Designing Personalized Online Learning Environments for Adult Learners

Kyong-Jee Kim*

Indiana University

Byeong-Min Yu**

Seoul National University

Abstract

Customizing instruction to meet individual needs is one of the foundational cornerstones of today's learner-centered paradigms. Adult learners have a wide range of differences in their backgrounds, interests, abilities, and learning styles; instruction, therefore, needs to be designed in such a way as to meet the highly diverse needs of adult education settings. The World Wide Web presents enormous potential for providing a technological environment for the optimal delivery of personalized instruction for individual learners. It is argued, however, that existing Web-based instruction fails to effectively customize instructions for individual learners. Therefore, we are in need of an ongoing refinement and creativity in our generation and treatment of theories of instruction geared towards the generation of personalized learning environments. Here, the attempt is made to develop an instructional-design theory for personalized online learning for online adult learners, with a special focus on the question of solving ill-structured problems. Theory, on a general level, is discussed insofar as it has emerged from the goals, preconditions, and underlying values, with an eye to the methods of instruction that are optimal for achieving the goals. The methods of instruction in this instructional-design theory are composed of four major components (goal-setting activities, engaging in the learning task, performing the task, and reviewing and reflecting upon the output of the task), with some corollaries detailing each major component. These methods incorporate the use of such Web technology as the learner management system, the learning objects system, and pedagogical agents to foster personalized learning process in online learning environments.

Key words: *personalized learning, adult online learning, customizing instruction, adult learning*

---

* Instructional Systems Technology School of Education, Indiana University, Bloomington, INU.S.A.

** Center for Teaching and Learning Seoul National University, Seoul, Korea; E-mail: basseryu@snu.ac.kr

Ⅰ. Introduction

Customizing instruction to address individual differences in learning is one of the key markers of the learning-focused paradigm in today's education and training. Reigeluth (Reigeluth, 1999) has convincingly argued that the social changes in the information age call for fundamental changes in the current paradigms of education and training. He claims that one of the key markers of the industrial age was standardization for mass production, shifting toward customization in today's information society (Reigeluth, 1997, 1999). These fundamental changes in the supersystem of instruction have important implications (Reigeluth, 1999). Customization of instruction is a key characteristic of the new paradigms of instruction in the information age, wherein the goal of instruction is to help learners reach their full potential in a way that is optimal to the varied characteristics and capabilities of individual learners.

Attempts have been made to provide personalized instruction in a variety of educational settings (Reiser, 1987) and personalized instruction has particular significance to adult learners. By definition, adult learners are those who perform roles associated by their culture with adults (e.g., worker, spouse, parent) and perceive themselves to be responsible for their own lives (Knowles, 1984). Adult learners seem to have unique characteristics distinct from children that are relevant to personalized online learning. First, they have a great volume and different quality of experience throughout their lives with a wide range of differences in their backgrounds, interests, abilities, and learning styles (Knowles, 1984). Therefore, an emphasis needs to be placed on adult learners to provide them with personalized instruction that addresses individual differences in their learning needs (Boud, 1992; Dunn, 1984; Martinez, 2000). Second, adults are often engaged in multiple commitments in their work, family, and social lives. People need to learn more yet they have less time available in which to learn it (Lee & Zemke, 1995). Thus, they need flexible learning environments to accommodate their learning with their busy schedules. Personalized instruction has of significance in providing flexible learning environments. Personalized instruction allows more flexibility in the pace of learning than do group-based approaches such as lectures or small-group teaching (Boud, 1992).

The World Wide Web (Web, henceforth) seems to have enormous potential for providing a technological environment for the optimal delivery of personalized instruction for individual learners. The Web medium is capable of providing more flexible learning environments than any other delivery medium which has existed in the past (Digilio, 1998; Khan, 1997). Research suggests that Web-based instruction permits learners to control their own learning (Bonk & Cummings, 1998; Yong, 1998), adapt material to different individual learning styles (Muir, 2001), and make pedagogical choices (Arnone, 2002). Therefore, the Web presents enormous potential for the optimal delivery of personalized instruction for individual learners (Digilio, 1998; Martinez,

2000).

Despite the potential of the Web for the optimal delivery of personalized instruction, most Web-based instruction, or online courses, offered nowadays are not designed to provide personalized instruction effectively. Existing Web-based instructions are not addressing the issue of differences in individual learning styles and preferences (Arnone, 2002; Martinez, 2001). They are often designed from the personalized instruction approach in the sense that they provide self-paced instruction in which the learner can skip some of the units that s/he has already mastered prior to the instruction. However, existing online courses do not provide learners with the locus of control in their learning i.e., all the learners are given instruction with the same learning goals and the same methods to achieve them. Thus, this instructional approach does not adequately address the issue of personalizing instruction for the individual learner. For adult learners, a particular emphasis needs to be placed on fostering higher-order thinking skills, in particular, on solving ill-structured problems. Today's workforce often deals with ill-structured problems which are not clearly defined, and new solutions need to be created to solve them. As Fred Nickols suggests (Gordon & Zemke, 2000), in the new economy, more and more jobs are shifting from a clearly laid-out job toone that deals with new and novel problems and has to be laid out as it goes along. Therefore, instructional-design theories to teach how to solve ill-defined problems are warranted in order to facilitate the development of competent knowledge workers in today's society. In effect, Jonassen (2002) argues that that online learning in universities and corporate training should focus on problem solving to address such societal needs. In this paper, an instructional-design theory to design personalized online learning environments for adult learners is proposed. This particular instructional-design theory is intended to illustrate the methods that can be applied to instruction to provide personalized online instruction on how to solve ill-structured problems from the new paradigm of instruction. It is our intention that this instructional-design theory will be able to provide educators and instructional designers in adult education settings with guidance on how to design personalized online learning environments to foster adult learners' skills to solve ill-structured problems.

Ⅱ. Literature Review

In this section, the instructional-design theory development process suggested by Reigeluth (1983; 1999) is briefly introduced, followed by the theoretical framework on designing instruction to facilitate problem-solving skills.

A. The Instructional-Design Theory Development Process

An instructional-design theory is a prescriptive theory that offers explicit guidance on how to better help people learn and develop (Reigeluth, 1999). In order for an instructional-design theory to prescribe explicit guidance on how to design instruction, the theory needs to identify the methods for supporting and facilitating learning and the situations in which those methods should or should not be used (Reigeluth, 1999). Developing instructional-design theories generally go through the following steps.

B. Identifying goals/purpose.

The goals of an instructional-design theory identify desired outcomes of the instruction designed from the given theory. Unlike learning goals that specify what to be taught, desired instructional outcomes include the levels of effectiveness, efficiency, and appeal (Reigeluth, 1983, 1999). First, the level of effectiveness is the extent to which the application of the theory attains the goal in a given situation. Second, the level of efficiency is the extent to which resources (costs in terms of time, money, etc.) are warranted for theory implementation. Lastly, the level of appeal refers to how enjoyable the resulting instructions are designed from the theory.

C. Identifying preconditions.

Preconditions of an instructional-design theory refer to the instructional conditions that need to be met in order for the theory to be applied in real instructional situations. Those conditions include (1) the nature of the learning domain to be learned, (2) the nature of the learner, (3) the learning environment, and (4) any constraints for instructional development (Reigeluth, 1999). It is important to identify preconditions of an instructional theory since an instructional method which works well under one condition may not work well under another, which Reigeluth (1997) refers to as "conditionality."Therefore, it is important that instructional-design theories explicitly state the situations for which their methods are recommended (Reigeluth, 1999).

D. Identifying underlying values.

In this step, values upon which the theory is based are identified. According to the systems design theory, the design of an educational system is grounded on the values that are shared by its stake holders and end users (Banathy, 1991). Reigeluth (1997) states that values play at least two important roles in designing instruction. First, they have an influence on the learning goals that are selected. Second, they influence the means for attaining the selected goals. Therefore, values lay the groundwork for establishing the criteria for judging between alternative means to accomplish goals.

E. Identifying methods of instruction.

The major feature of an instructional-design theory is to identify ways of supporting and facilitating learning in order to attain given goals. These ways are known as methods of instruction. These methods suggest an optimal instructional approach to attaining given instructional outcomes in given instructional situations (Reigeluth, 1983). Due to the conditionality of instruction, methods are intended to increase the probability that the desired results will occur, rather than to guarantee the attainment of goals (Reigeluth, 1999). Methods can be usually broken down into more detailed guidelines: they can describe parts or kinds of a more general method, or offer criteria that a general method should meet (Reigeluth, 1999).

F. Theoretical Framework on Teaching Problem - Solving Skills

Previous studies on teaching problem-solving skills are discussed here to lay a groundwork for methods of instruction to teach cognitive skills in personalized online learning environments in the instructional-design theory to be introduced here.

G. Definition and characteristics of ill-structured problems.

Jonassen(1997) defines well-structured problems as "constrained problems with convergent solutions that engage the application of a limited number of rules and principles within well-defined parameters" (p.65). In contrast, ill-structured problems "possess multiple solutions, solution paths, fewer parameters which are less manipulable, and contain uncertainty about which concepts, rules, and principles are necessary for the solution or how they are organized and which solution is best" (Jonassen, 1997).

Ill-structured problems are not overtly circumscribed and they are typically situated and emerge from a specific context that is encountered in everyday practice (Jonassen, 1997, 1999). In situated problems, the problem situations are not well specified, the problems are not clearly described or well defined, and the information needed to solve them is not contained in the problem statement (Chi & Glaser, 1985). Also, ill-structured problems are unstable and different solutions may be appropriate depending on the constraints placed on to the problem-solver (Petragia, 1998).

H. Instructional theories on teaching problem - solving skills.

Several researchers suggest that constructivist and situated cognition theories of learning are effective approaches to solving ill-structured problems. Jonassen (1997) claims that problem solving has moved slowly away from information-processing theory as its conceptual base for the past two decades, stating that traditional methods of problem-solving did not transfer to solving the problems situated in the real context. Also, Voss (1987) posits that it is necessary to develop an authentic task environment to teach ill-structured problem-solving skills because they are more context-dependent than well-structured problems. Ownership of the problem on the part of the learner is also

important to learning problem-solving skills,because learners are lessmotivated to solve the problem without a sense of ownership (Jonassen, 1999).

Several instructional-design models have been suggested for designing learning environments that foster the acquisition of problem-solving skills. Jonassen (1997) suggests an instructional design model for solving ill-structured problems situated in the real world based on constructivist and situated cognition approaches to learning. In his design model, the learners frame the design problem, recognize the divergent perspectives, collect evidence to support or reject the alternative proposals and ultimately synthesize their own understanding of the situation rather than find a solution for a prescribed problem, wherein learners must monitor the performance of the chosen solution and adapt it through an iterative process.

The instructional model that is centered on authentic contexts can be an effective guideline in providing the learner with a meaningful and authentic learning environment for problem solving. In order to provide authentic learning environments, it is important to design learning environments which support; (1) the construction of knowledge based on internal and social negotiation, articulation and reflection, (2) a meaningful and authentic context for learning and using the constructed knowledge, and (3) collaboration among learners and with the teacher, whose role is to coach or mentor the learners' construction of knowledge (Jonassen, 1994a).

The constructivist approach to designing instruction focuses more on designing learning environments that foster the construction of knowledge on the part of the learner rather than controlling its process by sequencing the information presented to the learner. Jonassen (1994b)suggests an instructional design model from the constructivist perspective. In this model, he suggests a learning environment that supports the construction of knowledge, meaningful and authentic contexts, and collaboration with the instructor and among the learner. In such a learning environment, the instructor plays the role of coach or mentor. Similarly, Savery and Duffy (1995) suggest the following theoretical principles for problem-based learning:

1. Learning should be relevant
2. Instructional goals should be consistent with the learner's goals
3. Cognitive demands and tasks in the learning environment should be consistent with cognitive demands and tasks for which the learner is being prepared
4. The teacher's role is to challenge students' thinking
5. Students' ideas should be tested against alternative views through social negotiation and collaborative learning groups
6. Reflection on the learning process should be encouraged (p.137).

Constructivists also emphasize learning through context-rich, experience-based activities for the learners' construction of knowledge (Duffy & Jonassen, 1992). There are several instructional approaches that are based on constructivist principles. Problem-based learning (PBL) is "a curriculum development and instructional system that

simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems" (Malopinsky, Kirkley, Stein, & Duffy, 2000).

Providing learners with authentic tasks is important for their active construction of knowledge (Duffy & Jonassen, 1992). To make learning authentic, learners need to be presented with thick problems, which are rich in information, similar to what we can encounter in everyday problems. Two examples of learning approaches in which thick problems are presented are anchored instruction and goal-based scenarios. Anchored instruction is a teaching technique in which a learner is provided with authentic problem-solving environments using multimedia technology (Cognition and Technology Group at Vanderbilt, 1990). A goal-based scenario is a learning-by-doing simulation in which students pursue a goal by practicing and using relevant knowledge and skills to achieve their goal (Campbell & Monson, 1994).

The review of previous studies on theories of teaching problem-solving skills indicate that there is a lack of theories or models for designing personalized learning environments, in particular in online learning environments. These models are not explicitly intended for personalized learning, nor do they provide guidance on how to apply them in online learning environments. Therefore, an instructional-design theory to provide guidance on how to design personalized instruction is warranted to address the needs for personalized online learning environments for adult learners for their acquisition of problem-solving skills in ill-structured domains.

Ⅲ. The Instructional-Design Theory

In this section, the instructional-design theory for facilitating adults to learn higher-order thinking skills in personalized online learning settings is introduced. The theory is developed through the instructional-design theory development process mentioned in the earlier section.

A. Goals / Purpose

The primary purpose of this theory is to identify the conditions and methods that are necessary to foster adults' personalized learning in online settings and how it can be best facilitated. This instructional theory is centered on fostering higher-order thinking skills: in particular, ill-structured problems are of major focus of this theory.

Rather than presenting only one approach to learning the skills, like in most instructional-design models, the goal of this instructional-design theory is to provide explicit guidelines on how to design learning environments in which learners can choose their own learning goals and the instructional approach that they prefer to reach their goals.

B. Preconditions

The following are preconditions that need to be taken into account in considering whether this instructional-design theory is well suited for given instructional situations. It is less likely that the given instruction will reach intended instructional outcomes in instructional situations that do not meet following conditions:

- Its methods are for individualized instruction especially in online learning environments - not intended for group instruction in a traditional classroom setting.
- This theory is targeted for teaching the cognitive domain, in particular problem-solving skills for ill-structured problems. Therefore, this instructional - design theory is not intended for fostering low-level learning (e.g., rote recall, simple concept acquisition, or acquisition of simple procedural knowledge) in the cognitive domain nor for other kinds of learning domains (i.e., psychomotor or affective domains).
- An animated pedagogical agent (Johnson, Rickel, & Lester, 2000; Moreno, Mayer, & Lester, 2000; Moreno, Mayer, Spires, & Lester, 2001)is available to guide learners through their learning activities.
- A learning management system (LMS) is available to help learners to manage their learning process.
- Learning objects are available for the learner's personalized and just-in-time access to learning resources and acquisition of prerequisite knowledge or skills.

C. Underlying Values

Some of the values upon which this theory is based include:

- Learners should be able to learn at their own pace, at any time and at any place.
- Learners should be active and self-directing in pursuing their learning goals.
- Learners are motivated to learn when they experience in their life situation "a need to know or be able to do in order to perform more effectively and satisfyingly" (Knowles, 1996).
- Learners should be taught in a way that they could link new knowledge to their prior knowledge / experiences.
- The learners should be taught in a way that they could transfer knowledge into their real-life situations.
- Learners need to explore cross-disciplinary subjects in order to acquire knowledge and skills for solving real-world problems.
- Learners have the option of choosing their own method of instruction "students as designer" (Banathy, 1991; Reigeluth & Nelson, 1997).
- Instructors need to act as mentors or guides to the learners by helping them become self-directed learners.

D. Methods

In this section, the ways of supporting and facilitating personalized learning for adult learners in online environments are discussed. The methods are broken into four components, which are detailed below.

1) Goal-setting activities.

In this first step of the instruction, the learner chooses a set of subjects that matches his/her learning needs. To help the learner do so, the learner's prior knowledge and experience level will be measured, providing prerequisite instructions and gauging the appropriate level of authenticity of the learning activities for the individual learner. Also, the learner will set his/her own expectations and goals of his/her learning, which will result in individualized learning objectives and methods to produce learning outcomes that meet individual needs. More detailed procedures of the goal-setting activities are as follows.

(A) The learner chooses the subject areas of his/her interest and needs.

- The animated pedagogical agent (henceforth, agent) provides the learner with a list of learning domains. The learner can choose learning domains that match his/her problem areas (e.g. economy, management, marketing, etc.).
- Since real-world problems often contain learning domains from multiple disciplines, more than one learning domain can be selected.

(B) Measure the learner's prior knowledge and experience level.

- The purpose of measuring the learner's prior knowledge is to determine the level of complexity in the task that s/he will be engaged in and to provide supplemental instruction to the learner as needed before s/he begins working on the task.
- A pretest is given to assess the learner's entry knowledge or the learner can rate his/her own knowledge/skill level.
- In addition to the learner's prior knowledge, the learner also rates his/her experience level in the subject in order to determine the level of complexity in his/her learning task that s/he will be engaged in.
- For the learner in the training setting, the peer and supervisor's feedback on their performance can be also taken into account in measuring the learner's entry level.

(C) The learner sets his/her expectations and the goals of learning with guidance from instructor.

- To set the learning goals that meet individual learning needs and also to guide the learner into self-regulated learning, the learner sets his/her own learning goal with

guidance from the instructor.

- The learner posts his/her expectations and goals of the instruction at the LMS and the instructor gives feedback on the posting regarding its clarity, plausibility, and the appropriateness of the anticipated learning outcomes.
- To give guidance on how to write goals and expectations to the learner, the instructor posts some examples of such statements on the LMS.
- The learner sets criteria that deem meaningful to him/her to evaluate his/her learning to facilitate self-regulated learning (Corno & Randi, 1999).

2) Engaging in the learning task.

In this step, the learner interacts with the agent to choose a task that s/he will be engaged in throughout the learning process in a problem-centered learning approach. Also, the learner acquires necessary prerequisite knowledge/skills and is given resources needed to perform the task in a just-in-time fashion.

(A) The learner chooses the context s/he is interested in for his/her learning task.

- The agent presents the learner a variety of contexts that the learner can choose from (e.g. business, education, technical)
- The learner selects a context that s/he wants to be engaged in based on his/her own learning need and interest.

(B) The learner selects a learning task in the context of his/her choice.

- The agent presents multiple forms of tasks that the learner can choose from (e.g. scenarios, cases, projects).
  - The tasks are provided in the context of his/her choice.
  - The tasks should be authentic ones that address real world issues.
  - The level of complexity of the task should be suited for the learner's entry level, as identified in the previous step. It should also be novel enough to represent a real-world situation.
- The learner selects a task of his/her choice from the list of tasks presented by the agent.
  - The expected duration of each task is given to help the learner's choice of the task.
  - The learner chooses the format of the task based on his/her preference.
  - The learner can control the expected duration of the learning at his/her pace.
- The learner can choose the format of the learning output (e.g., project report, presentation, action plans) by selecting a form of task, which leads to creating a product that s/he can use in his/her real life or work setting.

(C) For the concepts or skills the learner needs to acquire as the prerequisites for performing the task, relevant modules are selected from the learning objects and are presented to the

learner.

- The agent presents the prerequisites based on the results of the pretest conducted at the goal-setting phase.
- The modules are chosen from the learning objects, which are delivered via the Web.
- The learner learns the prerequisites through tutorial using a generality-examples-practice with feedback approach.
- When the learner explores the tutorial at his/her own pace and when s/he reaches the mastery level, the tutoring system guides him/her to move on to the task.
- The instructor answers any questions that the learner encounters while learning through learning objects.

(D) The learner is given additional resources on the task to be performed.

- Visualization tools (e.g., video, charts, graphs) are used to present the task (Jonassen, 1999).
- Worked examples present a model for learning (Jonassen, 1999).
- The instructor is available as a facilitator to provide further information on how to perform the task.
- The learner is provided with resources for exploring relevant information in a just-in-time fashion.
  - All the necessary resources should bereadilyaccessible via online for just-in-time access.
  - The resources need to provide rich information to support the learner coping with authentic problems.
  - A variety of formats present the information (text, graphics, animations, etc.).

3) Performing the task.

In this step, the individual learner engages in the task with assistance from the agent. The instructor also provides guidance to promote the constructivist learning environment.

(A) The learner performs the task exploring the information resources described earlier.

(B) The agent guides the learner to perform the task.

- The agent provides templates that the learner can use to perform the task.
- It also guides the learner to the module in the learning objects system when the learner has questions about a subject.

(C) Online communication with the instructor to foster the learner's cognitive development.

- The instructor can use a variety of modeling, coaching, and scaffolding techniques, as suggested by Jonassen (1999), to promote a constructivist learning environment. Those techniques are as follows:

? Modeling: model performance, articulate reasoning
? Coaching : motivational prompts which monitor and regulate the learner's performance, provoke reflection, or perturb learner's models
? Scaffolding : adjusting task difficulty, restructuring a task to supplant knowledge, providing alternative assessments (pp.231-236)

?Also, the instructor guides the learner on the process of his/her learning (e.g., what needs to be done and how s/he can do it).

?The instructor provides the list of online learning communities that the learner can participate to discuss with others on the problems/tasks s/he is engaged in.

(D) Reflection and feedback on the process and the output of learning

?While working on the task, the learner reflects on what worked and what didn't work in his/her approach to solving the problem and posts it regularly on the LMS.

?The instructor gives prompt feedback on the learner's reflections and provides appropriate coaching and scaffolding to the learner.

4) Evaluating and reflecting on learning.

Instructor's evaluation, reflective self-evaluation, and peer evaluation are conducted to evaluate the result of learning.

?The learner posts the output of his/her learning task on the LMS.

?The learner also posts his/her reflection on the learning process.

?The instructor and the learner evaluate the output and the process of learning according to preset evaluation criteria.

?The output is also posted in the learning community in which the learner has been engaged and receives feedback from the participants.

Ⅳ. Discussion

Below, the learning-focused paradigms in this instructional-design theory are discussed. Also, considerations in applying and improving this theory are discussed in what follows.

A. New Paradigms of Instruction in This Theory

Some learning-focused paradigms are adopted in this instructional-design theory. Those new paradigms are; (1) the instructor's role as a guide of learning, (2) the incorporation of technology to provide individualized learning, and (3) the use of a learning management system to foster self-regulated learning. Those learning-focused approaches are believed to provide learners with learning environments that are distinct from existing ones.

First, the learner takes initiative for the whole learning process and the instructor plays the role of guide or mentor in the methods of instruction (e.g., giving guidance to the learner to help him/her become a self-regulated learner) in this theory. Second, this theory guides the learner to set individualized learning goals and instructional methods using computer technology (e.g. animated pedagogical agent, learning objects system, and learning management system). Finally, most learning management systems in current Web-based instruction are used to control the learner - e.g., to control the learner to keep pace with the class schedule set by the instructor. In this instructional-design theory, the LMS is used as a tool to foster the learner's self-regulated learning and communication with the instructor rather than to control their learning.

B. Considerations in Applying This Instructional - Design Theory

It is important to consider the optimality of an instructional-design theory in terms of under what circumstances it can or cannot work in applying it into real instructional situations. As mentioned earlier, this instructional-design theory is developed for teaching how to solve ill-structured problems. Hence, the methods in this instructional-design theory are intended to require learners to invest their efforts in setting their own learning goals and planning their own learning processes. Therefore, applying this approach to teaching cognitive skills for solving well-defined problems, for which the learning goals and methods can be defined more easily than ill-structured problems, might cost learners too much investment of effort, which often causes them to be demotivated (Clark, 1994). Thus, it is suggested that the instructional-design theory presented here might not be an efficient approach to teaching cognitive skills in well-defined domains. A new instructional-design theory might be warranted to identify methods to teach such cognitive skills in personalized online learning environments.

In addition, particular attention needs to be paid to the instructor's role in applying this instructional-design theory in real instructional situations. The instructor needs to play the role of a guide or facilitator in a personalized learning environment in which the learner is provided with feedback and guidance on the learning process based on their personal learning needs. For this, the instructor can provide information on the learning resources and provide prompt feedback on the learner output in each step of the learning process. Most of all, guidance to the learner for him/her to become a self-directed learner is warranted. One way to achieve this goal is to help the learner to reflect on his/her learning process.

C. Need for Formative Research on This Theory

This instructional theory has not gone through any field-testing yet; thus, formative evaluation is recommended to find problems or areas for improvement in applying this

theory. An instructional-design theory can be evaluated on the basis of effectiveness, efficiency and appeal of instruction designed from that theory (Reigeluth & Frick, 1999). These three criteria may be valued differently in different situations according to the needs or wants of the stakeholders (Reigeluth & Frick, 1999). Therefore, what criteria are more important the learner needs to be considered in evaluating the plausibility of an instructional-design theory.

Also, no instructional-design theory is perfect, as the main concern for developing and testing an instructional - design theory is preferability - i.e., does this method attain the goals in a given situation better than any others? - rather than validity (Reigeluth & Frick, 1999). Therefore, instructional-design theory needs to go through formative research to make it more preferable. The underling logic or purpose of conducting formative research on an instructional-design theory is to apply the theory in a real instructional setting and identify weaknesses found in the application of the theory which may reflect ways to improve it (Reigeluth & Frick, 1999). There are several different approaches to conducting formative research on instructional - design theory and its methodological procedures are described in Reigeluth and Frick (1999).

Since the instructional-design theory presented in this paper is a new theory and has not been studied for its weaknesses, formative research is highly recommended to improve this theory so that it can better serve its purpose and attain desired outcomes.

References

Arnone, M. (2002, March 4). Online education must capitalize on students' unique approaches to learning, scholar says. *The Chronicle of Higher Education.*

Banathy, B. H. (1991). *Systems design of education: A journey to create the future.* Englewood Cliffs, NJ: Educational Technology Publications.

Bonk, C. J., & Cummings, J. A. (1998). A dozen recommendations for placing the student at the center of Web-based learning. *Educational Media International, 35(2),* 82-89.

Boud, D. J. (1992). Individualized learning systems: Individualized instruction in higher education. In M. Eraut (Ed.), *The international encyclopedia of educational technology.* New York: Pergamon Press.

Campbell, R., & Monson, D. (1994). Building a goal-based scenario learning environment. *Educational Technology, 34(9),* 9-14.

Chi, M. T. H., & Glaser, R. (1985). Problem solving ability. In R. J. Stenberg (Ed.), *Advances in the psychology of human intelligence* (pp. 7-77). Hillsdale, NJ: Lawrence Erlbaum Associates.

Clark, R. E. (1994). Assessment of distance teaching technology. In E. L. Baker & H. F. O'Neil, Jr. (Eds.), *Technology assessment in education and training* (pp. 63-78). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cognition and Technology Group at Vanderbilt. (1990). Anchored instruction and its

relationship to situated cognition. *Educational Researcher, 19(6),* 2-10.

Corno, L., & Randi, J. (1999). A design theory for classroom instruction in self-regulated learning? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 293-318). Mahwah, NJ: Lawrence Erlbaum Associates.

Digilio, A. H. (1998). Web-based instruction adjusts to the individual needs of adult learners. *Journal of Instruction Delivery Systems, 12(4),* 26-28.

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism; New implications for instructional technology. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction: A conversation* (pp. 1-16). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dunn, T. G. (1984). Learning hierarchies and cognitive psychology: An important link for instructional psychology. *Educational Psychologist, 19(2),* 75-93.

Gordon, J., & Zemke, R. (2000, May). The attack on ISD. *Training, 37,* 42-53.

Johnson, L. W., Rickel, J. W., & Lester, J. C. (2000). Animated pedagogical agents: Face-to-face interaction in interactive learning environments. *International Journal of Artificial Intelligence in Education, 11,* 47-78.

Jonassen, D. H. (1994a). Evaluating constructivistic learning. *Educational Technology, 31(9),* 28-33.

Jonassen, D. H. (1994b). Thinking technology: Toward a constructivist design model. *Educational Technology, 34(4),* 34-37.

Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research and Development, 45(1),* 65-94.

Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 215-239). Mahwah, NJ: Lawrence Erlbaum Associates.

Jonassen, D. H. (2002). Engaging and supporting problem solving in online learning. *Quarterly Review of Distance Education, 3(1),* 1-13.

Khan, B. H. (1997). Web-based instruction (WBI): What is it and why is it? In B. H. Khan (Ed.), *Web-based instruction.* Englewood Cliffs, NJ: Educational Technology Publications.

Knowles, M. S. (1984). *The adult learner: A neglected species (3rd ed.).* Houston, TX: Gulf Publishing.

Knowles, M. S. (1996). Adult learning. In R. L. Craig (Ed.), *The ASTD training and development handbook* (Vol. 4th, pp. 253-265). New York: McGraw-Hill.

Lee, C., & Zemke, R. (1995). *No time to train. Training, 32,* 29-37.

Malopinsky, L., Kirkley, J., Stein, R., & Duffy, T. M. (2000). *An instructional design model for online Problem Based Learning (PBL) environments: The Learning to Teach with Technology Studio.* Paper presented at the National Convention of the Association for Educational Communications and Technology, Denver, CO.

Martinez, M. (2000). *Successful Web learning environments: New design guidelines*(ERIC Document Reproduction Service No. ED 446 745).

Martinez, M. (2001). Mass customization: Designing for successful learning. *International Journal of Educational Technology, 2(2).*

Moreno, R., Mayer, R. E., & Lester, J. C. (2000). *Life-like pedagogical agents in constructivist multimedia environments: Cognitive consequences of their interaction.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications, Montreal, Canada.

Moreno, R., Mayer, R.E.,Spires, H. A., & Lester, J. C. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19(2),* 177-213.

Muir, D. J. (2001). *Adapting online education to different learning styles.* Paper presented at the National Educational Computing Conference, Chicago, IL.

Petragia, J. (1998). The real world on a short leash: The (mis)application of constructivism to the design of educational technology. *Educational Technology Research and Development, 46(3),* 53-66.

Reigeluth, C. M. (1983). Instructional design: What is it and why is it? In *Instructional-design theories and models: An overview of their current status* (pp. 3-36). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M. (1997). Instructional theory, practitioner needs, and new directions: Some reflections. *Educational Technology, 37(1),* 42-47.

Reigeluth, C. M. (1999). What is instructional-design theory and how is it changing? In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 5-29). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M., & Frick, T. W. (1999). Formative research: A methodology for creating and improving design theories. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 633-651). Mahwah, NJ: Lawrence Erlbaum Associates.

Reigeluth, C. M., & Nelson, L. M. (1997). A new paradigm of ISD? *Educational Media and Technology Yearbook, 22,* 24-35.

Reiser, R. A. (1987). Instructional technology: A history. In R. M. Gagn (Ed.), *Instructional technology: Foundations* (pp. pp.11-48). Hillsdale, NJ: Lawrence Erlbaum Associates.

Savery, J. R., & Duff, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. In B. G. Wilson (Ed.), *Constructivist learning environment: Case studies in instructional design* (pp. 135-150). Englewood Cliffs, NJ: Educational Technology Publications.

Voss, J. F. (1987). Learning and transfer in subject-matter learning: A problem solving model. *International Journal of Educational Research, 11(6),* 607-622.

Yong, Y. (1998).Learners' perceptions on learning through the Web. *Journal of Instruction Delivery Systems, 12(1),* 23-26.