ผลของการเรียนรู้โดยใช้ผังมโนทัศน์ด้วยคอมพิวเตอร์ : นวัตกรรมการเรียนรู้ทางครุศาสตร์อุตสาหกรรม

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บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อเปรียบเทียบผลสัมฤทธิ์การเรียนรู้โดยใช้ผังมโนทัศน์ด้วยคอมพิวเตอร์กับผังมโนทัศน์ด้วยวิธีแบบปกติโดยทำการทดลองกับผู้เรียนในรายวิชาหลักการบริหารอาชีวะและเทคนิคศึกษา กลุ่มตัวอย่างที่ใช้ในการวิจัย คือ นักศึกษาระดับปริญญาตรี ภาควิชาครุศาสตร์ไฟฟ้า คณะครุศาสตร์อุตสาหกรรมและเทคโนโลยี มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี จำนวน 89 คน การทดลองได้ทำการเปรียบเทียบกลุ่มที่เรียนรู้ด้วยผังมโนทัศน์ด้วยคอมพิวเตอร์ร่วมกับการเรียนรู้แบบปกติ เครื่องมือที่ใช้ในการเก็บข้อมูล ได้แก่ แบบทดสอบก่อนเรียนและหลังเรียน และแบบประเมินยุทธวิธีการเรียนรู้การสร้างผังมโนทัศน์ สถิติที่ใช้ในการเปรียบเทียบ คือ การทดสอบค่าที ผลของการวิจัยพบว่า คะแนนเฉลี่ยของกลุ่มทดลองโดยใช้ผังมโนทัศน์ด้วยคอมพิวเตอร์มีความแตกต่างอย่างมีนัยสำคัญในแบบทดสอบหลังเรียน นอกเหนือจากนั้นคะแนนเฉลี่ยของกลุ่มที่ใช้ผังมโนทัศน์ด้วยคอมพิวเตอร์มีความแตกต่างอย่างมีนัยสำคัญ จำนวน 2 ด้าน คือ ด้านการนำเสนอวิธีการแก้ปัญหา และด้านการยกตัวอย่างแนวทางการแก้ปัญหา ผลลัพธ์จากการวิจัยเป็นมิติใหม่แห่งการจัดการเรียนรู้โดยผู้สอนสามารถนำไปประยุกต์ใช้เพื่อจัดระบบทางความคิดของผู้เรียนโดยมุ่งเน้นตรรกะเชิงเหตุและผลเพื่อประสิทธิภาพของวิธีการสอนที่มุ่งเน้นการแก้ปัญหา

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Effects of a Computer-Based Concept-Mapping: The Learning Innovation in Industrial Education

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This study compared the achievement scores of the computer-based concept-mapping and the paper-pencil concept-mapping groups who studied in the principles of vocational and technical education subject at King Mongkut's University of Technology Thonburi (KMUTT). Participants were 89 undergraduate electrical technology education students. One group of students used a computer-based concept mapping. While another group used a paper-pencil concept-mapping. The knowledge acquisition test and concept mapping was used as data collection tools. Comparisons between groups were made using *t*-test analysis. The results revealed that there was a significant on the knowledge acquisition test and the knowledge representation test interaction reflecting that computer-based concept-mapping performed has better the achievement scores than the paper-pencil concept-mapping group. Moreover, the student scores of concept maps were examined by the structural scoring. There was a significant difference of knowledge representation structural scoring in the "hierarchical" and "examples". Students generally tended to initially over estimate their ability to generate ideas carry out the assignment was enhanced with knowledge representation structural scoring. Instructors could use it in student problem-solving for synthesizing the content procedures.

Key Words: Knowledge Acquisition, Knowledge Representation, Concept Mapping, Learning Innovation

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1. Introduction

Office of the Education Council (2009) has stated that technology is essential and enhances teacher in teaching and learning. Hilbert and Renkl (2009) has also advocated that many technology tools can be used to help lift the student up to an initial skill acquisition by giving them, namely computer-based concept-mapping (CB-CM). The potential of CB-CM applications has recently been recognized and most research has been reported on their effects (Hilbert & Renkl, 2009; Sturm & Rankin-Ericson, 2002; Wang, Cheung, & Kwok, 2008). Therefore, a need for research determining the effects of individualized personalization using CB-CM instruction on the principles of vocational and technical education subject has been established.

CB-CM is a method of computer graphically knowledge structure and their representing concepts. Nodes represent concepts and labeled links represent the relations between the concepts. For instance, Ausubel's assimilation theory of cognitive learning (Ausubel, Novak, & Hanesian, 1978), concept maps visualizes the hierarchy and relationships of concepts. Though the knowledge representation with a concept map, meaningful learning can be assisted (Novak, 1990). Moreover, Novak (1995) describes a variety of applications of concept mapping in learning.

For example, concept maps can assist the preparation of lessons and the sequence of topics presented; they can serve as a basis for discussions, and they can used as a tool for knowledge evaluation. Traditionally, students are generated using paper-pencil concept-mapping (PP-CM). However, using computer software to create concept maps allows learners to re-arrange, color-code, add, or delete nodes and links with relative ease. Learners usually prefer the higher flexibility of computer-generated concept mapping (Sturm & Rankin-Ericson, 2002).

Specially, the principles of vocational and technical education subject have been designing the instructional to support the problem-based learning (PBL) environment. Because of concept-mapping would be generated idea on PBL, the utilizes of an interactive approach to critical thinking and uses the students' current knowledge structure have increasingly. The development of new concepts and reasoning were intensively such as, uses authentic task, complex problems as the impetus for learning and fosters the acquisition of both disciplinary knowledge and problem-solving skills (Edens, 2000; Flynn & Klein, 2001). PBL assumed that frequent generation of ideas and solutions, greater transfer of learning than competitive learning strategies (Jonassen, 2004).

It can also be successfully employed in learning how to use a learning strategy. Students are adaptable of using PBL in both groups and their level of knowledge crucial issues for students in facilitated learning scenario. The current, issues, and situations has been argued that students should address a person's beliefs about his/her ability to create maps accomplish a learning assignment, rather than to specifically execute a certain function or sub-skills reasoning.

For these reasons, this study provides a new challenge on developing knowledge structure, thereby allowing students to improve knowledge acquisition, enhance metacognition and become more effective learning strategy (Jonassen, 2000). More importantly, students are encouraged to accept self-efficacy, self-regulation, and self-directed learning.

This study compared the achievement scores of the computer-based concept-mapping and the paper-pencil concept-mapping groups who studied in the principles of vocational and technical education subject at King Mongkut's University of Technology Thonburi (KMUTT). The hypotheses addressed the following: 1) Students who were trained in CB-CM group have better the achievement scores than PP-CM group in the knowledge acquisition test; and 2) Students who were trained in CB-CM have better the achievement scores than PP-CM group in the knowledge representation test.

2. Methodology

2.1 Sample and design

Participants were the second year undergraduate electrical technology education students at KMUTT in the semester 1/2009 (N = 89, 52 males, 37 females, mean age: 20.3 years, SD = 2.84). The students were simple randomly assigned to experimental group and the control group. The experiment group (n = 45) was trained in CB-CM by constructing from Institute for Human and Machine Cognition (IHMC) CmapsTool program one concept map on their own. The control group (n = 44) studied to produce PP-CM on their own.

2.2 Mapping software

Participants worked with the IHMC CmapsTool v5.04.01; software especially developed for concept mapping (http://cmap.ihmc.us/download/). The **IHMC CmapTools** program empowers users to construct, navigate, share and criticize knowledge models represented as concept maps in Figure 1.

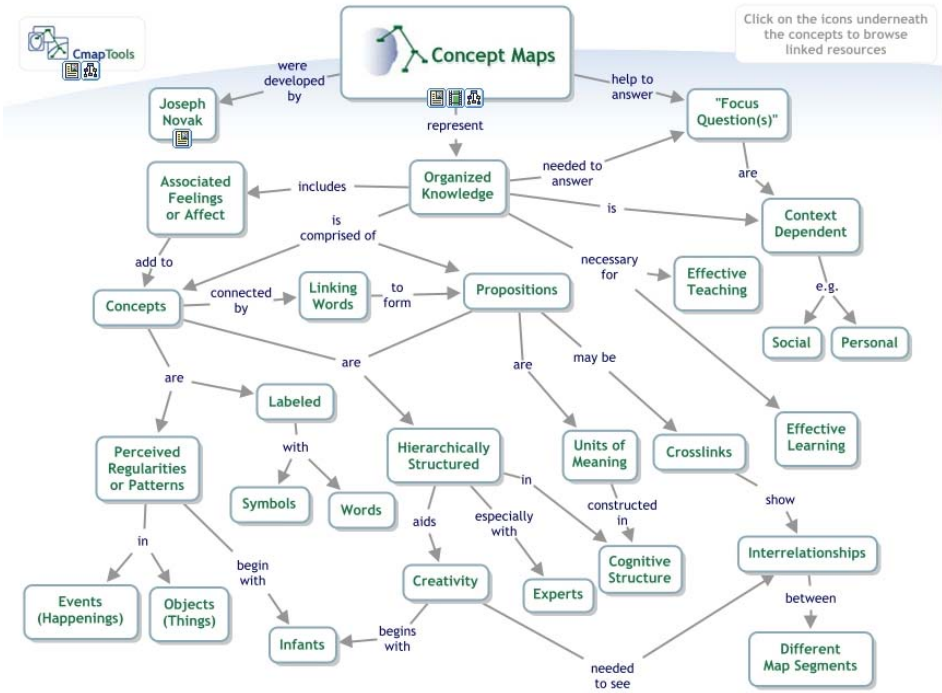

Figure 1. Example of concept mapping

2.3 Concept mapping in PBL

The learning materials in the experiment group consisted of one program file. The example included a fictitious student who constructed a concept mapping had a problem-solving process (Jonassen, 2004). The fictitious student created the causes of problem, problem presentation, and alternate solutions. They were also specifically chosen the topic of 10 symptoms Education Crisis in Thai Acquisition (Thongroj, 2008).

2.4 Concept mapping practice

Learners in the control group were provided with the experimental group. Learners were given blank sheets and were asked to construct a concept mapping based on their own, using PP-CM.

2.5 Procedure

At the beginning of the experiment, the content of "Education Crisis in Thai Acquisition Problems" was explained to the students. Though, the knowledge acquisition test was conducted as a pre-test in order to assess the knowledge level, and to motivate students in the study sample. Concept mapping and how to create concept maps were explained to the students in both groups, providing examples. The experiment group was using concept maps prepared with PBL in a computer-based learning. The control group was using concept maps prepared with the traditional paper and pencil learning method. Afterwards the students were asked to create their own concept maps regarding these concepts.

2.6 Learning assessment

The knowledge acquisition test "Exploring the problem statement of Thai Education" was comprised of 100 multiple choice questions on a 100-point scale. The questions were prepared by the researchers and the reliability has been established with Cronbach's alpha (α = .91). Concept maps prepared the topic of 10 symptoms Education Crisis in Thai Acquisition (Thongroj, 2008), and were evaluated on a 100-point scale.

2.7 Data analysis

A dependent sample t-test was used to evaluate the difference of the CB-CM and the PP-CM groups on both knowledge acquisition test and knowledge representation test. Whilst an independent sample t-test was used for inter-group comparison. For concept maps, the following structural scoring method developed by Novak & Gowin (1984) was evaluated:

- Relationships: 1 point for each valid position
- Hierarchical: 5 points for level of hierarchical
- Cross links: 10 points for each valid cross link
- Examples: 1 point for each valid example

3. Results

Both the CB-CM and the PP-CM groups were comparable as shown in Table 1.

Table 1. Comparison of knowledge acquisition test scores in the CB-CM group

CB-CM Group	*n*	*Mean*	*SD*	*t*	*p*
Pre-test	45	64.37	10.69	11.27	.000**
Post-test	44	81.69	9.52		

Note. *$p < .05$ **$p < .01$

Table 2. Comparison of knowledge acquisition test scores in the PP-CM group

PP-CM Group	*n*	*Mean*	*SD*	*t*	*p*
Pre-test	45	65.13	11.08	9.13	.072
Post-test	44	72.48	10.23		

Note. *$p < .05$ **$p < .01$

Table 3. Comparison of knowledge representation test in both groups

Structural scoring	Educational study				*t*	*p*
	CB-CM (*n* = 45)		PP-CM (*n* = 44)			
	Mean	*SD*	*Mean*	*SD*		
Relationships	68.36	4.96	61.52	6.89	0.02	.085
Hierarchical	82.91	7.47	74.11	8.53	2.42	.000**
Cross links	40.12	6.13	26.96	9.19	3.06	.096
Examples	30.65	7.79	24.57	10.64	1.86	.007**

Note. *$p < .05$ **$p < .01$

The results found that difference between the knowledge acquisition test scores in the CB-CM group had significant difference favor of the post-test. On the other hand, the control group had no significance difference favor of the pre-test and post-test scores. When the student scores of concept maps were examined by the structural scoring, a statically significant difference was seen in the "hierarchical" and "examples". There were no significant differences on the "relationships" and "cross links".

4. Discussion

This study compared the achievement scores of the computer-based concept-mapping and the paper-pencil concept-mapping groups who studied in the principles of vocational and technical education subject at King Mongkut's University of Technology Thonburi (KMUTT) on "Education Crisis in Thai Acquisition Problems". The results revealed that there was a significant on the knowledge acquisition test and the knowledge representation test interaction reflecting that CB-CM performed has better the achievement scores than PP-CM group.

The finding provided additional support a CB-CM was an effective learning strategy of undergraduate electrical technology education students. A potential concern about relying more increasingly on computer-based problem settings was that it may hinder student performance indicating (Hilbert & Renkl, 2009).

CB-CM were created by computer software allows learners to re-arrange, color-code, add, or delete concept nodes and links with relative ease. Learners usually employed the higher flexibility of CB-CM (Plotnic, 1997; Sturm & Rankin-Ericson, 2002). However, it was noteworthy that neither group of students achieved the score of 100 that was considered the threshold for high potential for create concept mapping. In this study, there was a significant difference in the comparison of knowledge acquisition test scores in the CB-CM group.

Learners could found the solutions on their own. From Table 3, there was a significant difference of knowledge representation structural scoring in the "hierarchical" and "examples". Students generally tended to initially over estimate their ability to generate ideas carry out the assignment was enhanced with knowledge representation structural scoring (Azevedo & Hadwin, 2005; Liu, Chen, & Chang, 2010; Mercier & Frederiksen, 2008; Yin, Ruiz-Primo, Ayala, & Shavelson, 2005).

In addition, Jonassen (2000) revealed PBL students might not perform as well on multiple-choice tests as students taught by lecture-based instruction; however, in initial skill acquisition in well-structured domains, example-based learning typically leads to better learning outcomes than learning by doing as shown in Figure 2 and 3. The apparent improvement in retention might be connected to the way learning occurs in PBL. Therefore, PBL has the potential to knowledge structure so that acquisition and recall were optimized, students developed self-directed learning skills, and there was an increase in the motivation for learning (Albion & Gibson, 2000; Bayard, 1994).

In addition to promote participants during the process, the finding was that the unconfident achievers and mild-confidence underachievers had the low level of knowledge structure in term of “relationship” and “cross links” (Akinsanya & Williams, 2004; Yampolskaya, Nesman, Hernandez, & Koch, 2004). A possible reason for the low scores of these was that they might be lack confidence that they would be able to repeat their previous information successes in concept mapping, because traditional concept mapping was generated using paper and pencil. Although concept mapping successfully fosters learning and understanding, beginner often lack of skills to productively use concept-mapping tools and thus cannot exploit their full potential (Liu, Chen, & Chang, 2010).

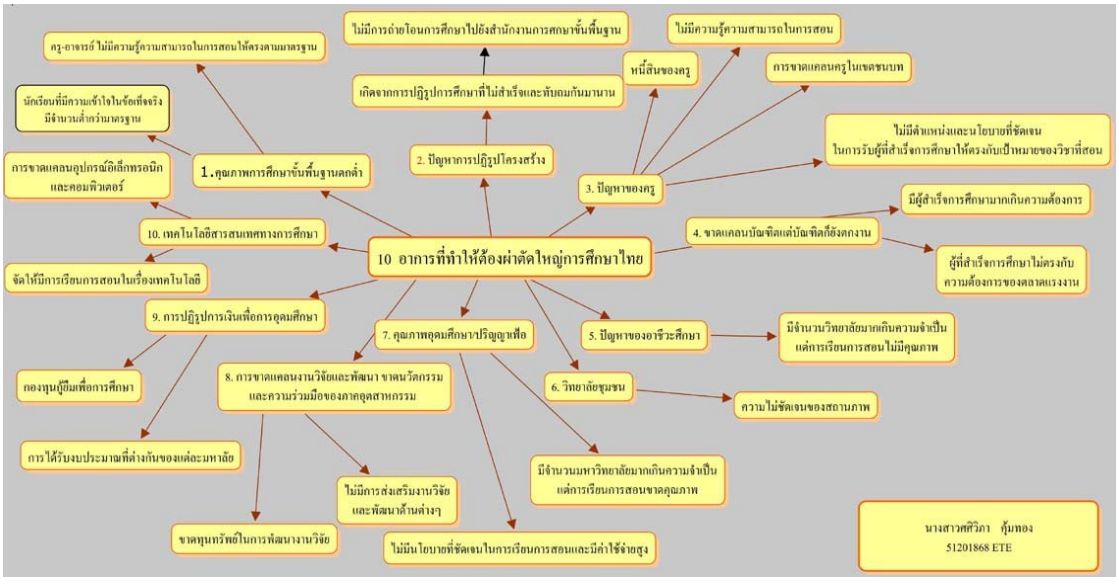

Figure 2. Example of an adequately student concept mapping

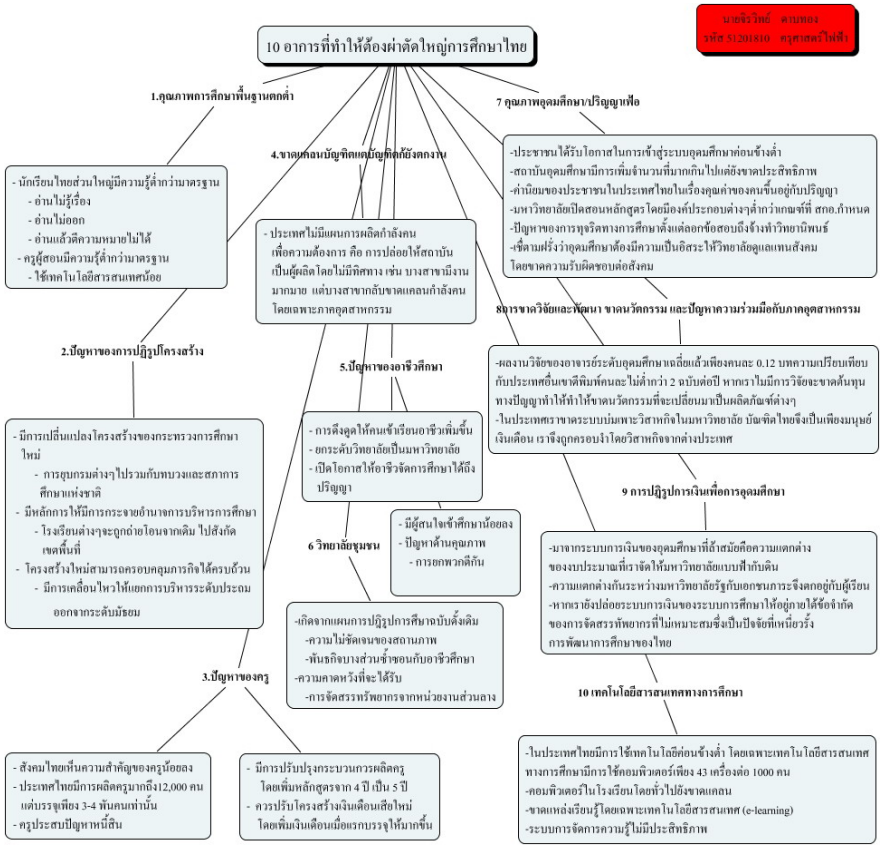

Figure 3. Example of an adequately student concept mapping

5. Conclusion

A computer-based PBL concept mapping enhances students' to analyze the knowledge structure by connecting the concepts in it. Through the concept mapping implementation, learners can prepare the essential skills as a metacognitive strategy and recall the previous experience which was forgotten due to create the maps (Rosas & Camphausen, 2007). Furthermore, learners can review the context, and problem statement or infer the current, issues, and situation when they understand as a whole concept mapping.

Structural scoring referred to a higher level of knowledge representation level. It emphasized the understanding of causes of problem, problem presentation, and alternative solutions. From the various on students' concept mapping, instructors can gain in-depth reasoning into students' knowledge structure development. Instructors could use it in student problem-solving for synthesizing the content procedures. It suggested that future research studies might discuss the problem-solving procedures and development of students' concept mappings.

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