning and interaction: (1) pedagogical models or constructs, (2) instructional and learning strategies, and (3) pedagogical tools or online learning technologies (i.e., Internet and Web-based technologies). These three components form an iterative relationship in which pedagogical models or constructs grounded in the situated cognition view inform the design of E-Learning by leading to the specification of instructional and learning strategies that are subsequently enabled or enacted through the use of learning technologies (see Figure 1 below). Furthermore, as learning technologies become ubiquitous and new technologies continue to emerge bringing forth new affordances (possibilities for action), pedagogical practices and social structures are transformed. Therefore, the three-component model in Figure 1 implies a transformative interaction affecting E-Learning. Educators and instructional designers can think of this model as a theory-based or grounded design framework that guides the design of E-Learning.

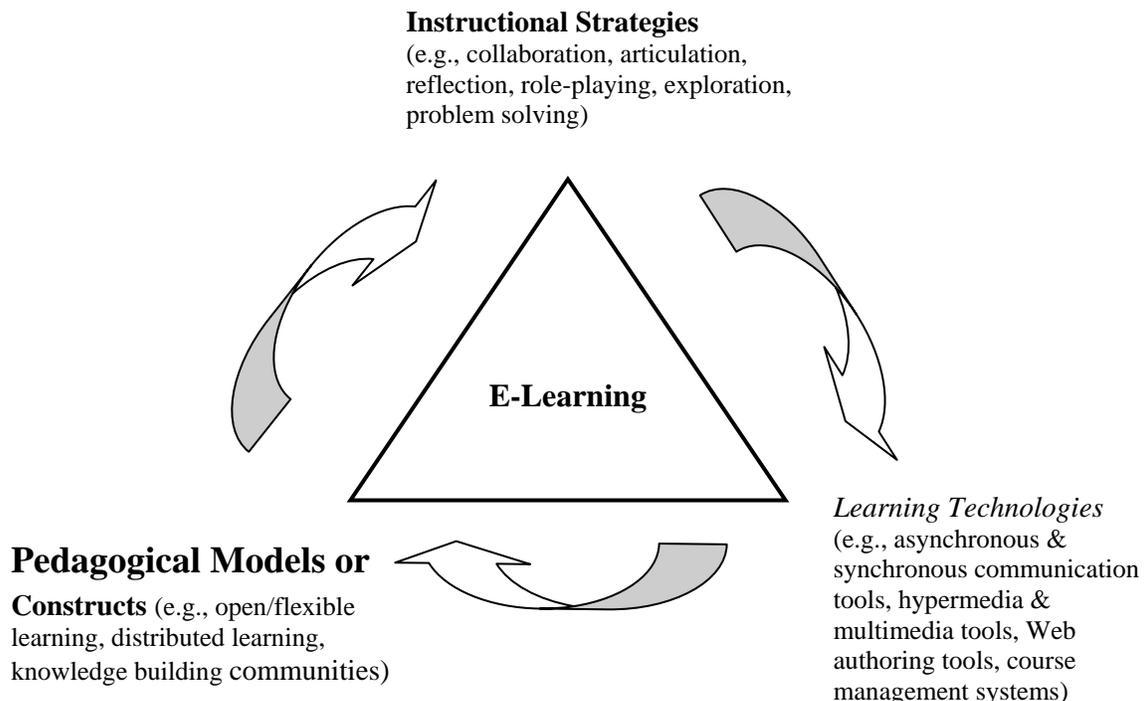


Figure 1. A Theory-Based Design Framework for E-Learning

The first key component of the theory-based design framework for E-Learning is *pedagogical models*. As described in this paper, pedagogical models are cognitive models or theoretical constructs derived from knowledge acquisition models or views about cognition and knowledge, which form the basis for learning theory. In other words, they are the mechanism by which we link theory to practice. Pedagogical models lead to the specification of *instructional strategies*, which is the second key component of the theory-based design framework for E-Learning as depicted in Figure 1. Instructional strategies are what instructors or instructional systems do to facilitate student learning. Jonassen, Grabinger, and Harris (1991) describe instructional strategies as “the plans and

techniques that the instructor/instructional designer uses to engage the learner and facilitate learning” (p. 34). Instructional strategies operationalize pedagogical models. In other words, they put them into practice. When implications of learning theory for education are discussed, instructional strategies are the specifics of how these implications are to be translated into instructional procedures (Shuell, 1980), resulting in “a plan, method, or series of activities, aimed at obtaining a specific goal” (Jonassen et al., 1991, p. 31). Instructional strategies are therefore derived from pedagogical models, which in turn are derived from learning theory.

Examples of instructional strategies that embody the characteristics of pedagogical models grounded in the situated cognition and constructivist views include: (a) promoting or supporting authentic learning activities; (b) facilitating problem-solving, exploration, and hypothesis generation; (c) promoting collaboration and social negotiation; (d) supporting or facilitating role-playing activities; (e) promoting articulation and reflection; (f) supporting multiple perspectives; (g) supporting modeling and explaining; and (h) providing scaffolding. Overall, the goal of these instructional strategies is to create a learning culture where collaboration, learning with self-awareness, multiple perspectives, and self-management are promoted, and where the role of the teacher is reciprocal, supportive, and communicative as it is responsive to learner needs (McLoughlin & Oliver, 1999). Following is a description of these instructional strategies.

PROMOTING AUTHENTIC LEARNING ACTIVITIES

Promoting authentic learning activities is the core of all instructional strategies. Authentic activities engage the learner in a realistic and meaningful task that is relevant to the learner’s interests and goals. By engaging learners in meaningful and relevant tasks, they can see the direct implications of their actions and apply the knowledge gained in real world situations (Wilson & Cole, 1996). Generally, authentic learning tasks are presented in a learning environment using scenarios, cases, or problems. Cases, problems, or scenarios that are used as a stimulus for authentic activity must have some of the important characteristics of real-life problem solving. These characteristics may be ill-defined and complex goals, an opportunity for the detection of relevant versus irrelevant information, active/generative engagement in finding and defining problems as well as in solving them, involvement of the student's beliefs and values, and an opportunity to engage in collaborative interpersonal activities (Young, 1993, p. 45).

Examples of how *authentic activities* can be enacted in E-Learning contexts using learning technologies, the third key component of the theory-based design framework for E-Learning, include:

- Using graphics to present elements of a case or problem to make it more realistic.
- Using digital audio and video to bring the case to life.
- Using animation to add context to the case (e.g., using an animated slide show).
- Using hypertext/hypermedia to provide elaboration on key text items in the case narrative.
- Developing a direct manipulation interface using web authoring tools to allow learners to immerse themselves in, and manipulate, certain aspects of the case environment.
- Facilitating Problem-Solving, Exploration, and Hypothesis Generation

Problem solving can be defined as a heuristic search process in a problem space (Newell & Simon, 1972) or as “any goal-directed sequence of cognitive operations” (Anderson, 1980, p.257). Problem-solving activities place more emphasis on learning how to learn, rather than learning specific content. In problem-solving activities, the

process of problem solving such as the learner's ability to form a hypothesis, find and sort information, think critically about information, ask questions, and reach a resolution or solution, becomes more important (Roblyer, Edwards, & Havriluk, 1996). When problem-solving activities are placed in an authentic context, students learn how to apply their knowledge under appropriate conditions. They see the implications of new knowledge and are more likely to retrieve the newly acquired knowledge in the same, real world, problem-based situation (Wilson & Cole, 1996).

Exploration encourages "students to try out different strategies and hypotheses and observe their effects" (Collins, 1991, p. 135). In exploratory learning, there is limited instruction and guidance from an instructor and more student-generated learning through exploring and discovering information. "This puts students in control of problem solving" (Collins, 1991, p. 135). Therefore, exploration and problem solving are closely related. Additionally, Collins claims that through exploration, students learn how to set achievable goals and manage the pursuit of those goals. They learn to set and try out hypotheses and to seek knowledge independently.

Hypothesis generation supports concept acquisition by setting forth, tentative hypotheses about the attributes that seem to define a concept, and then testing specific instances against these hypotheses (Bruner, Goodnow, & Austin, 1956). For example, when students are learning about the concept of the density of elements, they are often asked to hypothesize about what would happen when oil and water are mixed together in one container. Does the oil sink to the bottom? Why? Alternatively, when learning about the concept of gravity, they might be asked to hypothesize which object falls to the ground faster, a stone or a feather. The creation of hypotheses therefore is a type of formal scientific reasoning that is facilitated through scientific inquiry (Mayer, 1987). If an adequate and variant number of "what if" examples are provided, then hypothesis generation can lead to concept learning because learners can generalize their findings resulting in a working model or concept that can be further refined and compared to expert models. Hypotheses generation and exploration work hand in hand to help students acquire problem solving and decision making skills.

Examples of how *problem-solving, exploration, and hypothesis generation* can be enacted in E-Learning contexts using learning technologies include:

- Providing a *synchronous discussion area* to allow learners to discuss case issues that require real time brainstorming and sharing of information.
- Providing links to *online databases and knowledge repositories* that provide real time data such as up to date weather information and other scientific data and statistics.
- Using web authoring tools and scripting languages to develop self-contained instructional modules such as microworlds, simulations, and virtual reality environments that engage students in exploratory-type activities.
- Providing a link to a search engine in the course site enabling students to search for web-based resources to promote exploration.
- Using digital audio and video to present unfinished excerpts of real world events and occurrences, allowing learners to provide an ending to the scenario and a rationale of why they think it should end the way they envisioned.

SUPPORTING ROLE-PLAYING

Supporting role-playing is an instructional strategy that allows learners to assume practitioner and professional roles such as scientists, physicians, historians, salesperson, and other roles, in order to act out situations that these professionals face in the real

world. Learners can imagine that they are other people in different situations then make decisions as situations change (Heinich, Molenda, & Russell, 1993). Role-playing allows learners to practice their knowledge and skills in a simulated real world situation and immediately observe the results of their actions, prompting reflection and meaningful learning. Learners bring their own experiences into the role-playing situation and consequently gain “ownership” of the learning process. The goal is for the learner to accomplish a mission or task associated with their role in the scenario. In order to survive in their “role”, learners must acquire particular skills and knowledge. This is where and when learning takes place. The learning environment that supports role-playing activities is often fictitious or metaphorical but also engaging enough that it captivates and sustains the learner’s attention. In addition to learning the particular skills and knowledge of the “role”, students also acquire social skills, communication skills, and interpersonal skills, which are characteristics of self-directed learning.

In E-Learning context, role-playing can be facilitated through learning technologies or delivery models such as Multi-User Dialogue (MUD) or Multi-User Object Oriented (MOO). Tapped-In (www.tappedin.org) is an example of a knowledge network that supports MUD and MOO models. Another example of a MOO is a 3-dimensional (3D) educational world created using Activeworlds (www.activeworlds.com). Activeworlds is a software application that allows users to build a 3D virtual world on the Internet for other users to visit, and engage in, a powerful interactive experience. Educators can build a 3D “educational world” complete with social spaces, buildings, rooms, and all sorts of objects and artifacts. Students participating in these virtual worlds can take field trips, perform experiments, design products, explore content, and debate issues by taking on specific roles and interacting in real time over the Internet.

Examples of such “educational worlds” include science labs and clinical practice labs (e.g., Virtual Veterinary Clinic). Students assume roles as scientists, chemists, lab technicians, and veterinarians, and interact with each other and the learning tasks within these 3D virtual environments. Appropriate roles can be predetermined for each “virtual world” so that when students enter a world, they have to select a role from a pull-down menu list in order to participate. These roles are known as “avatars”. Avatars are identities or personas that identify the participant in a virtual world. Avatars can be programmed to run, jump, fly, dance, and to express a whole host of emotions (e.g., smile, cry).

PROMOTING ARTICULATION AND REFLECTION

Articulation involves “having students think about their actions and give reasons for their decisions and strategies, thus making their tacit knowledge more explicit or overt” (Wilson & Cole, 1996, p. 606). In other words, when students are provided with opportunities to *articulate* their knowledge or understanding of something, they are *explaining to others what they know*. As students articulate their knowledge to one another, they share multiple perspectives and generalize their understanding and knowledge so that it is applicable in different contexts (Collins, 1991). Articulation can also be achieved in a variety of other means, including working in groups, discussing and debating the issues, reporting, presenting findings, and negotiating and defending knowledge acquired through learning environments (Oliver, Herrington, & Omari, 1996).

Promoting reflection or reflective thinking involves asking students to review what they have done, analyze their performance, and compare it to that of experts and peers (Collins, 1991). Therefore, reflective thinking includes a process of analyzing and making judgment about what has happened to give a situation new meaning. Reflection and articulation are closely related. Wilson and Cole (1996) point out that reflection is

like articulation except that it is pointed backwards to previous tasks. Reflection can occur when students, for example, are asked to keep a journal about a learning experience and then revisit this journal at the end of the experience to reflect on their learning process and reconstruct what they have learned, giving new meaning to the situation. Another example of reflection is when students enrolled in a writing course are asked to write a paper about a topic at the beginning of the course, and revise it at the end of the course. By engaging in this type of activity, students are analyzing what they have written in the past, making a judgment about their paper, and applying newly gained knowledge to revise it.

Examples of how articulation and reflection can be enacted in E-Learning contexts using learning technologies include:

- Designing an activity that engages students in online discussions using bulletin boards or discussion forums. Students engaged in online discussions are articulating their understanding of the issues (making tacit knowledge explicit) by answering questions and explaining to others what they know. In addition to promoting articulation, these discussion areas can later be *revisited* by the student enabling reflection on one's postings and an analysis of one's learning performance.
- Providing students with a web posting area and appropriate tools to publish their work (e.g., draft papers or problem solutions). Students can then engage in an exercise of peer evaluation of each other's work, prompting reflective thinking.
- Designing an activity that engages students in keeping an online journal in which they reflect on their understanding of the reading material for the course. Students can be provided with a private web posting area to upload their journal entries. Providing a framework or a set of questions to guide students in how to structure this journal is important. The online instructor will have access to these journals and can provide feedback to each student via email. Students can *look back* on their journal entries at the end of the course and analyze the involvement of their learning and thinking process using the instructor's feedback and the course goals as a benchmark.

PROMOTING COLLABORATION AND SOCIAL NEGOTIATION

In its simplest form, a collaborative strategy can be defined as an instructional strategy that encourages interaction between and among two or more learners to maximize their own and each other's learning. From a constructivist or situated cognition perspective, collaborative learning can be defined as a collection of activities that emphasize (1) joint construction of knowledge; (2) joint negotiation of alternatives through argumentation, debate, and other means; and (3) student reliance on both fellow students as well as teachers as learning resources. Therefore, social negotiation is an integral component of collaboration. As Duffy and Cunningham (1996) state:

In collaboration and social negotiation, the goal is to share different viewpoints and ideas and to collaborate on problem-solving and knowledge building activities. Groups are formed to provide variation in classroom activity (face-to-face or virtual), share workloads (permitting larger projects), and promote peer tutoring (p. 187).

Examples of how collaboration and social negotiation can be enacted in E-Learning contexts using learning technologies include:

- Setting online group discussion areas focused around a topic or specific activity, goal, or project, such as a case study, using asynchronous discussion forums, to promote collaboration and social negotiation. Some group discussion areas can

be open-ended and un-moderated, allowing students to solicit information from each other, while others can take the form of a structured online discussion.

- Designing activities that allow group members to share documents related to a group project. Sharing documents online is a collaborative activity and can range from displaying the document in a designated web posting area to having group members work simultaneously on a document using groupware (an application sharing tool). In the case where the document is displayed, group members can discuss the contents of the document via email, videoconferencing, or chat. In the case where groupware is used, group members can co-edit the document online and annotate the document if the groupware has built-in annotation systems.
- Engaging students in data collection and organization activities when working on a group project by setting up a shared online database using database driven websites (dynamic web pages) and learning objects technology. Shared databases allow each group member to contribute data individually to the database in the form of references (e.g., a URL), contact info, pictures, and text documents, and retrieve data from it as needed.
- Engaging students in synchronous communication activities using virtual chat and videoconferencing. Real time collaborative activities allow groups to brainstorm ideas, debate problems, and develop action plans in a finite and short period of time.

SUPPORTING MULTIPLE PERSPECTIVES

Supporting multiple perspectives is an instructional strategy that emphasizes the construction of flexible knowledge. By exposing students to multiple points of view of understanding or judging things or events, learners rearrange information to construct new knowledge, acquiring flexible and meaningful knowledge structures (Duffy & Cunningham, 1996, p. 178). Essentially, promoting multiple perspectives involves presenting information in a variety of ways to encourage learners to view the knowledge base from multiple viewpoints and find their own connections and explanations (Jacobson, 1994). The goal of promoting multiple perspectives is to generate cognitive dissonance so that firstly learners are aware that there are multiple perspectives on an issue, which is the case in real world situations. Secondly, learners are engaged in exploring each perspective to seek a meaningfully resolution to the issue at hand, constructing new meaning in the context of their own experiences and knowledge.

Examples of how multiple perspectives can be enacted in E-Learning contexts using learning technologies include:

- Providing web links to cases that articulate different perspectives on an issue using.
- Including a search engine on the course website so that learners can seek additional information relative to their learning task.
- Providing a discussion forum to encourage students to articulate their viewpoint on an issue, hear other students' viewpoints, and ask questions.
- Providing an "ask the expert" email link or listserve for students to use when seeking expert opinions and perspectives about the issue at hand.

SUPPORTING MODELING AND EXPLAINING

Modeling and explaining provide learners with an example of the desired performance by focusing on the expert's performance (Jonassen, 1991). Traditional modeling and

explaining consists of integrating both the demonstration and explanation during instruction including false starts, mistakes, and dead ends, so that students can truly see how a process is handled (Wilson & Cole, 1996). Essentially, modeling shows how a process unfolds, while explaining involves giving reasons why it happens that way. Modeling and explaining of internal processes is an effective way to scaffold students' performance. By experiencing a teacher or expert's cognitive processes, students are better able to adopt the expert's mode of thinking (Gorrell & Capron, 1990). Therefore explaining the thought processes behind an action or decision is important to modeling expert performance. However, it is sometimes difficult to get experts to articulate their covert thought processes since experts form mental models or schemas of their problem solving skills that cannot be easily broken down into explicit or overt sequences or action scripts. Expert systems technology and modeling software have been instrumental in assisting instructional designers to capture expert performance to make it available to novices.

Examples of how modeling and explaining can be enacted in E-Learning contexts using learning technologies include:

- Providing access to a web-based area or website where solutions to problems or instructional challenges that have been deemed exemplary by teachers or experts are posted for others to peruse.
- Using digital audio and video to capture an expert's performance while performing a real world task.
- Providing access to a synchronous chat area where experts can use think-aloud protocols to walk students through a problem solving process.

PROVIDING SCAFFOLDING

Scaffolding is originally a Vygotskian (Lev Vygotsky, 1896-1934) concept based on the idea of providing supportive assistance to the learner within the parameters of a learner's zone of proximal development (ZPD) (Wood, Bruner, & Ross, 1976). Providing the right level of supportive assistance in a learning environment is a challenge for instructors and instructional designers. Novice students and students who already have a significant knowledge base require different levels and types of support to push them to perform at their potential development zone. Therefore, a layered structure to scaffolding is recommended in which novice learners get the support and information they need to help them engage in the learning task without slowing down advanced students who may not need the same level and type of support as novice learners (Dabbagh, 2003).

Scaffolding can be achieved through a variety of activities and related instructional strategies. In a traditional classroom setting, scaffolding is often achieved through one-on-one collaboration with the teacher, an expert, or a more competent learner. Scaffolding can also be achieved through modeling and explaining. When experts model their internal thought processes as discussed earlier, students are prompted to reflect on their own performance, compare it to that of the expert's, and improve their performance. Scaffolding can also be achieved by providing appropriate and varied resources and tools to support learning.

Examples of how scaffolding can be enacted in E-Learning contexts using learning technologies include:

- Providing one-on-one mentoring and guidance via email.
- Providing hypermedia links to embedded online tools such as a calculator, spreadsheet or database program, or other cognitive tools (e.g., the ability to draw

a concept map or diagram) that can either perform part of the task for the learner to reduce its complexity, or assist the learner in performing the task.

- Providing a discussion or chat area where students can seek help on how to perform certain tasks.
- Providing an online index and/or a glossary of important terms and their definitions.
- Providing hypermedia links to carefully selected web-based resources that support the learning task.
- Providing hypermedia links to worked examples of learning tasks or samples of previous projects to clearly communicate to the learners the requirements of the task.

AN APPLIED EXAMPLE

In order to better understand how the three key components of the theory-based design framework for E-Learning: pedagogical models, instructional strategies, and learning technologies, interact as depicted in Figure 1, consider the following three scenarios:

A COST EFFECTIVE TRAINING SOLUTION

An international voice communications industry that manufactures and sells cellular phones needs to train its sales force, which consists of 1500 employees, worldwide on the use of its newly designed cellular phone and corresponding market plan. An electronic performance support system (EPSS) that utilizes Internet and Web-based technologies is developed to facilitate this training event. Salespeople are able to access this electronic system through the Internet on an as needed basis to download job aids that explain the new and improved functions of this cellular phone and associated promotional marketing plans. Salespeople can also ask questions via email, obtain expert advice through teleconferencing, view video demonstrations, and explore appropriate resources to help them effectively market the new phone at their prospective retail outlets and sales areas. What pedagogical model of E-Learning does this learning environment most closely resemble?

SCHOLARLY EXCHANGE AT A DISTANCE

Three high school teachers in three different geographic areas of the country decide to collaborate on a presentation proposal for an internationally renowned conference in educational communications and technology. To facilitate this collaboration and document ideas in one accessible and shared location, one of the teachers sets up an exclusive asynchronous discussion forum using Blackboard's free courseware site (Blackboard is a course management system used to deliver and manage online courses) and emails the URL to her colleagues. The three teachers bookmark the URL for the site and begin discussing their ideas online. After three weeks, the presentation proposal outline emerges as a result of the discussion and the writing process begins. The teachers continue to post drafts of the proposal to the site until the final proposal is completed. What pedagogical model of E-Learning does this learning environment most closely resemble? What is different about the nature of communication that was enabled by this technology?

A TALE OF TWO INSTITUTIONS

Two faculty members teaching courses in instructional design (ID) at two geographically distant higher education institutions decide to conduct research on the impact of external versus internal student collaboration on solving ID cases. Group discussion and presentation areas were set up using WebCT (a course management system) to facilitate this process. Students in each course were divided into groups of 3-4 and assigned an ID case to solve as part of the course requirement. The ID case was posted to each group's presentation area in WebCT. Each group was asked to access the case online, prepare their solution, and post it to their designated group area in WebCT. The groups were then randomly paired with either a group at the peer institution (outside or external collaboration) or with a group in their own class (inside or internal collaboration) and asked to review their peer group's case solution and engage in a week long online discussion with their peer group to critique each other's solutions. What types of interactions are supported in this scenario?

The first scenario, A Cost Effective Training Solution, can be most closely aligned with the pedagogical model or construct of open or flexible learning since the focus of the training is on individual and local needs and requirements rather than the delivery of a pre-established curriculum. The communications company developed a customized training package that fits the needs of its employees, delivering anytime, and anywhere training. The Electronic Performance Support System (EPSS) is essentially a knowledge network at its core with enhanced capabilities that enable users to access information, seek expert advice, view video demonstrations, and explore resources on an as needed and just-in-time basis. The primary instructional strategies supported by this knowledge network are problem solving, collaboration, and exploration. The learning technologies that enable the implementation of these strategies include asynchronous and synchronous communication tools and hypermedia and multimedia technologies. The scenario can also be described as a distributed learning environment since learning takes place across time, place, and various media.

In the second scenario, Scholarly Exchange at a Distance, a group of teachers are collaborating online to achieve a shared goal: writing a presentation proposal for a conference. This effort can be most closely described as a knowledge building community. Knowledge building in this example is supported by Blackboard. The discussion forum feature of Blackboard enables an asynchronous learning network allowing the teachers to share their knowledge and transform this knowledge into a working product. The primary instructional strategies supported are articulation, reflection, and collaboration.

In the last scenario, A Tale of Two Institutions, the pedagogical construct implemented most closely aligns with distributed learning. Course events and activities are distributed across time, place, and various media. The primary instructional strategies supported are exploration, problem solving, and collaboration. Exploration is enabled using hypermedia tools, external collaboration and problem solving is supported through asynchronous communication tools, and internal collaboration and problem solving is supported synchronously through face-to-face interaction.

CONCLUSION

Designing effective and meaningful E-Learning requires a grounded design approach. The E-Learning developer or instructor must have a reflexive awareness of the theoretical basis underlying instructional design and the ability to link theory to practice in a systematic manner. This paper presented a theory-based design framework for E-

Learning that emphasizes the systematic and transformative interaction between pedagogical models, instructional strategies, and learning technologies consequently allowing the E-Learning developer or instructor to adopt a grounded design approach. In addition, it was argued that recent advances in Internet and Web-based technologies prompted the emergence of pedagogical models grounded in the situated cognition and constructivist views of knowledge necessitating the reconceptualization of distance learning as “an open and distributed learning environment that utilizes pedagogical tools, enabled by Internet and Web-based technologies, to facilitate learning and knowledge building through meaningful action and interaction”. Armed with this new understanding of distance learning and the theory-into-practice design framework that characterizes the instructional implications of situated cognition, E-Learning developers and instructors have the knowledge and tools to carefully craft E-Learning solutions and deliberately organize, coordinate, and enact distributed forms of interaction to promote meaningful knowledge acquisition.

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