The validation of knowledge construction model based on constructivist approach to support ILL-structured problems solving process for industrial education and technology students

Sakesun Yampinij\textsuperscript{a} * Sumalee Chaijaroen\textsuperscript{b}

\textsuperscript{a}Ph.D Program Student in Educational Technology, Faculty of Education, Khon Kaen University, Thailand
\textsuperscript{b}Associate Professor, Department of Educational Technology, Faculty of Education, Khon Kaen University, 40002, Thailand

Abstract

This research aimed to study the internal validation and the external validation of the knowledge construction model based on constructivist approach to support process in solving ill-structured problems. The samples were 42 fourth-year undergraduate students from the Department of Educational Communications and Technology, King Mongkut’s University of Technology Thonburi. There were 3 experts to verify the quality of internal validation of the model. The research design was based on Type II developmental research. The result from the internal validation of the model showed that the design of components inside the model was in accordance with the principles and theories adopted in the design. The study of the external validation of the model showed that the learners followed steps of the process in solving ill-structured problems in accordance with Jonassen’s principle (1997) in solving ill-structured problems. The learning achievement of students passed the criteria of 80 percent. The students’ opinion showed that the learning contents, the media on the network and the design were suitable for supporting knowledge construction and process in solving ill-structured problems.

Keywords: Knowledge construction model, constructivist approach, ill-structured problem, Technology students

1. Introduction

The knowledge and technology development affects the progress of the global for the effectiveness of educational management. The paradigm shift on educational system that changes the instructional techniques with student centered approach, cognitive development process can support the students in knowledge construction. The learning environment management and changing the students’ role in learning help the students to construct their knowledge by encountering the problem in real situation and transfer the experience for the new knowledge in the real context. (Brent G. Wilson, 1999) (Sumalee Chaijaroen, 2003) (Jonassen, 1997) (Scott Grabinger, 1998)

The process of instruction management as mentioned is same as the King Mongkut’s University of Technology Thonburi’s policy in student –centered approach for the students to apply theoretical knowledge in developing knowledge for career with real context. The mission of the faculty of industrial education and technology aimed to produce industrial teachers and industrial trainers. So the graduates should be fostered in constructing knowledge and lifelong learning. In addition, the development of industrial trainers to fulfill the knowledge and skills in industrial work is the one of very important mission. Many of problems in the industry are caused by lacking of...
knowledge and skills. The ill-structured problems of new trainers make them incapable to analyze the problem and solve that problem effectively.

The first research phase of a development of knowledge construction model enhancing the students’ complex structured problem solving skills. The research and development using instructional design (ID) theory followed the four steps of 1) to study the principle and theories 2) to study the contextual instruction 3) to synthesize the theoretical framework 4) to synthesize the instructional model designing framework. The results of first research phase has got 9 basic theories for instructional model as follows: constructivist learning theory that concern the structured problem solving process using Jonassen theory (1977) of Sumalee Chaijaroen (2003), using media attribution and media symbol system in form of hypermedia (texts, pictures, animations, and hypertexts) that help the information structure arrangement. The convenient of accessing the data that unlimited will help the students to gain the effective learning.

However the first research phase has no recommendation in the validity of the instructional model that identify the effective of model implementation. This second research phase aims to confirm the quality of the instructional model in terms of 1) internal validity by evaluating and adjusting the instructional model involves instruction design, content and network media and 2) external validity by studying the effect of instruction toward the students involves (1)enhancing the students’ ill-structured problem solving process toward Jonassen theory (1977) and (2) the students’ opinion on the instructional model and (3) the students’ learning achievement toward the instructional model. The results of this research would confirm the quality of the instructional model that can encourage the students’ knowledge construction and ill-structured problem solving process, and apply the knowledge in the future career.

2. Research Objectives

1. To study the internal validity of instructional model in terms of instructional design, content design and network media design
2. To study the external validity of instructional model in terms of the effect of instructional model to structured problem solving process, opinion and learning achievement.

3. Target Group

1. Experts were 9 experts for internal validation assessment to check the components of instructional model, included 3 contents experts, 3 instructional designers and 3 instructional media experts.
2. Students were 42 undergraduate students of Educational Technology and Communication Division, Faculty of Industrial Education, King Mongkut’s University of Technology, Thonburi who were studying in a course of Industrial Training Technology (EDT 431), the second semester, 2009 academic year.
3. The people concerned with the research such an instructional model designer, a learning environment designer, and the instructor of Industrial Training Technology (EDT 431) course.

4. Research Instruments

1. The instruments for internal validation were 1) assessment form of instructional model design 2) assessment form of content and 3) assessment form of media on network
2. The instruments for external validation were 1) interviewing form of ill-structured problem solving process for the students 2) questionnaire of students’ opinion in learning environment and 3) learning achievement test
3. The instrument for studying the characteristics of the people concerned with the research included 1) survey form of the instructional model designer’s characteristics 2) survey form of instructional model designer 3) survey form of instructors’ characteristics and 4) interviewing form of instructional model designer on the process of designing and development.

5. Data Collection

The steps of collecting data were as follows
1. The data for internal validation included instructional model design, content design and media on network design. The researcher presented the theoretical framework and instructional model design to the experts and collected data the experts assessed.

2. The data for external validation included ill-structured problem solving process, students’ opinion and learning achievement from using the instructional model. The steps of collecting data were as follows 1) introduce the students to study with learning environment via LMS 2) group the students of triads 3) the students study with learning environment designed for 3 times, 4 hours each. The description of studying were to study the problem situation, cooperative learning using the components of the instructional model included center for best practice of problem solving process, instrument and technology support unit, center for transferring the problem solving process, infromation center for knowledge construction, knowledge sharing unit, center for counselling and tranferring knowledge from the experts, and center for problem solving strategy. After studying, the students submitted the group’s answers via the discussion board. The experts checked the students’ answers, giving advices and introducing the problem solving strategy. The instructor and students discussed and summarized the knowledge constructed. The instructor checked the misunderstanding of the students and advised. Finally, the researcher studied the ill-structured problem solving process by interviewing the students, tested for learning achievement, surveyed the students’ opinion and summarized the implementation of instructional model.

3. The data of the people concerned with the research; instructional model designer/developer and instructor, were collected by using the survey form of characteristics and in-depth interviewing form.

6. Research findings

1. Internal validity of the instructional model included the design of ID (instructional design) model using theories, content design and media on network design. The results showed the quality of ID model (internal validity) as follows:

   1.1 The learning environment on network was identified that 9 components of the instructional design model were harmoniously related to basic theories used.
   1.2 The contents on the network was evaluated that were accurate and adequate for applying in daily life. The contents delivering was modern, concise, and easy to understand.
   1.3 The media on network had links to access the information in various kinds of contents. The learners can step by step learn and understand.

2. External validity of the instructional model included the ill-structured problem solving process, the students’ opinion and the students’ learning achievement. The results showed the external validity as follows:

   2.1 The ill-structured problem solving process of the students had 7 steps and harmonize to the Jonassen’s principle of problem solving (1977):
   2.1.1 The students could create problem space and mentioned the context limitation by comparing the goals with real situation. They knew the obstacles to reach the goals such the empirical evidence as “The students could not finish their work on time because of the limitation on their own capable, the cooperation, the damaged machine and damped wood.
   2.1.2 The students could identify the problem from the stakeholder in empirical evidence as “The unclear problem was the products could not be produced on time... the different view was that the marketing department mentioned the problem caused by the production department.... but the production department mentioned that the fault was the marketing department about the over-order that caused the delay of production.”
   2.1.3 The students could analyze the problem and find the possible way to solve the problem as empirical evidence “The delay of production was caused by 4 main reasons; the officer, the cooperation, the machine and the wood used in production” and created the possible way to solve the problem as in empirical evidence “The cause of damp an substandard of wood used in production were caused by the lack of knowledge in stacking the wood and knowledge of checking the wood. So there were two ways to solve the problem; the training course of stacking wood should be held and made the standard for wood stacking” and assess the alternative that could decrease the problem as empirical evidence “These two ways could solve the main problem because the right way to stack the wood could decrease the damaged wood from dampness and did not waste time to solve the problem of wood and the delay”.
   2.1.4 The students could prove the alternative by the evidence and identify the personal
belief as empirical evidence “From the expert’s advice, the wood stacking by using a small piece of wood between each piece of wood to let the air circulation or using the wood stain substance to coat the wood surface or stack on by one piece of wood and coated to protect the water. The training of wood stacking and create the standard of wood stacking would help and decrease the problem about wood”.

2.1.5 The students could check the relation between alternative and cause of problem to reach the goal of problem solving as empirical evidence “The training of wood stacking and making standard of wood stacking could decrease the problem of damped, bent wood and did not waste time to solve the problem of wood. The problem of delay would be decreased”.

2.1.6 The students could follow up the problem solving steps and adjust the way to solve that problem as empirical evidence “The additional finding in the chart concluded that the main problem was the lack of knowledge about wood stacking. The lack of working skill could lead to the training course”.

2.1.7 The students could adjust the way to solve the problem by checking the cause of the problem and adjust how to solve as the empirical evidence “There was the way to solve the solve the problem that matched the exact cause of the problem......the problem about officer about the draft and writing wrong number could not be solved by training. But the training about the standard of wood stacking could help”. This identified the adjustment of problem solving toward the framework of Jonassen (1977).

2.2 The students’ opinion on learning environment of network found that contents, media on network and learning environment of network were proper and encourage the process of problem solving.

2.3 The learning achievement of the students toward the learning environment model had mean of 26.4 from 30 which means 88% and pass the criterion of 80% and showed that the learning environment model designed could encourage the students to learn.

7. Research Discussion

The finding of the instructional model was that the model had both internal and external validity. The external validity could be traced back from effect of instructional model that encourage the ill-structured problem solving process of the students which consisted of 7 components. The students’ opinion that instructional model (learning environment) was proper and encouraged the process of problem solving and could upper the learning achievement. These findings confirmed the quality of instructional model and the external validity. The instructional model also could be used to encourage the students in the class. The study conform to the study of Sumalee Chaijaroen et. al (2008), Isara Karnjak (2009), Jarunee Sarmart (2009), Suchat Watanachai (2010), Wanwisa Chorum (2011) and Ratsa Laohasurayotin (2011) that studied the internal validity by experts and found the similar findings that media on network and learning environment design in any components of the instructional model had quality and harmonize to the principle and basic theory used.

The finding of internal validity might be caused by the design on basic theory of Jonassen (1997) about the process of ill-structured problem solving. Each component of learning environment such as the center for best practice of problem solving process let the students practice the process of problem solving using the similar problem and study from the experts’ example for the students to think and transfer the experience and applied to solve their own problem. This included the characteristics of the industrial educational designer and the experience in teaching in instructional design theory which could be applied in design the instructional model of learning environment. The synthesis of principle and theory of instructional model, the components identified in the instructional model of learning environment were all the indicators of internal validity in this research.

Those empirical mentioned could be indentified the internal validity of learning environment model that the components design in the instructional model harmonized with the theories used included the content and media on network validity. The findings on students’ opinion about the effect to the students that could encourage the ill-structured problem solving process showed the design of instructional model on learning response of the students. The students could upper their learning achievement and transferred the knowledge learned in their future career.
8. Suggestions

1. The study of ill-structured problem solving process and mechanism on any industrial education field should be longer studied to encourage the students in problem solving in their specific field of study.

2. The procedures for model using and conditions that promote successful of model using should be studied to find the effective of model using that suit for any field of the students.

Acknowledgement

“This work was supported by the Higher Education Research Promotion and National Research University Project of Thailand, Office of the Higher Education Commission, through the Cluster of Research to Enhance the Quality of Basic Education, Faculty of Education and the Research and Technology Transfer Affairs Division, Khon Kaen University.”

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