

# **Applying Constructivist and Objectivist Learning Theories in the Design of A Web-Based Course: Implications for Practice**

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## **Abstract**

The paper provides an overview of the process of designing and developing a Web-based course using instructional design principles and models. First, it will describe instructional design principles and models and how they can be used in designing web-based instruction. Second, upon establishing an instructional design model, it will explain the process of implementing the model in designing and developing a web-based undergraduate teacher education course. Finally, the instructional design model is evaluated in light of the processes and findings from the implementation and evaluation results of the web-based course.

## **Keywords**

Constructivism, Learning theories, Objectivism, Web-based instruction

## **Introduction**

Today, with new technologies coming online, there is a great deal to learn when one begins to develop Web-Based Instruction (WBI). Key questions about visual design, site organization, usability design, file and database structure are becoming increasingly central to web design and use. In this regard, questions are raised for educators regarding instructional design and integrating the Web into their instructional systems, as such are vital to good instruction. Most educators are in agreement that the information encountered and accessed on the web by the learner is not the same as the knowledge constructed. Employing instructional design principles and models in creating WBI can help ensure that what is produced is of high quality and is able to present significant challenges to students.

However, throughout the brief history of the WBI, the overriding educational principle has been access to information, and not the knowledge that guides it and results from it (Salomon, 2000). Even though many faculty and teachers are engaged in designing and delivering WBI, they still seem to be more concerned with information presentation than with creating instructional sites that are designed to attain well-intended positive outcomes (Becker, 1999; Downs, Carlson, Repman & Clark, 1999; Salomon, 2000). Thoughtful analysis and investigation of how to use the Web's potential, together with instructional design principles, may utilize existing Web resources to construct instructional strategies that help learners construct learning experiences in alignment with prescribed curriculum (Betz, 2000).

This paper provides an overview of the process of designing and developing a Web-based course using instructional design principles and models. First, it will describe instructional design principles and models and how they can be used in designing web-based instruction. Second, upon establishing an instructional design model, it will explain the process of implementing the model in designing and developing a web-based undergraduate teacher education course. Finally, the instructional design model is evaluated in light of the processes and findings from the implementation and evaluation results of the web-based course.

## **Instructional Design Principles and Models**

Instructional design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of an instructional system that meets those needs. It includes development of instructional materials and activities, trial and evaluation of all instruction and learner activities. Instructional design process has the ambition to provide a link between learning theories (how humans learn) and the practice of building

instructional systems (an arrangement of resources and procedures to promote learning) (Gros, Elen, Kerres, Merrienboer, & Spector. 1997). A number of instructional design models have been developed to help educators and instructional designers incorporate fundamental elements of the instructional design process and principles. The process focuses on how to design and develop those learning experiences, while the principles focus on what learning experiences should be like after they have been designed and developed. In other words, instructional design models are guidelines or sets of strategies, which are based on learning theories and best practices. Two commonly used instructional design models and principles are: (1) objectivist, traditional instructional design models (e.g., Dick and Carry's Instructional Systems Design, 1996; Gagne, Wager, & Briggs' Principles of Instructional Design, 1992), and (2) constructivist or interperivist instructional design models (e.g, Spiro's Cognitive Flexibility Theory, 1992; Jonnassen's Constructivist Learning Environment, 1998; Hannafin, Land, & Oliver's Open Learning Environment, 1999). The traditional models are associated with behaviorism and cognitive science. Behaviorism influenced traditional design models by providing prescriptions about the correlation between learning conditions and learning outcomes. Cognitive science has also contributed to traditional models by emphasizing the learner's schema as an organized knowledge structure. The interpretive or constructivist models are associated with cognitive science and constructivism. Constructivist has many roots in social psychology and social learning paradigms.

The underlying philosophical views of traditional and constructivist models are objectivist and constructivist theories of knowledge. Objectivists believe that knowledge and truth exist outside the mind of the individual and are, therefore, objective. Learners may be told about the world and be expected to replicate its content and structure in their thinking (Jonnassen, 1991). An instructional developer who uses traditional design models analyzes the conditions which bear on the instructional system (such as content, the learner, and the instructional setting) in preparation for achieving the intended learning outcomes. Constructivists, on the other hand, believe that knowledge and truth are constructed by the learner and do not exist outside of his mind (Duffy & Jonassen, 1992). Therefore, according to constructivists, learners construct their own knowledge by actively participating in the learning process. Constructivist instructional developers value collaboration, learner autonomy, generativity, reflectivity and active engagement.

Consistent with their underlying philosophy of learning, traditional instructional design models provide a series of steps that, if followed, will lead eventually to the production of effective instruction. In spite of some differences among objectivist traditional design models, all models require designers and developers to set or identify: learners' prior knowledge, goals or general expected learning outcomes, specific learning outcomes or performance objectives, instructional strategies, assessment strategies and techniques, and evaluation procedures. The most widely used traditional design model is Dick and Carey's Systematic Instructional Design Model (see Dick & Carey, 1992). Within this model Gagne's categories of learning outcomes, conditions for learning (1985) (see Table 1), and nine events of instruction (see Table 2) are used both as decision-making tools and framework for designing and delivering of instruction.

Overview	Learning Outcomes		Conditions for Learning
This theory stipulates that there are several different types or levels of learning. The significance of these classifications is that different types of learning require different types of instruction. <b>Principles:</b> -Different instruction is required for different learning outcomes.	<b>Verbal Information</b>		Draw attention to information to be learned. Link the new, incoming information with prior knowledge. Provide and clarify the hierarchical relationships among ideas. Use associational (e.g., mnemonics, images, analogies), organizational (e.g., clustering, chunking, using graphics organizers), or elaborative techniques when appropriate. Use spaced practice. Provide cues for effective recall and generalization
	<b>Intellectual Skills</b>	<b>Discrimination</b>	Provide examples that clearly embody all of the necessary (critical) attributes (characteristics) of the object, event, and phenomenon. Have the learner examine the example and non-examples. Provide practice. Provide feedback.

<p>- For different learning to occur, specific conditions of learning need to be present.</p> <p>- The specific operations that constitute instructional events are different for each different type of learning outcome.</p>	<b>Concepts</b>	Present the best examples. Guide learners to discover the underlying concept and its attributes. Present learners with matched non-examples. Guide learners to discover the non-relevant attributes of the concept. Encourage learners to think of their own examples of the concept. Provide feedback.
	<b>Rules/Principles</b>	Guide learners in reviewing the concepts underlying the principle/procedure. Make sure that learners have more than declarative knowledge of the underlying concepts. Present the learner with a statement of the principle/ procedure and with subsequent examples of the principle's application. Guide learners to identify the features of a situation that suggest a particular principle/ procedure should be used.
	<b>Problem solving</b>	Confront learners with an actual problem or represented problem situation not previously encountered. Guide the learner in defining and decomposing the problem into sub- problems. Guide learners in recalling general problem solving strategies and developing an appropriate plan for attacking the problem. Guide learners in searching, selecting and combining rules and cognitive strategies to solve the problems. Guide learners to compare and contrast alternative ways of solving the problems given identified rules. Guide learners to use monitoring techniques for appraising the appropriateness of the solution.
	<b>Cognitive Strategies</b>	Frequently present learners with novel and challenging problems.
	<b>Attitude</b>	Provide models, reinforce proper behavior and provide verbal guidance.
	<b>Motor Skills</b>	Provide models; provide verbal directions; provide and reinforce practice.

Table 1. Gagne's conditions of learning (Gagne, Wager, & Briggs, 1992)

<b>1. Gain attention</b>	Present a good problem, a new situation or a novel idea to gain students' attention. (Use John Keller's ARCS (Attention, Relevance, Confidence & Satisfaction) Model).
<b>2. Informing Learner of the Objective</b>	In some manner or other, the learner should know the kind of performance that will be used as an indication that learning has, in fact, been accomplished. Objectives are to be communicated effectively to the learner (use words, even pictures, if appropriate).
<b>3. Stimulate Recall of prerequisites</b>	The previously acquired capabilities must be highly accessible to the learner. This must be ensured by having learners recall previously acquired capabilities just before the new learning takes place.
<b>4. Presenting the stimulus Material</b>	Stimuli that are to be displayed are those involved in the performance that reflects the learning. For example, if learning a concrete concept is the objective of the lesson, the concept's physical characteristics are to be emphasized. This can be done by enlarging the differences and similarities among examples and non-examples of the concept to be identified.

<b>5. Providing Learning Guidance</b>	The amount of hinting or promoting will vary with the kind of learner and the difficulty of the task/the lesson objective.
<b>6. Eliciting Performance</b>	Having learners show that they can carry out the task. This is usually done informally.
<b>7. Providing Feedback</b>	Once the correct performance has been exhibited by the learner, there should be feedback concerning the degree of correctness/appropriateness of the learner's performance.
<b>8. Assessing Performance</b>	At this level the teacher gathers formal and convincing evidence (valid and reliable) regarding the learner's performance.
<b>9. Enhancing Retention and Transfer</b>	Varieties of new tasks are to be assigned to enhance the learner's understanding and to assure the transfer of learning.

*Table 2. Nine Events of Instruction (Gagne, Wager, & Briggs, 1992)*

Constructivist models, on the other hand, are based on a set of philosophical assumptions and provide designers with a set of very general guidelines and principles that can facilitate designing a constructivist-learning environment. While several models embody constructivist concepts (e.g., cooperative learning, project-based or problem-based learning, reciprocal learning, etc.), all models utilize the following concepts, as these are central to the constructivist instructional design (Wilson & Cole, 1991):

1. Learning is embedded in a rich authentic problem-solving environment;
2. Authentic versus academic contexts for learning are provided;
3. Provisions for learner control are incorporated;
4. Errors are used as a mechanism to provide feedback on learners' understanding; and
5. Learning is embedded in social experience.

Among several constructivist instructional design models (e.g., Bednar, Cunningham, Duffy, & Perry, 1995; Hannafin, Land, & Oliver, 1999; Willis, 1995) Jonassen's "Constructivist Learning Environment" model is widely used to design and develop instruction for computer-based learning environment. In his model, Jonassen (1998) lists a number of design principles that can be used to develop what he calls the "constructivist learning environment". These design principles are as follows:

1. Create real world environments that employ the context in which learning is relevant;
2. Focus on realistic approaches to solving real-world problems;
3. The instructor is a coach and analyzer of the strategies used to solve these problems;
4. Stress conceptual interrelatedness, providing multiple representations or perspectives on the content;
5. Instructional goals and objectives should be negotiated and not imposed;
6. Evaluation should serve as a self-analysis tool;
7. Provide tools and environments that help learners interpret the multiple perspectives of the world, and
8. Learning should be internally controlled and mediated by the learner (pp. 11-12).

When using constructivist models, designers are guided to: identify the learning domain (boundaries of the content), identify fairly complex problems or cases to be studied within the identified learning domain, identify learning elements which the designer feels are most important within the defined domain (declarative and procedural knowledge that make up the learning domain), map multiple paths through cases (guided paths that create trails through the domain leading the learner to optimal results from the designer's perspective), provide tools for learner controlled path (where the learner sets his own objectives and decides where to go from there), encourage self-reflection (questions, guidance), and provide tools that help the learner decide what to do next based on self-reflection.

### **Theoretical Framework: Toward a Mixed Approach in Designing and Developing Web-Based Instruction**

The literature on debate between objectivist and constructivist instructional design models points to the fundamental philosophical differences between these two instructional design models (e.g., Bednar, Cunningham, Duffy & Perry, 1995; Dick, 1995; Rowland, 1995). However, in practice, a mix of old and new (objective and constructive) instruction/learning design is being used (e.g., Davidson, 1998). In contrast to instructional design theorists, instructional design practitioners tend to believe that what works where and how

we knit everything together to give us some focus in our approach to instructional design are the key concepts in producing the best practice. They further argue that instructional designers and developers must allow circumstances surrounding the learning situation to help them decide which approach to learning is most appropriate. In addition, it is necessary to realize that some learning problems may require prescriptive solutions, whereas others are more suited to learner control of the environment (Schwier, 1995).

Along the same line of argument, Jonassen, McAleese, and Duffy (1993) proposed the Continuum of Knowledge Acquisition Model, in which they identified three types of learning and matched them with what they believe to be appropriate learning theory approaches. They described a continuum of knowledge acquisition that leads from ignorance to expertise (see Figure 1). The learning phases that characterize the knowledge growth are introductory, advanced and expert. Introductory learning occurs when learners have very little directly transferable prior knowledge about a skill or content area. It represents the initial stages of schema assembly and integration. In the second phase of knowledge building, learners acquire more advanced knowledge to solve more complex, domain specific problems. Expertise is the final phase where learners usually assume extensive experience that can be transferred from previous phases of learning (Jonassen, McAleese, & Duffy, 1993), and learners require very little guidance in learning the new content. Jonassen and his colleagues believe that the initial knowledge acquisition is better served by instructional techniques that are based upon traditional instructional design models whereas constructivist-learning environments are most effective for advanced knowledge acquisition stage of learning.

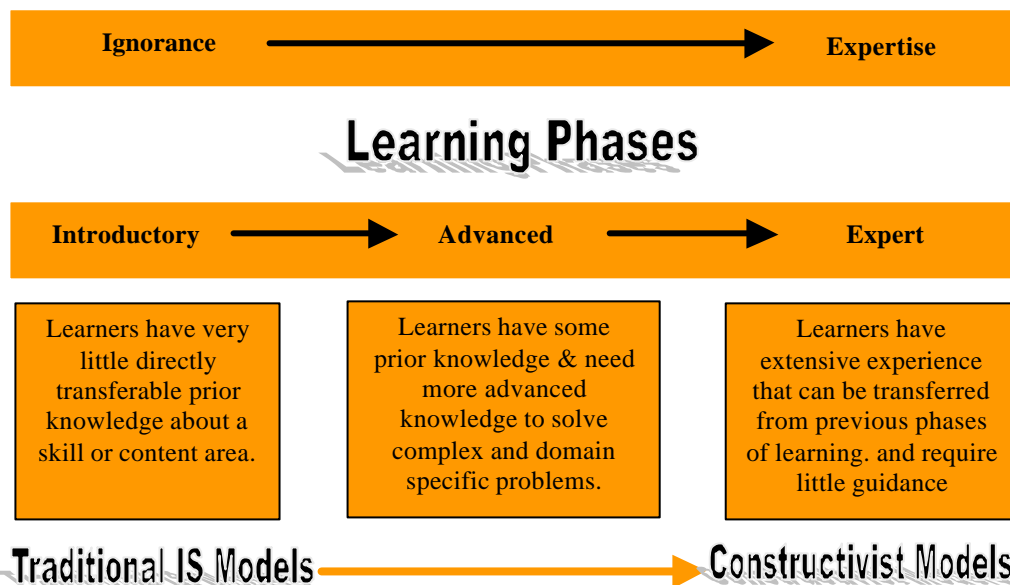


Figure 1. The Continuum of Knowledge Acquisition Model (Jonassen, McAleese, & Duffy, 1993)

After having compared and contrasted behaviorism, cognitivism and constructivism, Ertmer and Newby (1993) also argue that the instructional approach used for novice learners may not be efficiently stimulating for a learner who is familiar with the content. They, therefore, do not advocate one single learning theory, but stress that the instructional strategy and content addressed should depend upon the level of the learners. Similar to Jonassen and his colleagues, Ertmer and Newby match learning theories with the content to be learned. They believe that the strategies promoted by different learning theories overlap (the same strategy for a different reason) and that learning theory strategies are concentrated along different points of a continuum, depending on the focus of the learning theory and the level of cognitive processing required.

The combined methodology described above is employed for the design and development of the course described in this paper. This method was found to provide a practical solution, if not a theoretical solution, to the existing dichotomy between objectivist and constructivist models. It was assumed that effective WBI depends on learning experiences appropriately designed and facilitated. Learners have different backgrounds, experiences, and learning styles; and, therefore, WBI should address these differences by providing significant experiences for each individual learner. In designing WBI courses, accommodation of different learning styles and needs can best be accomplished by utilizing mixed instructional design models.

## **Designing and Developing A Web Based Course: Linking WBI to the Instructional Design Models**

### **Course description**

The course that was re-designed for delivery over the Internet is titled, “Instructional Design and Classroom Evaluation”. It is a required, three-unit foundations course for an undergraduate teacher education program. The course expects prospective teachers to acquire knowledge and skills related to designing a course, a unit of instruction and a lesson.

The course was re-designed for the web delivery using a Web-based course management tool (Eduprise Database) adopted by the university. Similar to the other Web-based course management tools, Eduprise Database provides instructor’s tools, learner tools, technical tools and administrative tools needed to ensure appropriate creation and delivery of WBI. The instructor’s tools provide a basic organizational structure for setting up the course (course home page, calendar, assignment page, course topics, course content and lessons, forum, library resources, electronic mail, etc.). However, the instructors are to decide how and in what ways they want to use each feature of the program in designing their courses.

### **Course design specifications**

The constructivist-learning environment was used as the general framework for the design of the course. As guided in this model, a real-world problem or project (design and develop a course for a grade level and subject area) was identified for the course. The project was further divided into three subprojects (course design, unit design and lesson design) in order to provide some structure and time line for student work. The project aimed to create a learning context and to organize and drive learning needs for students. It also helped the designer to conduct a task analysis and to identify required knowledge domains and skills for the course. The identified knowledge domains and skills then were clustered into six interrelated units (domains) of instruction. The continuum of knowledge acquisition model (Jonassen, McAleese & Duffy, 1993) was then applied to further determine the best instructional design model for each unit of instruction given students’ prior knowledge and experiences and types of learning outcomes addressed in each unit. As a result of this analysis, constructivist models were found to be appropriate for designing and developing first, second and fifth units, where students had more advanced knowledge of the content and the learning outcomes were primarily problem solving and applications of multiple principles. Objectivist, traditional design models, on the other hand, were found to be appropriate for designing and developing third, fourth and sixth units, where students had very little directly transferable prior knowledge and the learning outcomes were focused on learning new concepts and principles.

Dick and Carey (1992) and Gagne, Wager and Briggs’ (1992) models were used as theoretical framework for units with objectivist design. Jonassen’s constructivist learning environment model applied to units with constructivist design.

To apply Dick and Carey’s systematic instructional design model, for each unit a list of general goals and specific performance objectives and related test items were developed. Given the identified goals and objectives, each unit was divided into a number of well-sequenced lessons. Gagné’s conditions of learning was used as a decision making tool to determine the best instructional strategies for each objective (see table 1). Gagné’s nine events of instruction (see Table 2) was also used as a framework for developing each lesson.

To apply constructivist learning environment model, for each unit a focusing problem or question was identified. The problem or question was further integrated into realistic, classroom-based cases. Each case then became the focus of a lesson. A list of information resources, cognitive and interpretive support mechanisms were also prepared to facilitate students’ problem solving efforts.

### **Course development specifications**

The Eduprise tools for instructor (course data base, forum data base, library database and test database) were used to develop the course. In addition to developing the course home page and links to pages such as the syllabus, course calendar, assignments, and readings, the course data base tools were utilized to present students with web pages that described the overall project students were expected to design and develop at the conclusion of the course, and a concept map of how the project was related to the course units and lessons, or the knowledge

domains (see Figure 2). In the project description page, it was recommended that students work in teams (groups of three). Also from the project description page, students received instruction and were able to link to a designated team area forum (where they could communicate and discuss with their team members as they were designing and developing their projects). Also from this project description page, students were able to access a common forum area (where they could interact with the instructor and other members of the class). The project description page also provided links to resources such as the university library (where all course extra reading materials were available in text), the library curriculum materials center (where the state and district adopted textbooks and other educational materials are indexed), and the state site for public instruction (where standards for different grade levels and subject areas are available). The course library site was also used to index a number of sample projects (course design, unit design, lesson design) as performance models (Jonassen, 1999). As part of the project requirements, students were expected to complete written documentation that outlined the course, the unit and the lessons that they had designed as a team. The documentation was submitted at the conclusion of the course. However, teams were asked to submit their drafts for each part (course design, unit design, and lesson design) at certain points during the course for review by the instructor. Students were given the opportunity to revise their work, if necessary.



Figure 2. Course units & lessons

In order to help students identify their own learning styles and study skills and to know one another better, they were directed to complete and post a brief autobiographical sketch with their pictures in the “common forum” (the synchronous and asynchronous discussion area). The autobiographical assignment page provided students with questions that they could consider in preparing their autobiography. It also provided links to other sites where students could self assess their own learning styles, thinking styles, and study skills and report the results in their autobiographical sketch. In order to make the project drive the learning needs, the course home page and project were also linked to different course units and lessons. Although a sequence in the presentation of units and lessons was suggested in order to manage the course and organize the readings and interactions, all units and lessons were made available to students in case they wanted to explore them on their own and out of the given order. For each unit or related lesson(s), a list of reading assignments was recommended. To help students develop a common knowledge base, they were further instructed to read the designated reading materials before the scheduled lessons or units, and to post a synthesis summary as an individual assignment.

**Units and lessons with traditional design models:** As indicated above, units with traditional design models were divided into well-sequenced lessons. They were designed so that the concepts or principles learned in earlier lessons would be prerequisites for the following lessons. The lessons' format followed nine events of instruction suggested by Gagné, Wager, and Briggs (1992) (see Table 2). Given this model, several strategies were used to *gain students attention (event 1)*. For example, the lessons' content, activities, lectures, examples, etc. were made relevant to students' needs and future jobs as teachers. Furthermore, all lessons were linked directly to knowledge and skills that students needed to master in order to complete the course project (a real-world task). Several practice activities (individual and group) were developed for each lesson so that students would feel confident that they have mastered the objectives of the lesson, and as a result, feel satisfied. *To inform students of expected learning outcomes (event 2)*, each lesson provided students with an overview of the content covered in the lesson and a list of specific performance objectives. *To inform students of prerequisite skills (event 3)*, they were reminded of the readings and prerequisite knowledge that they must have completed and achieved before the lesson. Students were also provided with a brief review of the previous concepts or principles and with links to the course library database in which other readings and Web sites were indexed and linked for further review. The formal *presentation of the stimulus materials and learning guidance (event 4 and 5)* included the following activities: instructor's lectures (slide presentation and the instructor's elaborate notes, which consisted of explanations, elaborations, analogies, examples and non-examples or demonstrations of principles), group discussion (threaded discussion conducted in the common forum), group assignment (focused team assignments completed by teams in the team area of the forum), and individual assignment (completed and self-assessed by individual students). In all of the above materials visual images and video clips were added for more clarity. Several strategies were used to *elicit student performance and provide feedback (event 6 and 7)*. First, for each lesson the instructor initiated a threaded discussion related to the lesson's objectives. In this discussion she would ask questions, answer students' questions, prompt and elaborate on students' responses. Second, the instructor monitored team activities; and once teams submitted their responses, the instructor read responses and provided corrective feedback to each group. All individual assignments were also linked to response pages where students could self-assess their own performance. Units with objectivist design were also *formally assessed (event 8)* by paper and pencil tests at the end of each unit. *Transfer of knowledge (event 9)* was assumed to be achieved, as students would try to apply the knowledge and skills acquired in the lessons to design their own project for the course.

**Units and lessons with constructivist design model:** The visual format of the constructivist lessons was kept similar to lessons with objectivist design (in order to provide visual consistency). However, the constructivist lessons followed a different design model. As suggested by Jonassen's constructivist learning environment model, each constructivist lesson provided students with an authentic, real world problem. The problem was presented in a case form to assist learners in understanding the issues implicit in the problem presentation (Jonassen, 1999). Whenever appropriate, the problem or case was supported with visual images to help learners construct mental images and visualize the activity. In order to prompt learners to investigate the problem, a list of focusing questions and information resources (e.g., suggested readings, links to related Internet sites and search engines and other information resources) was provided. As indicated before, the core concept of the constructivist learning environment is collaboration and shared knowledge. The problem or case was presented as a collaborative team activity in which students were required to work in groups of four to solve the given problem and submit their responses as teams. The team area forum, where teams could have synchronous and asynchronous discussions supported the teams' conversations and collaboration. In order to support collaboration within a group of participants, several strategies were used (see Brandon & Hollingshead, 1999). First, collaborative work and responsibilities of team members were explicitly described in a separate web page that was linked to the collaborative team activity. Second, a team assessment tool was provided so that team members could evaluate their teams' collaborative work and use the results as a means to improve their collaborative work. Third, the team size was kept small (4 members) for individual accountability, and teams were asked to identify one member as a team leader and one member as a team recorder for each problem-solving task (case), and to rotate the responsibilities so that every member would get a chance to serve both as a leader and as a recorder. Finally, teams were told that the instructor would monitor individual members' active participation and contributions to the task as a way of evaluating team performance. Emphasis was placed on group participation and overall involvement with the task, and not on the final, written response posted. In order to provide expert support for each problem-solving task, the instructor initiated a threaded discussion in the common forum where she encouraged teams to participate. The role of the instructor in these threaded discussions (as compared with the threaded discussion for objectivist lessons) was more of a coach encouraging teams to reflect on their beliefs and to consider alternative interpretations of the issues and problems. In order to provide proper scaffolding and coaching, the instructor read respective team conversations in the team area once the problem was assigned to the teams. The instructor used the information gathered from respective team conversations to prompt students' thoughts, and to encourage reflection and articulation of the ideas presented.

In addition to reading and analyzing team responses and providing formative feedback related to the effectiveness of their performance, the instructor also formally assessed individual student performance by open-ended exams, where students were required to analyze cases and prepare well-reasoned responses.

## **Implementation and management issues**

Different instructional design models required different implementation and management strategies. For units and lessons within traditional design models, one of the main implementation and management issues was monitoring students' progress and making sure that they had mastered the lessons' objectives (reviewed prerequisite knowledge and skills, studied the instructor's explanations, elaborations and examples or demonstrations, completed individual assignments, self-assessed their own achievement of the objectives, etc.). Except for focused team activities in which students would have to work together to complete the assignments and submit their responses to receive the instructor's feedback, it was almost impossible to monitor individual student progress effectively as the student was completing the lessons (no tracking system was available). Furthermore, it seemed more difficult to have students participate in the threaded discussions and engage them in conversation with other students and the instructor. Therefore, even though individual assignments for each lesson contained self-assessment instruments, the instructor had to develop more formal assessment strategies (quizzes, tests) to monitor student completion of the tasks and performance in order to provide further instruction if needed.

Implementation and management of the units and lessons prepared in accordance with the constructivist design model were more complex and time intensive. Scaffolding students' learning, coaching their performance, providing immediate feedback, helping teams to stay on task and to explore alternative solutions, and developing tolerance to deal with the ambiguity of the tasks and the multiple perspectives (as opposed to one, correct response) demanded a lot of the instructor's and the students' time on line. Students not only had to spend more time on line, but they also had to coordinate their online time with other students. The instructor also had to read team conversations and to be ready to provide proper scaffolding and coaching, both in the team area and common forum area. Another management issue was related to effective collaborative teamwork. It was a challenge to develop a collaborative work environment in order to help teams learn how to work effectively and collaboratively. Independent and task-oriented students seemed to get frustrated easily and appeared to be more concerned about completing the task rather than exploring alternative solutions and negotiating multiple perspectives. Another team related issue was searching for resources that would further foster students' thinking process. When not prompted by the instructor, teams tended not to explore extra readings and resources that were available to them. In spite of the aforesaid difficulties, encouraging and motivating students to engage in conversation with their team members, classmates and the instructor was not difficult. The real world, ill-defined and open-ended task created the proper context for discussion and conversation.

## **Formative evaluation strategies and results**

Students' satisfaction with the course design and achievement of the course objectives across two design models were assessed using the analysis of the following data sources:

- The first day of the course, a "help" thread was created in the common forum and students were instructed to post their general questions and concerns about the course in this thread. The purpose of creating a "help" thread instead of using e-mail was to prevent asking and answering similar questions. The content and nature of students' posting (or e-mail messages) were analyzed across the two instructional design models.
- Twice during the semester (one at the end of unit 3 and the other at the end of unit 6), students completed a questionnaire in which they responded to a list of questions about the course design specifications across two instructional design models (e.g., which components of the course helped you understand the content, ranks using scale 1 to 4; Rank the following components of the lessons and explain why; Rank components that contributed to the quality of the course as a learning environment and explain why; what has been the greatest challenge for you; what changes could be made).
- Students' responses to the first assignment (autobiographical sketch) were examined to identify their preferred learning styles and study skills.
- Students' performance results (proctored test results, responses to problem solving tasks, projects written documentation) across the two design models were analyzed and compared.
- Students' postings in the team area and common forum were examined to identify the frequency and the quality of the responses across two design models.

- Students were interviewed at the end of the semester and responded to open-ended questions (e.g., what do you think about the course? If you were to take another online course what would you do differently? Think about the course design specifications and tell what you liked or disliked. If you were to take the course again what do you want to see changed?).

The results presented here are based on the analysis of the data gathered from 21 (5 males and 16 females) students enrolled in the Web-based course. Analysis of the data from the “help” thread and e-mail messages revealed that students posted more questions and concerns during the first (24 messages) and second units (22 messages) of instruction (with constructivist design). The content of the questions and concerns centered on the following issues: what is important to know?, what do we do if a member does not participate?, what do we do if we fall behind and cannot finish with readings?, how much time should we spend discussing?, is there a right answer for the case? how can we find out?, and how do we know whose solution is better?. However, the frequency of students’ questions and concerns were notably decreased (6 messages) during the fifth unit of instruction, which was also based on constructivist design model. The frequency and nature of students’ questions and concerns changed during the third (10 messages), fourth (6 messages) and sixth (3 messages) units of instruction (with the traditional design model). Students posted less help messages, and the content of their messages was more directed to the instructor (e.g., How can I find more examples?, Can I see you in person?, can we have a live review session?, I have a hard time phrasing my questions, I do not know what to say and ask in the forum, Am I doing okay if I am completing the assignments with a few errors? etc.).

Interestingly enough, the results of the questionnaire data reflected that more than 77% of students ranked the instructor’s elaborate lecture notes (examples, explanations, elaboration, etc.) as the most helpful component of the course in helping them understand the content. About 63 % of students ranked individual assignments as the most important characteristics of the lessons. 78% of students thought the interactions between the instructor and students were the most important contributor to course learning environment.

When students’ preferred learning styles and study skills (as described in their self-reported autobiographical sketch) were compared with their responses to the questionnaire, the results pointed to the relationship between students preferred learning style and their ranking of the course design components. For example, students who described themselves as self-motivated and self-directed (task-oriented and competitive) learners tended to rank textbooks, information resources and forum discussions as high as the instructor’s elaborate lecture notes. Students who indicated that they would learn better by doing and discussing (collaborative) ranked collaborative team activities and focused team assignments as high as individual assignments. The same group of students also thought that the interactions between and among students were as important as the interactions between the instructor and the students.

Overall, students’ performance results (both proctored, objective tests and essay and case analysis tests) across all units were comparable with the students’ performance results gathered from face-to-face section of the course (taught by the same instructor). When students’ level of participation in the team activities and common forum discussions were compared with their performance in the tests, the following results were noticeable: Students who actively participated in the common forum discussions (posted a minimum of three messages every week) and team activities (participated in all team activities by contributing ideas) and indicated that they completed all individual assignments did as well as, and in some cases better than, their counterpart students, who enrolled in the face-to-face section of the course (attended the class and completed their assignments). The same result was not observed for students who were not active in the forum discussions and team activities. Furthermore, while all students thought that they did well on the course project and enjoyed working on it, the quality of the teams’ written documents for all three sections of the course project was higher for students who attended the face-to-face section of the course, rather than those enrolled in the Web-based section.

The distribution of test scores for the units with traditional design models (objective tests) and units with constructivist design models (essay and case analysis) were very similar. However, further analysis of the relationship between test scores and students’ participation in the common forum discussion and team and individual activities pointed to some differences. Students who minimally participated in the common forum discussion (did not post comments/responses regularly) and team activities, but indicated that they liked and completed individual assignments did better on objectives tests than essay and case analysis tests. On the other hand, students who actively participated in the common forum and team activities, but did not specifically like individual assignments did better on essay and case analysis tests.

Analysis of students’ postings in the team and common forum discussions revealed that, in general, more students participated in the team and common forum discussions during the units and lessons with constructivist

design model than units with traditional design models. The frequency, content and quality of the postings (measured by the relevancy and novelty of the message to the topic) were also higher during the lessons within the constructivist design model. However, across both design models more students participated in the team discussions than they did in common forum discussions. In addition, students' discussions in the team area were more informal than the discussions in the common forum. In the team area, students tended to spend some time chatting about different issues (unrelated to the task) and supporting one another emotionally. In the common forum, on the other hand, students tended to be more formal and addressed the instructor's comments and prompts more than their peers' comments/responses.

The results of the interview data further revealed that students who participated minimally in the common forum discussions were intimidated by the thought that their responses or comments might not have been intelligent enough. They also felt uneasy about the fact that their responses were saved in the common forum. Students who were not active in the team activities indicated that they could not trust their peers' responses and preferred to complete the task on their own and receive the instructor's feedback. Several students also mentioned that they tended to fall behind in their readings and did not feel comfortable participating in the discussions. The majority of students indicated that they liked working with their teams (15 out of 21) and tended to like team activities more if they had good experiences with their team members. Most students (17 out of 21) indicated that they liked the course and would suggest the course to those fellow students who are highly self-disciplined. Finally, very few students (3 out of 21) were able to suggest any changes in the design of the course and thought the course was well designed.

## **Discussion and Implications**

The paper provides descriptive evidence in support of both traditional and constructivist design models. A combination of structured, self-paced, individualized instruction along with a problem-based, collaborative learning environment seemed to work well for the content, curriculum goals, and the diverse group of learners in this Web-based course. Given the results of the formative evaluation, one can advocate the idea that different learners and learning contexts may require a different design model for learning (Ertmer & Newby, 1993; Jonassen, McAleese, & Duffy, 1993). As Jonassen and Grabowski note, a large range of individual differences including learners' prior knowledge and experiences interact with both learning outcomes and instructional techniques (Jonassen & Grabowski, 1993). The evaluation results support the knowledge continuum theory. Results show that by identifying learning domains and considering students' prior knowledge and experiences when designing a WBI, it is easier to provide proper conditions for learning. Once presented with a complex, ill-defined problem, students with no or limited knowledge of a topic (introductory level) should be supported. This support can be in the form of helping students identify the particular knowledge domain that they need in order to be able to solve the problem at hand. If not supported, students with no or limited knowledge of a topic (introductory level) do not engage in conversations and discussions when provided with an ill-structured problem. In such cases, perhaps it is more appropriate to use traditional design models and provide interested learners with what Spiro and his colleagues (Spiro, et. al, 1992) refer to as "conceptual oversimplification" (p. 58). In the project presented in this paper, posing a real world, complex problem at the beginning of the course allowed students to discover individual learning needs. The problem also provided opportunity for advanced knowledge acquisition. However, further identification of the domains (units) and how they were related to the problem at hand made it possible for the designer to provide supportive lessons (learning conditions).

In addition, given the results of this study, although it appeared that self-dependent, competitive learners preferred traditional design models due to its self-paced, individualized orientation (they ranked components of lessons within the traditional design model higher), said learners did equally well and even better in problem-based collaborative learning environment, as long as instruction provided enough flexibility and freedom and the instructor practiced direct supervision and constant monitoring of the teamwork for individual accountability (so that students made sure they were recognized for their work). On the other hand, while hands-on, collaborative (socially-oriented) students preferred discussions, interactions and teamwork, they became easily frustrated with the ambiguity of the problem solving tasks. Results showed that these students performed better when the instructor provided more scaffolding and coaching strategies. Hands-on, collaborative students also seemed to benefit from the highly structured environment provided by the traditional design models (even though they said that they did not like individualized self-paced instruction) when they were challenged to complete the self-paced instructional materials and individualized assignments. The implication of these results for WBI is that both traditional and constructivist learning environment has challenges and preferences for some learners and either instructional conditions need to be adjusted to the learners' preferences to be effective.

Furthermore, the paper provides evidence that it is possible to provide a useful link between learning theories and instructional design practices. The two design models used in this project involved two different learning perspectives integrated into the design of a single course. It supports the potential of instructional design models at bridging the gap between instructional and learning theory and the development of powerful learning environments.

The paper also provides evidence that different instructional design models place different demands on learners. The complexity of managing oneself in a constructivist learning environment requires individual learners to have some familiarity with the knowledge domain and tolerance for the ambiguity of real world tasks. On the other hand, traditional design models (with their emphasis on the hierarchy of learning and pre-specified learning objectives) require learners to pay close attention to the stimulus event (presentation of the materials, examples, non-examples, etc.), to practice, and to demonstrate mastery of knowledge and skills. The extent to which a learner is able to respond to these demands makes one model more appropriate for him/her than the other. This result also points to the critical role that the instructor plays in the WBI. While the instructor's role may differ across two instructional design models, he/she plays a significant role in the success of the instructional systems. The absence of the social context cues in the WBI presents a substantial challenge in managing and monitoring online activities and assignments. If we agree that teaching is a complex task, teaching a Web-based course is an even more complex task and has more demand on the instructor's ability to mentor, interpret, coach, scaffold, motivate, manage, and help.

Finally the paper offers evidence that employment of instructional design principles and models in creating WBI can help ensure that learners construct learning experiences in alignment with prescribed curriculum. Students' performance results in this Web-based course demonstrated that the goals and objectives of the course were achieved. In addition, students agreed that the course, not only challenged their thinking, but it also helped them learn how to work collaboratively and independently.

Notwithstanding, this paper tried to describe the design and development process of a Web-based course with some formative evaluation data for improvement. More descriptive and experimental studies are needed to examine different aspects of a Web-based instruction and its design specifications. How the learner's preferred learning style may influence the course design needs to be explored in future studies. The role of the instructor and the management strategies for different design models varied. Further studies should address how, and in what ways, the instructor's role will change when employing different design models in WBI. Students' participation in computer-mediated communication continues to be a challenge for WBI. A few strategies were used in the design of the course described in this paper. However, a more focused study is required to closely examine some of these strategies for their effectiveness for learners with different learning styles and study skills.

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