HOW CAN WEB-BASED LEARNING SYSTEM ENHANCE ADULTS LEARNING IN PRODUCT DESIGN

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ABSTRACT

Optimal learning in product design occurs in the simulation of real world and problem-based learning (PBL) activities. This is the core of teaching and learning in most of engineering disciplines. These learning activities happen in a safe environment where errors are expected, and failure will deepen learning experience. The internet is proving to be an effective way of delivering teaching and learning in engineering discipline.

The advent of information and communication technologies (ICT) in teaching and learning process has created a global revolutionary of adult education and training. As society shifts from industrial to an information age, adults are becoming majority that involve in utilizing e-learning for education, professional and personal purposes.

The teaching and learning environments in current higher learning institutions are undergoing major changes from teacher-centered, memory-based learning to a learner-centered, problem-based and self-directed learning (SDL) that can enhance learners' critical thinking, creativity and outstanding performance. This is the major challenge and the responsibility of adult educators to think and to substitute homogenized and linear flows of e-learning to fluid and multi-dimensional pedagogies that will promote and accelerate meaningful learning process.

The purport of this paper is to discuss how web-based learning system can enhance learning in product design among adult learners in higher learning institution. This paper will also provide general understanding on several learning theories namely andragogy, SDL and PBL which can help educators to develop an effective web-based learning system for their adult learners.

INTRODUCTION

During the last twenty years, there have been a number of crucial global trends that have significant impact on adult education provision. The advent of ICT in teaching and learning processes has created a global revolutionary of adult education and training. As society shifts from industrial to an information age, adults are becoming more involved in utilizing the ICT especially e-learning for education, professional and personal purposes. Eastmond (1998) emphasizes that rapidly changing economic, technological, societal and work environments demand continuous learning and adults are the new majority pursuing education for personal development and personal enhancement. Nowadays, there is not surprise to see a large number of adults pursuing learning in higher education setting.

The current teaching and learning environments are undergoing major changes. Knowles (1998) has foreseen technology as one of the major forces that shape adult learning in the twenty-first century. E-learning not only introduced us to new technology for teaching but actually introduced us to a new way of thinking about teaching and learning. There is a shift from teacher-centered and memory-based learning to learner-centered, problem-based and SDL. These current educational practices have significant contribution towards learners' critical thinking, creativity and outstanding performance.

Garrison and Anderson (2003) discover that learners in higher education are not accepting the learning experience that can assist them to develop the critical and self-directed skills required for

life long learning. The learning outcomes are basically substandard with regard to the demand of the twenty first century. Basically, lecturing is only about delivering information and not inspiring critical thinking, acquiring self-directed skills or even understanding ideas. Learners normally have no problem in accessing to information because higher education institution offers greater access to unfathomable amounts of information. However, the power and capacity of web-based learning system is not based upon how many information can be accessed. What is required and offers by web-based learning is fundamentally better ways to process, make sense and recreate the information.

ADULT LEARNERS: CHARACTERISTICS, ASSUMPTIONS AND THEORIES

Different from other groups of learner, adults are unique where they posses more life and working experience. Driscoll (1998) has identified that adults are more motivated to learn as response to their life and working changes. Knowles (1998), the father of andragogy, has introduced the term andragogy into American educational literature in 1968. He has defined andragogy as "the art and science of helping adults learn". According Knowles, Holton and Swansons (2005; p. 236), *andragogy is not a panacea, but it is a system of idea that can improve the quality of learning.*The andragogical model suggested by Knowles (1998) is based on several assumptions as follows:

(i) *Real-life experience.* Adults possess a myriad real-life experience which can be very useful resources for learning. Instructors should create interactions in which learners can share their experience with peers.

(ii) *Problem-centered learning.* Adults are very motivated to learn as a response to problems in their lives. Instructors should organize the contents of learning programs by problem area rather than by broad subject. Menus, examples and exercises can be used to emphasize methods learners can learn new skills and knowledge to solve real-life problems.

(iii) *Continuous learners.* Adults are continuously learning to solve problems and negotiate changes in their lives. Web-based learning is one of the best ways to provide learning at the time is needed.

(iv) *Adults prefer problem-centered or performance-centered learning.* Adults prefer to learn in a various way where there is no one "the best" method of learning. Some adults might tend to read, some enjoy animation, and others might prefer to participate in online discussions. Instructors should utilize the various tools and multimedia options available in web-based learning to accommodate these various learning style.

(v) *Responsibilities beyond learning environment.* Adults have responsibilities beyond the limits of the web-based learning program that may directly affect their learning. Obstacles to learning such as personal commitment, community responsibilities and changes in the working environment might exist. Instructors must be aware of the personal and professional context in which learning will be delivered.

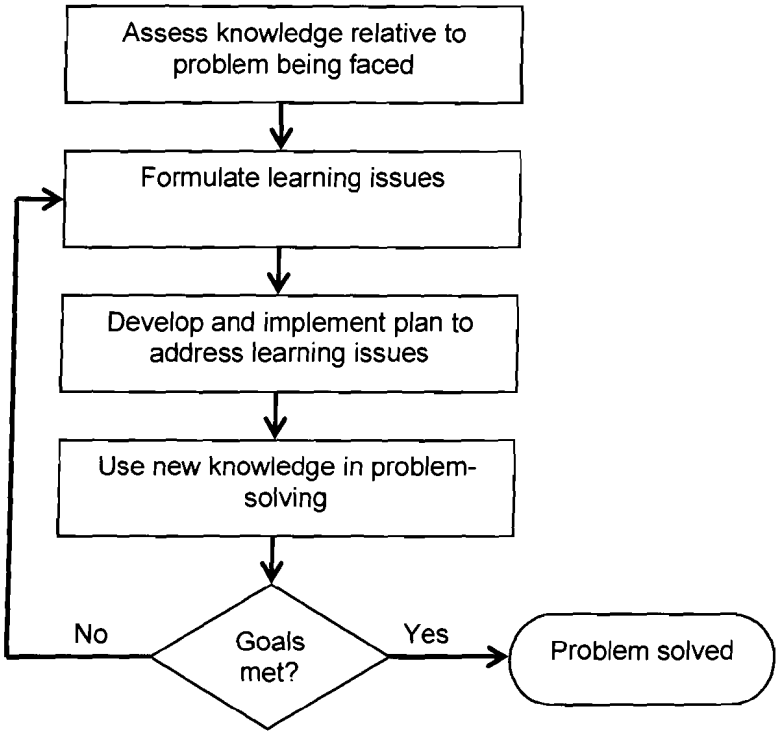
(vi) *Meaningful learning.* Adults expect tasks and examples based on real-life problems, actual events and applications to which they can relate. Instructors should create communications that are meaningful, and facilitate the program with multimedia component that add new perspectives to their lives. Web-based learning program can include link to external experts, real databases and live application that make learning more meaningful and relevant.

The aspects of andragogy that have received so much attention are SDL and PBL (Knowles, Holton and Swanson, 2005; Garrison and Archer, 2000). Knowles, Holton and Swanson (2000) emphasize that adults prefer a problem based-solving orientation to learning where they can learn the most when new information is presented in real-life context. Because of discovery nature of learning in PBL, learners acquired skills needed for SDL as they manage their learning goals while solving the problems (Barrow in Hmelo and Lin, 2000). Hmelo and Lin (2000) identify features of PBL that encourage the development of SDL skills as follows:

(i) the learner-centered nature of PBL
(ii) having learners attempt to identify and solve a problem with their existing knowledge
(iii) recognizing knowledge deficits and generating suitable learning issues

(iv) the independent research effort
(v) evaluating the resource used for research
(vi) applying the new knowledge to the problem
(vii) collaborative reflection on SDL

Hmelo and Lin (2000) point that all these features has an significant function in supporting the development of SDL skills and they summarize those SDL activities that occur during the process of problem solving in Figure 1.



(Hmelo and Lin, 2001)

***Figure 1**: A Self-directed learning model*

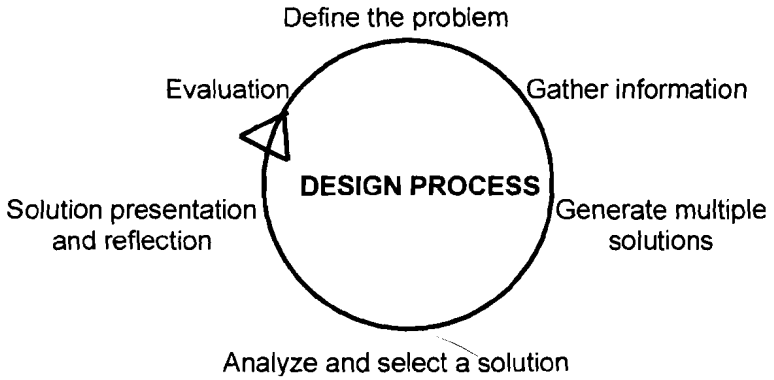
PRODUCT DESIGN

Product design is the processes of creation and invention for real human needs (Hill, 1998). Basically, it involves the processes of converting an idea into a form; of changing existing conditions into preferred ones; of putting onto paper the specific features of real product, process or system (Johnston, Gostelow and Jones, 1999). They also accentuate that process of design includes all the creative, analytical and documentation activity that needs to be fulfilled in order to define product, process or system, so that human need can be met and problems can be solved. In a product design, learners are provided with the opportunity to utilize a variety of materials and processes to solve real-life problems; to develop technological skills and concepts and the ability to use tool (including computers); to acquire an understanding of various technological systems and processes; to evaluate the impact of technology on community and the environment; and to develop the confidence in solving real-life problems (Hill, 1998).

Problem solving is the foundation of all design activities (Howell, 2002). Fundamentally, design involves creative and disciplined problem-solving process. It is important to incorporate problem solving and design processes as part of the product design curriculum. Hill (1998) emphasizes that when learners are allowed to move through problem solving using design as exploration, creativity is nurtured and this will help to enrich learners learning. Creativity is important in product design because it can improve the quality of solutions to life's problems.

Designs problems are seen as open-ended in nature, vaguely defined and usually have many correct solutions. Figure 2 depicts the continuous iterative process of solving the design problems. The process has been modified from original five steps of design process introduced by Howell (2002). The six steps adapted for solving design problems are as follows:

(i) Define the problem
(ii) Gather appropriate information
(iii) Generate multiple solutions
(iv) Analyze and select the best solution
(v) Solution presentation and reflection
(vi) Evaluation



(Howell, 2002)

***Figure 2**: Design product process model*

Howell (2002) discovers that solving design problems is an iterative process. Learners will find themselves continually refining the design. They might discover that the solution they have developed is inappropriate, unsafe, will not function, does not fulfill the user's demands or too expensive. The learners will go back to the earlier stage of the problem solving process and modify the solution until it satisfies the user's demand.

Because the design problems presented are ill-defined and vague, problem solving task in product design require learners to collaborate in groups. In a group, they pool their expertise and experience, and collaboratively manage the complexities of the issues that must be considered (Hmelo and Lin, 2000). When the learners work through the problems, Hmelo and Lin (2000) have identified that they have opportunities to recognize gaps in their knowledge and they will set their learning goals and conduct research to overcome these gaps. The functions of instructors are as facilitators that guide learners' reflection, assisting learning of the cognition and social skills that are needed to solve design problems and for SDL.

In the solving of product design problems, the learners need various supports that also known as scaffolding to help them cope with the complexity of the problems. Scaffolding is a form of assistance given to learners by instructors or more capable peers that allows them to perform tasks they are not able to complete independently (McLoughlin and Marshall, 2000). Social cultural theorists recommend that learning involves social interaction and dialogue, negotiation and collaboration and that assisted or 'scaffolded' learning can increase learners' cognitive growth and understanding.

WHY UTILIZE WEB-BASED LEARNING?

Web-based learning by no means represents the most appropriate environment for all types of educational programs. Organization must consider important aspects such as learner background, technology facilities and financial availability before decided to replace traditional classroom-based learning environment to web-based learning. However, employing the World

Wide Web as a medium to deliver teaching and learning transaction has advantages. Jolliffe, Ritter and Stevens (2001) suggest the advantages of utilizing web-based learning as follows:

(i) *Increased client based.* The potential statistics of users will be increased by placing the learning materials on to the web.

(ii) *Increased learner accessibility.* The learner can access the learning materials at any time as soon as they are places on the server.

(iii) *Ease of updating the learning materials.* Learning materials can be easily updated and learners can access the updated materials immediately.

(iv) *Platform independence.* Using the web as delivery platform with a suitable format of the learning events enables the learning materials to be independent of any application software and computer type. Anyhow, learner's computer has to be ensured to have a browser capable of displaying the materials as they were intended to be displayed.

(v) *Increased learner effectiveness.* In traditional classroom-based learning environment, learners are always considered homogeneous and the learning materials are presumably suitable for all. However, with a web-based learning, the diversity of the learners in terms of knowledge, experience, skill and ability can be considered by offering different strategies, remediation and opportunity for the learner to proceed at their own pace.

(vi) *Administrative support.* Variety features such as electronic bulletin boards and discussion facilities enables the learners to keep up with changing learning materials and events. Administrative information such as examination results, timetables, grades and announcements can be easily distributed and accessed by the learners.

(vii) *Resource and reference.* All types of materials can be placed on the web and made accessible. Learners can equally access the information which is developed searchable using the indexing programs and utilities.

(viii) *Changing nature of knowledge.* Knowledge is increasing rapidly and doubling approximately every three years. Research has shown that 50 per cent of what has been learnt in school today will be obsolete in five years. Obviously, there is a need for lifelong learning, and web-based learning has been seen as one of the best solution and cost-effective way of providing such learning.

Knowles, Holton and Swanson (2005) point that technology-based learning environment presents new opportunities for providing adults with rich learning experiences in the andragogical perspective. They discover that technology-based learning caters to adult's need to become self-directed in their learning. It can provide adult learners with the perfect SDL experience. Technology-based learning also enables adults to adapt the learning experience to fit their prior experiences. It permits learners to select alternative path in the learning process based on their prior learning and experience. Well-developed technology-based learning can simply allow learners to adapt the learning to their real-world problems. They can immediately apply the learning to their problem setting as it is usually employed in the learner's real-life setting.

ePRODUCTDESIGN: A CONCEPTUAL FRAMEWORK OF PRODUCT DESIGN WEB-BASED LEARNING SYSTEM FOR ADULTS

In this research, the product design web-based learning system for adult learners is called eProductDesign. The instructional strategy for eProductDesign is based on rapid prototyping model by Tripp and Bichelmeyer (1990). This model provides an appropriate framework to ascertain that instructional product is effective and attractive in order to achieve learning objectives (Tripp and Bichelmeyer, 1990). Basically, rapid prototyping involves five primary stages namely (1) analyze needs and content, (2) set objective, (3) design of learning, (4) development of prototype, and (5) implementation of the eProductDesign. Figure 3 shows a conceptual framework of eProductDesign.

Analyze needs and content

Primary principles underlying teaching and learning strategy of eProductDesign are andragogy and self-directed learning (Knowles, Holton and Swanson, 2005; Knowles, 1990; Merriam, 2001a; 2001b; Merriam et al., 2001c; Mifflin, 2004). Knowles (1998) emphasizes that principle of adult learners underlying andragogical concepts are (1) adults need to know why they need to learn

something before undertaking to learn it; (2) adults self-concept of being autonomous and self-directed; (3) adults have a greater volume and a different quality of experience which are the richest sources for learning; (4) adults become ready to learn something that enable them to cope effectively with their real life situations; (5) adults are life-centred or problem-centred in their orientation to learning; (6) internal factors are the principle motivation of adult learning.

Set objectives

The primary of objectives of the study is to produce a product design web-based learning systems that can assist adult learners learning product design effectively. In addition, the learning system is developed to help adults to improve their problem solving and self-directed learning skills.

Design of learning

This study employs the combination of SDL model by Hmelo and Lin (2000) and design process model by Howell (2002) to produce an appropriate teaching and learning strategy for adults to learn product design effectively in the web-based learning environment. PBL in the constructivist learning environment (Simoff and Maher, 2002) will be the foundation of the design activities (Howell, 2002; Eggleston, 1996; 1994). The constructivist learning environment supports the active and constructive learning process, supports social interaction in learning and supports real-live problem solving (Jonassen, 1994; Leflore, 2002).While solving the problems, learners will actively construct an internal representation of knowledge by interacting with the material to be learned and by communicating with teacher and peers.

In solving the invention problems, the adult learner requires a lot of support to solve the complex problems (Brockett and Hiemstra, 1991). This approach is known as scaffolding. Lerners will receive support from instructors and more competent peers to help them to solve the problems (Vygotsky, 1978; Eggen and Kauchak, 1997; Salvin, 1997; Savery and Duffy, 1995; Driscoll, 1993). Crowl, Kaminsky and Podell (1997) also stated that the scaffolding can help learners to enhance their problem solving skills.

Learners have to go through a few stages in order to come out with the best solution or idea of product design. Learners have to first define the design problems and assess any knowledge that relative to problems in hands. Learners will gather information and have the opportunities to conduct independent research. The next stage demands learners to generate new ideas that may solve the problems before they can select the best solution. If the selected solution does not appropriate to the learning outcomes, they can return to the previous stages. The group collaborative discussion can support the reflection process. The next stage will be the problem solution presentation and reflection. At this stage, learners will present their final product and questions will be asked by their instructors and peers. Finally, the evaluation will be done by the instructor. The evaluation will be based on design and product evaluation scheme. The evalution is based on ideas book, working drawing, proposal documentation and 3D model.

Development of prototype

The prototype is built using the principles of effective web-based learning for adults (Driscoll, 1998) namely, interactive, nonlinear, easy-to-use graphic user interface, structured lessons, effective use of multimedia, attention to educational details, attention to technical details and learner control.

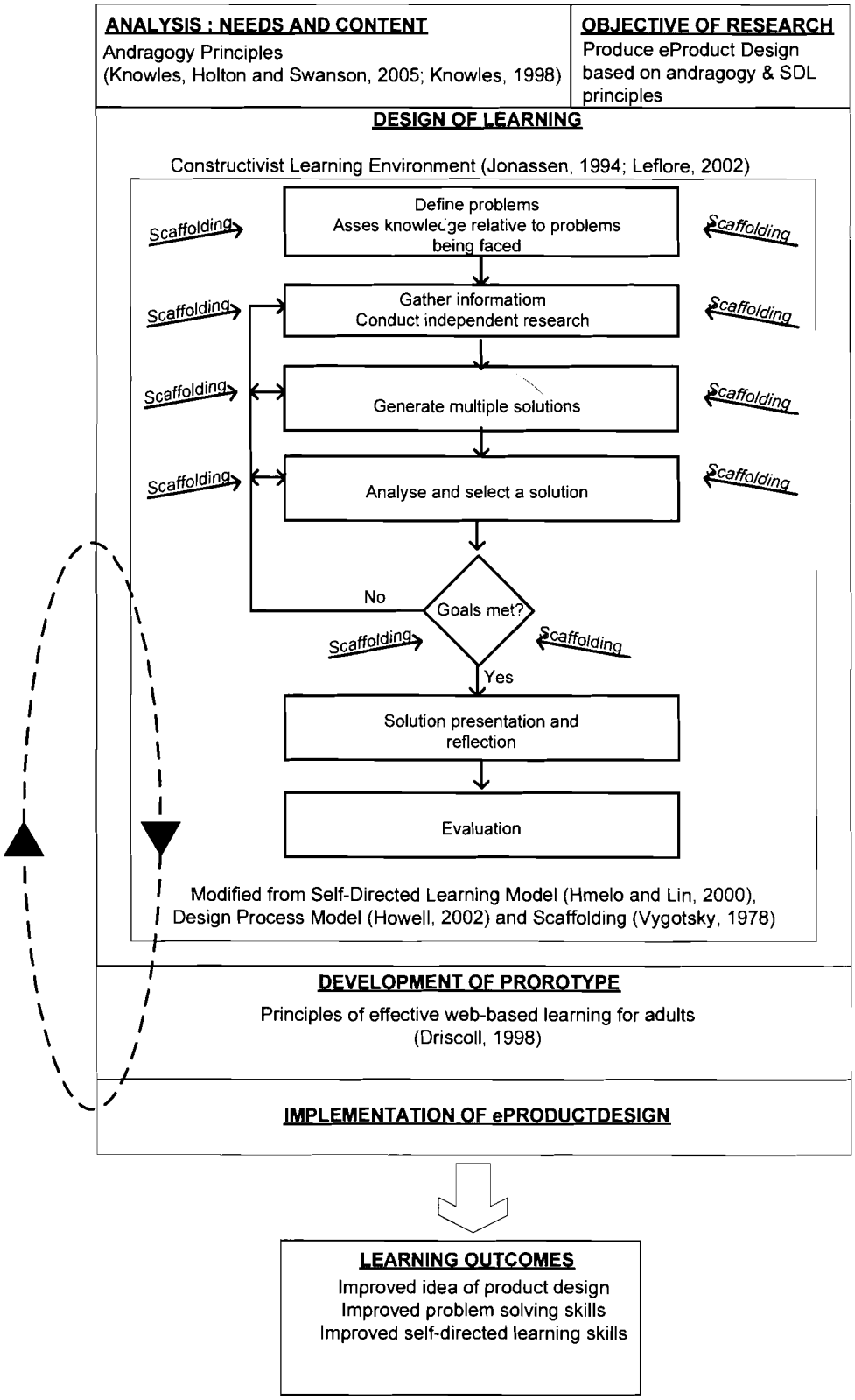


***Figure 3**: A Conceptual framework of eProductDesign*

Implementation of eProductDesign

eProductDesign will be finally implemented into the teaching and learning process. The process will be monitored through out the semester. Data is gathered through the pre and post test, observations, interviews and learners' final learning products. The effects of eProductDesign will be evaluated in the contexts of learners' final ideas of product design, problem solving and SDL skills.

Paterson (1999) has discovered that the World Wide Web provides an excellent framework for learning, communication, information exchange, and collaboration in engineering education including design education. Even though social aspects can be integrated in web-based learning platform, face-to-face contacts with instructors or even with other learners are still essential to ensure the maximum learning support to the learners. In product design, the final presentation and evaluation of the final outcomes will be held face-to-face in the classroom environment. Instructor can place the evaluation comments on the website for learners to get immediate feedback of their final products. In product design, creative process, collaboration and discussions with instructors and peers are important for the development of the ability to perform well in the learning process. To adult learners, these demand self-confidence and an environment that allows free, safe and unrestricted development of innovative ideas. Thus, web-based learning platform is essential to provide such processes as well as the development of the ability to perform creatively in product design course.

CONCLUSION

There are numerous studies comparing traditional classroom-based instruction with technology supported instruction. According to John and Aragon (2003), there are no significant differences in critical educational variables such as learning outcomes and learner satisfaction. They emphasize that the primary factor that determine the effectiveness of any kind of instructional initiative is the quality of the instructional design that is implemented. They also hypothesize that quality of learning environment should be based on instructional principles that are derived from the appropriate learning theories. Through an analysis of existing literature and experience-based practices, a set of instructional principles for product design web-based learning have been identified. As the learning system meant for adult learners, andragogy, SDL, PBL and constructivist learning environment principles have been applied in the online learning environment. Using these instructional principles as a framework, a web-based learning environment will be appeared to have the power to significantly amend adult education landscape especially in learning product design.

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