DESIGN STRATEGIES FOR HIGHER EDUCATION FACULTY

Deniz PALAK

Abstract
This paper reports the current findings in literature on the impact of instructional technologies on teaching and learning environments pertaining higher education institutions. This study investigates the instructional design strategies in terms of (1) the scope of change in design strategies as a result of current school reform in the United States (2) impact of instructional technologies on teaching and learning, (3) evolving roles of teachers and learners within these new environments, (4) new networked technologies available for teaching, and (5) implications for changes in instructional strategies. The paper also brings two models of instructional technology integration (Harris' genres of telecollaborative activity structures and Tomei's Taxonomy of Instructional Technologies) for higher education faculty who are interested in applying learner-centered design principles. As this paper is an interactive document taking advantage of the full range of hyperlinks, it is recommended to be viewed to online.

Higher education institutions are undergoing substantial changes as a result of education reform that is taking place at schools. Universities are making the shift from face-to-face print only delivery to digital delivery in both traditional face-to-face and online courses. Coupled with socio-economic and pedagogical changes over the last decade, higher education faculty has become increasingly responsive to creating flexible technology-supported teaching and learning environments. In this growing demand, higher education faculty has begun to integrate instructional technologies into their existing course design. The paper investigates the instructional design strategies in terms of (1) the scope of change in design strategies as a result of school reform (2) impact of instructional technologies on teaching and learning, (3) evolving roles of teachers and learners within these new environments, (4) new networked technologies available for teaching, and (5) implications for changes in instructional strategies used by faculty in higher education.

Scope of Change in Design Strategies for Higher Education Faculty

From a larger perspective, two most important recent developments have shifted the focus on instructional design strategies for conditions of successful teaching: (1) social and economic forces of change and (2) a dramatic shift in the beliefs of learning and education itself. These two developments have neither developed in isolation nor independent from each other. They reflect the larger social and economical conditions that are shaping the industrialized democratic societies of today. Specifically, the movement of educational change or reform began in the 1990s in the US. Today's social and economic change forces – demographic, economic, and global - are affecting higher education organizations and their functioning (Morrison, 2002). Student enrollments in higher education institutions are increasing in numbers and becoming ethnically diverse. International movement in capital, labor, products, technology, information exchange and business are expanding beyond national boundaries. Technology is both changing and being changed or reshaped due to the current social and economic forces, affecting the local as well as global economy and culture in which we do everyday business.

In parallel to social and economic change forces, education reform since 1990s suggests a fundamental shift in the direction of educational beliefs (Wasser, 1996). Due to recent neuroscience research and convergence of evidence from a number of scientific fields, human intelligence is now believed not to be a fixed entity, but a spiraling and evolving human capacity. Recent findings indicate that there is a positive relationship between the amount of experience in a complex environment and the amount of structural change in the human brain (Bransford, Brown, & Cocking, 1999). More specifically research now points to evidence that (1) learning changes the physical structure of the brain, (2) learning organizes and reorganizes the brain, and (3) different parts of the brain may be ready to learn at different times. The shift in the belief of learning, moving away from a fixed entity to an ever-evolving non-linear process that is enriched by providing learning experiences, has yielded the revision of learning theories, giving way to constructivist learning environments for successful teaching and learning.

Changing social and economic forces combined with changing beliefs in learning have compelled an educational reform to sketch out the expectations of what students should know and be able to do. Since the quality of learning has a direct relationship to the quality of teaching, new educational standards have been reinforced to ensure the preparation of teacher professionals to meet the demands of the modern post-industrialized society. In the last few years, higher education institutions that prepare future teachers have been expected to the respond to these changes in society at large by following the standards to achieve reform. To ensure that beginning teachers are prepared to meet standards, National Commission on Teaching and America's Future (NCTAF) prepared the following criteria as benchmarks for teacher preparation, licensing, and hiring. These benchmarks reflect the emerging, research-based consensus on learning and social and economic forces of the last few decades. The benchmarks outline the expected standards for "highly qualified beginning teachers" in line with current education reform that is taking place at schools. The standards for highly qualified teachers are the following:

- Possess a deep understanding of the subjects they teach;
- A firm understanding of how students learn;
- Demonstrate the teaching skills necessary to help students achieve high standards;
- Create positive learning environments;
- Use a variety of assessment strategies to diagnose and respond to learning needs;
- Demonstrate and integrate modern technology into school curriculum to support student learning;
- Collaborate with colleagues, parents, and community members, and other educators to improve student learning;
- Reflect on their practice to improve future teaching and student achievement;
- Pursue professional growth in both content and pedagogy;
- Instill a passion for learning in their students.

Higher education institutions must prepare the teachers of the nation to meet the demands of knowledge-based, pluralistic society of the 21st century. Students of the 21st century will not be able to meet the changing demands of society unless teachers are prepared to meet the high standards. The amendments, such as the Higher Education Act Amendments of 1998 and Title II made the teacher preparation programs accountable for the quality of their graduates. Consequently, new design strategies need to be developed in higher education institutions whose mission is to prepare new qualified teachers as well as to enhance the quality of teaching for in-service teachers through professional development.

Technology is an integral part in the changing face of education reform. Not more than a decade ago, society at large was beginning to experience the Internet and multimedia revolution before their eyes. Computers at schools were beginning to enter specifically designated labs with software for the purposes of drill-and-practice, tutorial, and games. Computer technologies were seen as an "add-on" or a new media to deliver instruction. This view formed the earlier type of instructional technology model, namely Computer-Based Instruction (CBI) (Kearsley, 2000).

Within two decades the advancements of PC, Internet, and multimedia communication technologies have allowed educators to create new learning environments, opportunities, and qualities for learning and teaching. Technologies are no longer mere media to deliver of instruction, but they are tools, environments, activities, or methods to foster student learning (Jonassen, Peck & Wilson, 1999). Instructional design integrates technologies that are curriculum-based and rooted in student activities. In this new framework of instructional design, technologies are used to (1) bring exciting curricula based on real-world problems into classroom through the integration of video/audio, simulations, and networked connectivity to concrete data and outside experts and learners, (2) provide scaffolds and tools to enhance learning by participation in complex cognitive performances, (3) give students and teachers more opportunities for feedback, reflection, and revision, (4) build local and global communities that include teachers, students, experts, parents, administrators, and other interested people, and (5) expand opportunities for teacher learning (Bransford, Brown, & Cocking, 1999).

Given today's education reform movement, all learners are being held to high education standards, which in turn have shifted learning environments to prepare the students of the 21st century. As society is changing due to social, economic, demographic, and global forces, it is imperative that all learners are furnished with higher order thinking, presentation, communication, collaboration, and technology skills (Riel & Fulton, 1998). In this new paradigm of learning and school reform, transmitting knowledge shifted to constructing knowledge in authentic, meaningful learning environments with support of technology.

Impact of Instructional Technologies on Teaching and Learning Environments

The goal of integrating instructional technologies is to build teachers' capacity for sustaining practice to improve the quality of teaching and learning in line with current education reform. The challenge is incorporating new content and pedagogical standards into higher education curriculum to model new design strategies for future teachers. The challenge will be met when higher education faculty use technology to build the capacity for sustaining reform objectives from within their instructional design. How do such faculty implement instructional technology strategies that connect content and classroom practice with technology? Following is a framework of effective learning environments with the opportunities made possible by access to communication technologies. The four dimensions of the effective learning environments reflect the consensus in the learning sciences research as they are outlined in the book, *How People Learn: Brain, Mind, Experience, and School* (Bransford, Brown, & Cocking, 1999). The four dimensions of effective learning environment are (1) learner-centered, (2) knowledge-centered, (3) assessment-centered, and (4) community-centered.

Learner-Centered Learning Environments

In learner-centered environments, integration of instructional technology is seen as a tool to foster learning. The purpose of integration is not an end of itself or to deliver instruction with different media. Instead, technology is integrated as a means to create new and exciting instructional opportunities for best teaching and learning practices. Because in technology-supported learning environments, learning is an active process in which students construct knowledge based on their goals and real-world problems, learner-centered design addresses to the needs of the learners holistically and systematically. The focus is on the process of creating knowledge with the community of learners that engage students with authentic and project-based challenges (McCombs, 2000).

The learner-centered environments mirror learning in real life settings in which learning is often characterized as playful, non-linear, engaging, self-directed, and meaningful from the perspective of learners (McCombs, 2000). Learners are not seen as "blank slates" with respect to their goals, opinions, knowledge, and time (Bransford, 2000). The authority of curriculum is shared with the learner and instructional design takes learners' goals, needs, strengths, and interests into account. The learner-centered design honors preconceptions, cultural values, and special strengths of each individual learner as each may have something to contribute to unique classroom interactions in proactive learning environments.

The International Communication and Negotiation Simulations (ICONS) Project is an example of how learner-centered curriculum can be a powerful teaching strategy in regards to enhancing learners' ability for interactive learning, critical thinking skills, appreciation of controversial issues, and an awareness of cultural differences with negotiation and problem-solving. The ICONS provides a laboratory where university level students around the world can test theories about how decision-makers resolve conflicts. Working in teams, students perform research in order to develop policies on issues of international importance, such as nuclear proliferation, human rights, trade, narcotics trafficking and environmental degradation.

Global SchoolNet Foundation (GSN) is a non-profit international online education organization, dedicated to prepare young learners for the workforce and help them become literate and responsible global citizens. GSN works with schools, universities, businesses, government and community organizations to provide meaningful Internet-based learning programs and professional development. GSN hosts over 700 online projects organized by grade level of students and partnering with 25,000 schools in the US and 89 schools all over the world. GSN provides online synchronous, asynchronous, and, publishing tools for both learners and teachers.

Knowledge-Centered learning Environments

As Bransford (2000) indicated there are many overlaps between knowledge-centered and learner-centered since knowledge centered learning activities are conducted in learner-centered environments. The learner-centered design yields open-ended learning environments through inquiry-based constructivist design strategies in which learners build knowledge around the solution of problems with authentic tasks and project-based learning activities. The design strategies in knowledge-centered learning environments (1) use a problem solving approach to acquire knowledge (2) have a specific curriculum focus requiring active student engagement through inquiry, (3) expect active student engagement and learning (4) and negotiate solutions with a community of learners. In knowledge-centered learning environments, students are expected to do something: solve a problem, produce an artifact, and organize their ideas to present and/or disseminate.

Although nothing appears to be new at first in knowledge-centered instructional design strategies, technology's capacity to extend the physical boundaries, community of learners, providing opportunities for in-depth active learning have a great impact in the quality of teaching and learning. Instructional technologies strengthen learners' ability to think, reflect, and solve problems by accessing ideas, assumptions, and conceptions of both people and resources, which are otherwise beyond the reach of the learners. In the knowledge-centered design, knowledge is constructed in meaningful, open learning environments. Knowledge is built within the community of learners who may be geographically far away from each other; knowledge-building learning activities are meaningful, context-specific and acquired through inquiry with problem and project based authentic learning tasks that are negotiated with the learner in the design process.

Hebert Simon once stated that (as cited in Bransfrod, Brown, & Cocking, 1999) knowing is no longer seen as remembering and repeating information; rather knowing is being able to find and use information. Below are some examples of how knowledge can be built in the learning communities using the Internet or networked resources.

The Science Learning Network (SLN) provides online community of educators, students, schools, science museums and other institutions with a model for inquiry in science education. The network incorporates inquiry-based teaching approaches, telecomputing, collaboration among geographically dispersed teachers and classrooms, and WWW content resources. Participant schools may exhibit their findings in the four U.S. science museums as well as partnering six international online museums. The SLN is an example of how students accomplish inquiry in knowledge-based curriculum.

Study Skills Help Page Dr. Carolyn Hopper provides help in learning skills. Qualified students can take her course online or take advantage of the resources she made available on the website.
Assessment-Centered Learning Environments

The implications of the learner, knowledge, and community-centered networked environments result in schools' becoming hubs (Carroll, 2000). As education delivery moves away from self-contained classrooms to open networked resources in which knowledge is constructed through inquiry and authentic tasks, it is imperative that assessment methods align with the instructional strategies. The former methods of multiple choice, short answer, and standardized tests, however, will not reflect the learning outcomes that take place in networked learning environments. In the assessment-centered learning environments, student learning is active, intentional, authentic, and cooperative. The method of assessment is about finding out "how students make meaning" as a result of their interactions in the networked environments with the other community of learners. The measurement of meaning-making is a qualitative and process oriented method, which requires learners to be assessed while they are making the meaning through interaction, inquiry, and negotiation.

Formative evaluation methods, such as portfolios, rubrics, self-reflection sheets, checklists, student reports and videos documenting students' performances are some of the tools to assess performance-based learning strategies. Technology plays a crucial role in both documenting student performance and giving instant feedback to students about their performance-based learning process.

The National Center for Technology Planning (NCTP) specifically helps teachers determine what resources, assessment and design tools they will need for educational networks. This site is a clearinghouse for the exchange of many types of information related to higher education technology planning, assessment, and educational web portals.

The Jason Project gives students all over the world a chance to directly participate in science, mathematics, social sciences, language arts, and technology projects through exploration and discovery. The Jason Project follows a standards-based curriculum and provides a variety of assessment tools appropriate to the project in online learning environments. These curriculum-based assessment tools are performance-based, standards and assessment rubric, student and self-assessment.

Helen C. Barrett, a predominant researcher in portfolio development, provides a wealth of information on her website on the process of digital portfolio development.

The Gallery Walk Projects, ISTE's Assessment & Technology Forum, has several examples of electronic portfolio approaches and portfolio products both from K-12 and college/university projects. In addition to the available portfolio help website, there are also number of commercial electronic portfolio providers, such as Chalk & Wire, LiveText, TaskStream, and ProfPort.

World Lecture Hall contains open links to university-level course materials in 83 categories that instructors can browse. Course materials may include the syllabus, audio, video, and course notes.
Community-Centered Learning Environments.

Riel (2000) argued that "fundamental change in the next decades will result from participation in education by a larger community of people who the Internet brings together, rather than from access to technology". The Internet brings the access to a larger community of people. Designing community-centered learning environments connects communities of people - learners, teachers, and professionals - toward a common goal. Community-centered environments facilitate collaboration and cooperation, which are to some, the biggest single change (Kearsley, 2000) as well as challenge (Harris, 2002) that networked technologies bring to the changing face of education. Community-based learning expands both the human and technological resources, provides students a meaningful context for knowledge construction, an environment for building social and academic skills, such as negotiating a meaning, turn taking, and reaching a consensus.

The Center for Curriculum, Transfer, and Technology (C2T2) is a peer-based professional development organization from British Colombia provides higher education faculty access to information and resources to improve student learning. The organization offers tools, publications, reports and materials that document innovative solutions in teaching and learning.

Project Bio is a partnership for biology education involving educators in Iowa State University. The materials developed in Project BIO are available worldwide on the Internet. The project aims to enhance biology distance education by developing biology distance courses and share teaching resources to promote shared curriculum development. The site provides higher education faculty with resources for creating web-based lecture and adding audio to lecture.

Teachers Helping Teachers site was developed by Dr. Scott Mandel to provide basic teaching tips and new ideas in teaching methodologies for inexperienced teachers as well as to provide a forum for experienced teachers to share their expertise with colleagues around the world.

Searle Center for Teaching Excellence is Northwestern University's higher education teaching effectiveness center assists higher education faculty in research, assessment, and in a wide range of services with resources and peer feedback.

The Northwest Regional Educational Laboratory (NWREL) makes numerous resources as well as projects available for educators, policymakers, parents, and the public. NWREL provides research and development in six areas: assessment; child and family; education, career and community; program evaluation, rural education; and school improvement program, in addition to four in training and technical assistance: equity center; comprehensive center; mathematics and science education center; and national mentoring center.

The Training & Development Community Center provides a gateway for those educators who are interested in professional organizations, discussion boards, training and development listservs, or similar information and engagement in the field of instructional technology and human resources development.

The IMS Global Learning Consortium develops and promotes online distributed learning activities, such as locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems.

Evolving Roles of Teachers and Learners within These New Environments
The integration of instructional technologies into the new learning environments has a great impact on the roles of teachers and students. Professionally-engaged teachers who integrate instructional technologies differ significantly from classroom teachers who are isolated behind the closed environments of traditional classrooms (Riel, 2000). The learner-centered design compels teachers to change their roles significantly both in their design and instructional delivery.

Traditional closed classrooms place the teacher not only as the sole authority to design and deliver instruction, but also as the central person who stands and delivers the content while students sit and receive the knowledge.

However, in the learner-centered constructivist environments, learners solve complex and realistic problems, work together with other community of learners to solve the problems, and take ownership of their own learning. Learners are active participants in the learning environments, working together with teachers both as designers and learners as opposed to being seen as "empty vessels waiting to be filled" (Driscoll, 2000).

Teachers play entirely new roles along with the student in the new instructional environments where teachers are likely to be knowledge managers and learners are more autonomous individuals with greater responsibilities for their own learning process. The following framework is adapted from Newby, Stepich, Lehman, and Russell (2000) to describe the changes of roles of both teachers and students in the learner-centered environments.

For the TEACHER **A shift from:**	**A shift to:**
Always being viewed as the content expert and source for all of the answers	Participating at times as one who may not know it all but desires to learn
Being viewed as the primary source of information who continually directs it to students	Being viewed as a support. Collaborator, and coach for students as they learn to gather and evaluate information for themselves.
Always asking the questions and controlling the focus of student learning	Actively coaching students to develop and pose their own questions and explore their own alternative ways of finding answers
Directing students through pretest step-by-step exercises so that all achieve similar conclusions	Actively encouraging individuals to use their personal knowledge and skills to create unique solutions to problems
For the LEARNER **A shift from:**	**A shit to:**
Passively waiting for the teacher to give directions and information	Actively searching for needed information and learning experiences, determining what is needed, seeking ways to attain it
Always being in the role of the learner	Participating at times as the expert/knowledge provide
Always following given procedures	Desiring to explore, discover, and create unique solutions to learning problems
Viewing the teachers as the one who has all the answers	Viewing the teacher as a resource, model, and helper who will encourage exploration and attempts to find solutions to problems

New Networked Technologies for Teaching

The emerging major theme in the technology-supported learning environments can be described briefly as students' actively building knowledge through inquiry with telecollaborative activities that are housed in the Internet, networked resources. In the Virtual Architecture's Web Home, Harris (1998) introduced a structure to conduct telecollaborative activities using a variety of networked tools. Harris (1998) stated "the tool, in and of itself, no matter how powerful its features, cannot make learning happen". The application of these tools makes learning an active, holistic, idiosyncratic process that is modeled, situated, and authentic and built with community of learners. From this perspective, networked technologies are dealt with within the framework of three genres: interpersonal exchange, information collection & analysis, and problem solving. The genres are organized into three categories of student action depending on the dominant type of learning act to accomplish curriculum-related learning goals (Harris, 1998).

Below is the table of the three genres of activity structures. The examples of specific telecollaborative activities are provided with a hyperlink in the "example" column. The "tools" column states the specific software, hardware, and online resources that can be used to accomplish the telecollaborative activities. Although the use of each tool appears to be separated by the type of genres, any tool appropriate with the design strategies can be used to conduct a specific telecollaborative activity. In fact, majority of the tools that are used in the telecollaborative activities are embedded in the telecollaborative project web pages. Teachers may take advantage of the available tools in the Internet and create their own specific learning environments in collaboration with their own students and others.

<table>
<tr><th>Genre</th><th>Activity Structure</th><th>Examples</th><th>Tools</th></tr>
<tr><td rowspan="7">INTERPERSONAL EXCHANGE</td><td>Keypals</td><td>epals is a classroom exchange platform for teachers of higher education and K-12, students, and parents</td><td rowspan="7">Asynchronous tools: bulletin boards, newsgroups, listservs, streaming audio and video, and email (voice or text).

Synchronous tools: Chatrooms, instant messaging, desktop video conferencing (CU-SeeMe), electronic whiteboards.

Software tools: Java applets, spreadsheets, word processing, desktop publishing, web page development, presentation, concept mapping, speech synthesis, and file transfer protocol software.

Other WWW tools: search engines, virtual tours, webcams, MUDs & MOOs.</td></tr>
<tr><td>Global Classroom</td><td>The Globe Program Curriculum-specific collaboration among participating global classroom for targeted grade level.

The Global School House Project-based K-12 telecollaborative learning with schools around the world.</td></tr>
<tr><td>Electronic Appearances</td><td>Ask the Space Scientists is NASA's site for K-12 students</td></tr>
<tr><td>Telementoring</td><td>The Math Forum: Person-to-person interaction

(4D) Electronic mentoring Project, for native American Children</td></tr>
<tr><td>Question & Answer</td><td>CIESE, Educational Links Several links to educational ask an expert websites.</td></tr>
<tr><td>Impersonations</td><td>Ask Thomas Jefferson for K-12</td></tr>
<tr></tr>
<tr><td rowspan="2">INFORMATION COLLECTION & ANALYSIS</td><td>Information Exchanges</td><td>Global Grocery List Project Students report prices on various groceries and then compare their data with that of people in other areas.</td><td rowspan="2">Speech Processing,

Swiki/CoWeb, is a collaborative hypertext tool allows both teachers and students to create collaborative activities. Anybody can create or edit the pages; pages are linked by their names. By</td></tr>
<tr><td>Database Creation</td><td>Plantwatch Learners observe flowering times for plant species and to report these dates electronically.</td></tr>
</table>

	Electronic Publishing	E-Link Writer's Corner K-12 students publish poetry Kid's International Peace Museum Student created exhibits on peace	allowing students the same power and flexibility as the teacher, agency shifts so that teachers become participants in the students' activities and students become critical consumers of the teacher's activities.
	Telefieldtrips	Virtual China Students virtually travel to china Online from Jupiter NASA Quest	
	Pooled Data Analysis	The Global Sun Temperature Project Students determine how where they live affects daily temperature The PathFinder Science Students determine the effect of several ongoing science projects	
PROBLEM SOLVING	Information Searches	Hunt for Country Capital Games Peer-to-Peer information collection games Internet Math Hunt Math scavenger hunt in which students compete to find math answers	WebQuest Design Page WebQuest Examples Online Educational Simulations Online Digital Libraries Virtual Reality Ebooks Palms
	Peer Feedback Activities	How Far Does Light Go Students discover, defend, and refute theories about how far light travels. Classroom Anatomy Online Students post fictional case studies about patients. Other students, in turn, use on-line forms to offer their diagnoses.	

PROBLEM SOLVING Continued	Parallel Problem Solving	A Day in the Life of an Ice Cube Students from around the world measure how long it takes an ice cube to melt in their location Inventions Project Students brainstorm and design inventions that may change the way we live.	
	Sequential Creations	I have a Dream Electronic Project a Students compose a series of poems sequentially. Worldwide F.A.X Project Students from Nebraska and Japan create sequential stories using e-mail.	
	Telepresent Problem Solving	KidCast for Peace with CU-SeeMe videoconferencing technology students meet and discuss world peace	
	Simulations	Educational Space Simulations Project Space simulations by National Association of Space Simulating Educators (NASSE) educators. Biology Labs On-Line Interactive, inquiry-based biology simulations for high schools students.	
	Social Action Projects	The International Communication and Negotiation Simulations (ICONS) has several social action projects. IEARN Social Action Projects with international participation	

Implications for Changes in Instructional Strategies Used by Faculty in Higher Education Beginning to Integrate New Technologies

As noted above, the socio-economic forces have shaped the school reform movement since the 1990s. Recent findings from the learning sciences have had an impact on the way we understand what learning is and how learning environments need to be designed. Constructivist philosophy has emerged in line with our new understanding on the ways in which learners' knowledge need to be built to respond to the needs of today's growingly complex postmodern society. The constructivists believe in meaning making with authentic complex goals that are solved in context specific learning environments with purposeful strategies similar to the ways in which we learn in real-world situations. Since constructivist philosophy has a great impact on instructional design regarding learning conditions and instructional strategies (Driscoll, 2002), creating appropriate learning environments are essential for successful teaching and learning.

Networked computer and multimedia technologies support creating complex learning environments to implement the new design strategies. This is why, when constructivists talk about technologies, they don't refer to it as a separate entity (media to deliver instruction), but rather as a tool or method that students *learn with*. Learning with technologies has implications for changes in designing instruction. These changes bring new dimensions to the following components of design principles: (1) instructional strategies, (2) interaction, and (3) taxonomy of instructional technology objectives.

Instructional Strategies

Conditions of learning in the learning environments that are learner, knowledge, community, and assessment-centered are created with the following instructional strategies: (1) problem-based, (2) project-based, (3) inquiry, (4) collaboration, and (5) cooperation. The key elements of these instructional strategies are that they are context-driven as opposed to content-specific. That means context houses the learning conditions in which students build knowledge through mentoring, apprenticeships, and problem-based scenarios. Learning context is modeled by the community of learners that include students, teachers, outside experts. Learning is situated specific to the context and facilitated through the cases or problem scenarios that are built on what students already know (Maddux, Johnson, & Willes, 2001).

Morrison and Lowther (2002) described Problem-Based Learning as a teaching strategy consistent with a learner-centered approach in which students are provided with the problem first, before they began studying the material. Students must then think about what they know individually and collectively and what they need to learn to solve the problem. By determining what they need to know, the students develop knowledge structures, based on problem-solving approaches rather than subject matter approaches as presented in text-books.

Project-Based Learning focuses teaching and learning around projects that are driven by an authentic question or problem that is central to the curriculum (McGrath, 2002). The project-based activities involve a community of learners toward building student constructed products. Technology becomes embedded in project-based student activities since it supports and extends the possibilities for inquiry, data collection, collaboration, analysis, construction, and communication.

Inquiry learning is another learner-centered design tool that was previously called discovery learning. This approach requires students to seek information in order to discover concepts (e.g., classification) and relationships (e.g., principles) between ideas (Morrison & Lowther, 2002).

Cooperation and collaboration are sometimes referred unanimously, but in essence, they are two separate strategies. Judi Harris (2002) described the difference between these two strategies with the following analogy. In the first situation, two children are playing in a sandbox next to each other, each of whom is building their own sandcastle while sharing a shovel or a bucket. Their castle resides side-by-side in the same sandbox. In the second situation, however, the same two children are in the same sandbox, working together on a single castle. Although each of these situations takes place in a learning community, the first example represents cooperation and the second collaboration. Telecollaborative activities are collaborative conducted through the Internet networked resources. Harris cautions that telecollaborative activities are more challenging for teachers to conduct since they require active and ongoing coordination on part of the teacher. Telecollaboration is also challenging because collaboration requires negotiation with others (teachers and students) what we are and what we will be doing during a learning activity (Harris, 2002).

Internet based networked technologies provide the tools, the means to accomplish instructional strategies that are problem and project-based and conducted through inquiry. Harris' activity structures foster learning through cooperation or collaboration among peers who are both present in the same location and distant from each other.

Information is sought not for the sake of collecting knowledge but is collected and negotiated in context specific learning environments. Making knowledge of that information is active, holistic, and idiosyncratic process that is modeled, situated, and authentic

Interaction

The concept of interaction in either face-to-face or distance education programs are fundamental for creating effective instruction (McIsaac, & Gunawardena, 2002). In constructivist learning environments, learners communicate one to other electronically, collect information, and analyze, share, or publish their constructed knowledge in the electronic environments, there is a heavy involvement of the learner with HTML pages. Due to the learner's involvement with the electronic resources and communities during this process, the learner spends considerable amount of time in navigating through non-linear hypertext environments. This involvement of interaction between the learner and technology, thus, naturally brings a new type of interaction, *Learner-Interface*. The learner-interface interaction has been proposed by Hillman, Hills, and Gunawardena in addition to the three others (learner-instructor, learner-learner, and learner-content interaction) that were introduced previously (McIsaac, & Gunawardena, 2002).

The learner-interface interaction proposes that instructional design strategies in the new technology-supported learning environments must consider the learners who may or may not have the skills required to use the communication mediated through technology. Since collaboration involves a high degree of interaction, instructional design strategies must ensure the continuous degrees of interaction that take place among the learners, instructor, content, and the electronic interfaces.

Assuring interaction though four levels (learner-instructor, learner-learner, learner-content, and learner-interface) is the key in the new learning environments. Moore and Kearsley (1999) proposed that the amount of distance is no longer measured by geography in either traditional or distance education courses. Greater "transactional distance" occurs among the instructor and the learners if the instructional design is highly structured toward teacher-centered curriculum with limited interaction. When there is more dialog and less structure, the instructional design has *less transactional distance*. Course design with less transactional distance is learner-centered in which learners are given greater autonomy, high levels interaction and less structure in the learning environments.

Taxonomy of Instructional Technology Objectives

The implications of changes in constructivist learning environments yield orchestrating different instructional strategies in which technologies are integrated in the overall instructional design. Since integration of instructional technology becomes an embedded teaching strategy in the learning environment, designers will benefit from determining at what level they achieve technology-supported learning objectives. For many decades, Blooms' Taxonomy of Educational Objectives has given educators the criteria for measuring learning objectives in the cognitive domain. Complementary to Bloom's Taxonomy, Lawrence Tomei's (2002) taxonomy for the technology domain provides educators with the most robust classification of determining the hierarchical level of instructional technology integration in the new design environments. Tomei's Taxonomy of Instructional Technologies is a framework of reference to help teachers determine at what level they have integrated instructional technologies. The table below is adapted from Tomei's (2000) *Technology Façade: Overcoming barriers to effective instructional technology*.

Taxonomy Classification	**Actions that Present Intellectual Activity on this Level**
Literacy: understanding technology and its components	Apply computer terminology in oral and written Consider the various uses of computers and technology Master keyboarding, clicking, and dragging object Use web-based search engines Download information via file transfer protocol Operate input and output devices Duplicate solutions of hardware and software problems
Communications: sharing ideas, working collaboratively, and	Use technology tools for writing and communications Participate in demonstrations of DE applications Share information electronically

forming relationship Value work conducted cooperatively and collaboratively with technology
using technology Respond to opportunities for sharing electronic information
Communicate interpersonally using electronic mail
Interact with the electronic community via chatrooms
Subscribe to online newsgroups
Access remote information via telecommunications

Decision Making: Apply electronic tools for research, information analysis, and problem solving
using technology Design effective instruction
in new and concrete Evaluate the accuracy, relevance, and bias of electronic information resources
situations Formulate new ideas with software
Prepare an electronic spreadsheet
Create calendars, address books, and class schedules
Conduct research that enhances learning

Instruction: Teach, differentiate, and discriminate using technology
breaking down Appraise educational software for its pedagogical strengths
technology-based Support learning goals by choosing multimedia resources
instructional material Formulate a collegial environment for teaching using technology-based tools
into its components Theorize instructional opportunities that might be adaptive to diverse learners
Integrate technology into student guidance, career, awareness, and student web-based materials
Create text-based materials using technology
Create visual-based classroom presentations

Integration: Assimilate technology into a personal learning style
reassembling Facilitate lifelong learning by constructing a personal schema for technology
technology-based Address personal skill deficits using technology
instruction to create Consider the consequences of inappropriate uses of technology
new materials Enhance personal productivity with technology

Society: Support copyright and fair use laws for using technology
the value of Debate the issues surrounding legal/ethical behavior when using technology
Argue and assess the historical evolution of technology and predict its probable future roles in society
Rate the promises for using information technology to solve real-world problems
Judge the responsible uses and abuses of technology

Conclusion

Higher education institutions have yet to overcome the evolving design strategies to accomplish best teaching practices to foster student learning. Current education reform and pedagogy suggest a shift toward learner-centered design and delivery. Instructional technology integration will only improve teaching and learning provided that technology tools are applied with sound design strategies. The combination of the instructional strategies that are employed in the new learning environments suggests different design strategies, affecting the roles of teachers and learners, learning conditions, and objectives. Evolving design strategies where instructional technologies are integrated appear to be a challenge until teachers learn how to operate these tools to foster learning.

In the framework of current literature of instructional design, this paper investigated design principles for creating learner-centered instruction, specifically focusing on new networked technologies available for teaching. Two models for integrating instructional technologies have been brought: (1) Harris' genres of telecollaborative activity structures for problem, project, and inquiry based learning and (2) Tomei's Taxonomy of Instructional Technologies for determining the level instructional technology integration. Harris' activity structures that are accomplished through networked technologies facilitate the orchestration of the design principles in learner-centered constructivist learning environments. Tomei's Taxonomy is a tool to measure how successfully teachers achieve the expected learning outcomes in the learner-centered environments where technologies are integrated. These two models are references for higher education faculty who are interested in creating learner-centered design supported by instructional technologies.

References

Bransford, J.D. (2000). Toward the development of a stronger community of educators: New opportunities made possible by integrating the learning sciences and technology. Retrieved May 9, 2003, from, http://www.pt3.org/technology/html/bransford.html

Bransford, J. D., Brown, A.L., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Caroll, T.G. (2000). Do today's evaluations meet the needs of tomorrow's networked learning communities? Retrieved May 9, 2003, from, http://www.pt3.org/technology/html/carroll.html

Driscoll, M.P. (2002).Psychological foundations of instructional design. In R.A. Reiser & J.V. Dempsey (Ed.), *Trends and issues in instructional design and technology*. Upper Saddle River, N.J.: Pearson Education.

Driscoll, M.P. (2000). *Psychology of learning for instruction*. MA: Allyn &Bacon.

Harris, J. (1998). Curriculum-based telecollaboration: Using activity structures to design student projects. *Learning and Leading With Technology, 26*(1), 6-15.

Harris, J. (2002). Wherefore art thou, Telecollaboration? *Learning and Leading With Technology, 29*(6), 55, 57-59. Retrieved May 10, 2003, from, http://virtual-architecture.wm.edu/Foundation/index.html

Harris, J., & Grandgenett, N. (2002). Teacher's authentic e-learning. *Learning & Leading with Technology, 30*(3), 54-58.

Jonassen, D.H., Peck, K.L., & Wilson, B.G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Merrill/Prentice Hall.

Kearsley, G. (2000). *Online education: Learning and teaching in cyberspace.* Book version. Belmont, CA: Wadsworth. Retrieved May 10, 2003, 2003 from, http://home.sprynet.com/sprynet/gkearsley/cyber.htm

Maddux, C.D., Johnson, D.L.& Willis, J.W. (2001). *Educational Computing. Learning with tomorrow's technologies*. Needham Heights, MA: Allyn & Bacon

McIsaac, M.S., & Gunawardena, C.N. (2002). Distance Education. In David H. Jonassen (Ed.) *Handbook of research for educational communications and technology* (pp. 403-437). Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.

Moore, M.G., & Kearsley, G.(1999). *Distance education: a systems view*. California: Wadsworth Publishing Company.

Morrison, J.L. (2002). The University is dead! Long live the university! Retrieved May 9, 2003, from, http://horizon.unc.edu/projects/seminars/futurizing/The%20University%20is%20Dead.asp.

Morrison, G.R., & Lowther, D.L. (2002). *Integrating computer technology into the classroom (2nd Edition)*. Upper Saddle River, NJ: Pearson Education.

McCombs, B. L. (2000). Assessing the role of educational technology in the teaching and learning process: A learner-centered perspective. Paper presented at the Secretary's Conference on Educational Technology: Measuring the Impacts and Shaping the Future. Washington, DC. Retrieved May 10, 2003, 2003 from, http://www.ed.gov/Technology/techconf/2000/mccombs_paper.html

McGrath, D. (2002). Getting started with project-based learning. *Learning & Leading with Technology. 30*(3), 42-45.

Newby, T.J., Stepich, D.A., Lehman, J.D. & Russell, J.D. (2000). *Instructional technology for teaching and learning: Designing instruction, integrating computers, and using media.* Upper Saddle, River, New Jersey: Prentice-Hall.

Riel, M. (2000). New designs for connected teaching and learning. U.S. Department of Education: Secretary's Conference on Educational Technology, September, 2000. Retrieved May 10, 2003, 2003 from, http://www.gse.uci.edu/mriel/whitepaper/ent

Riel, M. & Fulton, K. (1998). Technology in the classroom: tools for doing things differently or doing different things. Retrieved May 9, 2003, from, http://www.gse.uci.edu/vkiosk/faculty/Riel/riel-fulton.html

Tomei, L.A. (2002). *The technology façade: Overcoming barriers to effective instructional technology*. Boston, MA: Allyn & Bacon.

Wasser, J.D. (1996). Reform, restructuring, and technology infusion. Retrieved May 9, 2003 from, http://ra.terc.edu/publications/terc_pubs/tech-infusion/reform/reform_frame.html

