UTILIZING CONCEPT MAP AS THE TEACHING STRATEGY BASED ON CONCEPTUAL CHANGE THEORY FOR THE COURSE INFORMATION TECHNOLOGY AND SOCIETY

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Abstract:
The development of information technology has already influenced everyone’s daily life in our society nowadays. Therefore, it becomes one of the most important issues for the instructors in the technological and vocational education systems to integrate the current topics and the relative concepts into their courses. This study explored the conceptual change of the technical and vocational university students on the course “information technology and society”. Concept maps provide a graphic representation of a person’s structural knowledge or conceptual understanding of a particular topic. Concept maps can be used as a tool to visualize and measure the depth, breadth, and organization of a person's knowledge. It provides not only a clear module structure for the learners, but can also make the conceptual framework of the learners transparent. With its help, teachers can thus firstly understand the prior knowledge of students and consequently revise their misconception. Based on the conceptual change theory, we adopted the five-stage teaching model which includes orientation, elicitation, restructure, application, and review (Driver and Oldham, 1986) for our course design. This model emphasizes students' conceptual change through feedback and continuous improvement to enhance students' learning performance. To realize whether and how the concepts of students are changed after having the 18-week-lasting course, the students were asked to map their understanding of the concepts at the beginning and the end of the course respectively. Besides, qualitative data were also collected from in-depth interviews. The goal of this research is to examine whether teachers’ teaching activity does lead to an adjustment, revision and reorganization of students' understanding through concept mapping teaching strategy. The study found that students already have prior concepts on the course content even before the course started and some of the tuning and revision of these concepts is obtain through the help of the teaching activities.

Key words: Concept map, Conceptual change, Information technology and society

1. Introduction
The development of information technology has already influenced the different aspects of the society. Thus, incorporating the scientific concept of information technology and the society into the curriculums of technical and vocational
universities is already a natural trend. This study used the theory of conceptual change as basis and adopted the five-stage conceptual change teaching model developed by Driver and Oldham (1986) [1] as the course design of this study. This study explored the conceptual change of the technical and vocational university students on the course “information technology and society” by asking students to draw concept maps at the beginning and the end of the course and by in-depth interview. It also summed up the suggestions of the students on the course to serve as references in modifying and developing the course “information technology and society” in the future. Qualitative method is used in this study and 35 students were randomly selected from the 4 classes with 220 students of a technical and vocational university. This study explores whether the teaching activities of this study will cause the students to have tuning, revision and reorganization in their prior concept of information technology and society through analysis comparison to obtain the optimal learning performance.

2. Literature review

2.1 Concept map and conceptual change

According to Novak and Gowin (1984), concept maps provide a graphic representation of a person's structural knowledge or conceptual understanding of a particular topic [2]. Concept maps can be used as a tool to visualize and measure the depth, breadth, and organization of a person's knowledge as [2]-[5]. Concept map often looks like a spider web consisting of nodes that are connected by links to create diagrams that demonstrate relationships among key ideas in specific topics [6]-[7]. The nodes consist of words or ideas that represent information. According to Kevin et al. (2009), the links between various nodes show that the concepts are conceptually and logically related within the concept map [7].

From the learning viewpoint of cognitive psychology, scholars believed that concept maps can truly show the cognitive structure of the learners or assist learners show their thinking process and can reveal the main conceptual framework of the course even more. Some literatures stated that students already have prior concept before taking the course where these knowledge might came from their past experiences and these knowledge were restructured in the learning process through practicing operation [8]-[13]. For teachers, concept mapping is a teaching strategy and a learning tool. Besides that it can clearly show the prior conceptual frameworks of the learners, concept maps can also show the lessons of all the teachers. With the help of concept maps, teachers can help students have meaningful learning, obtain the teaching goal of understanding students’ prior concept before they learn new knowledge and effectively revise student’s wrong concepts. Thus, concept mapping is not only an effective teaching tool; it can also improve concept learning achievements when incorporated into the learning process. And the learning perspective of constructivism believed that students can promote their learning performance by restructuring their own meaningful concept through the unification of old experience and new information [14].

2.2 Conceptual change

Chiu (2000) and Rumelhart and Norman (1981) believed that there are 3 modes of conceptual change: accretion, tuning and restructuring [15]-[16]. Accretion is the main structure in the prior knowledge module before changing and is just an added
knowledge. Tuning is making the modified prior knowledge module smooth, effective and automatic during implementation or usage which also means expanding the basic model. Last, restructuring is the reorganization process of the knowledge to obtain a deeper understanding.

The occurrence of conceptual change should conform with these three conditions: understandable, rational and abundant. In the teaching process, teachers should pay attention to the prior knowledge of the students and adopt different teaching strategies to different types of students. Furthermore, according to Novak(2002) [17], Esen and Ömer(2005) [18], conceptual change is the necessity for meaningful learning to occur. Meaningful learning requires well-organized relevant knowledge structure and high commitment to find relationships between new and existing concepts. When concepts maps are used to facilitate learning, they not only aid coaching and scaffolding, they also serve as metacognitive tools for improving students’ learning [17].

For conceptual change to occur in learning, Posner et al. (1982) stated that four conditions are necessary: (1) there must be dissatisfaction with existing conceptions. (2) A new concept must be intelligible. (3) A new concept must be plausible. (4) A new concept must be fruitful [19]. Therefore, teachers should develop strategies to create cognitive conflicts in students’ organized instruction to diagnose errors in students’ thinking and help students translate from one mode of representation to another.

This study was prepared based on the conditions of Posner et al. (1982) [19]. Therefore, by conceptual change texts, students had the opportunity to compare their ideas with scientific concepts and then they became ready to enhance and stabilize their learning by using of concept maps.

2.3 Conceptual change teaching strategy

Nussbaum(1989) highly praised the constructivist teaching sequence of Driver & Oldham(1986) which conforms to the teaching model of the constructivist approach [20]. Driver & Oldham(1986) believed that the misconception of the students should be considered when designing the curriculum so that the students can integrate and construct a scientific concept by using the experiences from the curriculum and their own prior concept [1]. Thus, the five-stage conceptual change teaching model was developed. The five phases of this model are the following: 1. Orientation: in this stage, the students should already have a clear idea on the objective of the curriculum and initiate their learning motivation. 2. Elicitation of ideas: the teaching activities in this stage include group discussions, oral presentations and written reports to help students express their thoughts or ideas into their own concept. 3. Restructure of ideas: this stage let students understand their own concepts and the difference with the concepts of others through discussion and comparison of concepts with others. This stage also let them try to develop different concepts to explain these phenomena or attempts for concept revision and restructure. 4. Application of ideas: this stage let students apply the newly developed concept in different scenarios for them to understand the feasibility of the new concept and trust the new concept. 5. Review conceptual change: this stage let students understand the difference between the newly developed concept and the prior concept through written reports and examine the transformation process of the concept itself.

Hence, the design of the teaching activities of this study mainly followed the conceptual change teaching model proposed by Driver & Oldham(1986) [1]. This
Study let students integrate and construct scientific concepts by using their experiences from the curriculum and their own prior concept. This study applied concept mapping, a metacognitive tool, in the course “Information Technology and Society” of technical and vocational universities. The course and teaching activities were mainly divided into 5 stages.

3. Research design

3.1 Teaching strategy

The five phases of the conceptual change teaching model included in the lessons of “Information Technology and Society” are showing as follows (Figure 1):

1. Orientation: the teaching method adopted includes showing of video/films, delivering of speeches by experts from different fields and demonstrations through action news for students to be clear on the objective of the course and initiate their learning motivation on the course contents. 2. Elicitation: the teaching activities for the students in this stage include sharing of videoed proposals, group discussions of life issues and concept mapping so that students can express their ideas or thoughts and for them to be consciously aware of their prior concept. 3. Restructure: the teaching activity in this stage is to adopt actual demonstrations and peer-evaluation for students to construct concepts meaningful to themselves through discussions and comparison with the concepts of others. 4. Application of ideas: the design of this stage is to let students learn concepts related to information technology and society such as intellectual property rights and information privacy to be applied to different scenarios where it should be portrayed in short videos. The purpose of making the video is for students to understand the feasibility of new concepts and to strengthen their trust toward the new concept. 5. Review: this study adopted the pre- and post-test concept mapping for students to understand the difference between the new concept after teaching and the prior concept and examine the transformation process of the concept itself.

3.2 Course content design

The most discussed issues of information technology that impacts the society were used as the main topics for discussion of the course content of the concept map. The concepts were organized based on the different influence layer. The eight concepts were online shopping, internet dating, internet addiction, privacy, internet crime, internet etiquette, digital divide and intellectual property rights.

3.3 Sampling

Qualitative method is used in this study and 35 students were randomly selected from the 4 classes with 220 students of a technical and vocational university. This study explores whether the teaching activities of this study will cause the students to have tuning, revision and reorganization in their prior concept of information technology and society through analysis comparison. This study used the five-stage conceptual change teaching model developed by Driver & Oldham (1986) [1] as the main teaching strategy and concept mapping was used as the tool in the teaching process of conceptual change. The researchers and the teachers discussed and coordinated many time before teaching to further confirm the clearness and explanation method of concept mapping to explain the depth and broadness of the course content and control the length of the lecture.
4. Results and discussions

This study mainly explores the conceptual change before and after teaching concept mapping on technical and vocational university students in the course “information technology and society”. This study applied concept mapping at the beginning and the end of the lecture. The 2 concept mapping by the students and the in-depth interviews underwent comparison analysis. Because majority of the students don’t have any
ideas on concept mapping before taking the course, the teacher of this study used the course content students have already learned and explain the important components of concept maps based on the principles developed by concept mapping experts [2]. The teacher explained the composition points of concept mapping and how to create a concept map through an actual example for students to fully understand the technique of concept mapping. The pre-and post-test concept maps of the samples S was used as the example by this study to explain the qualitative data analysis process. The analyses of the research results are discussed below:

4.1 Analysis of the students’ concept map

![Pre-test Concept Mapping of Research Sample S in the Case of Internet Dating](image1)

![Post-test Concept Mapping of Research Sample S in the Case of Internet Dating](image2)

Through the comparison analysis of the pre-(Figure 2) and post-(Figure 3) test concept mapping of research sample S, the results showed that there is a misconception in the pre-test concept mapping of the student (the area with red dotted lines in Figure 2). The student confused the general concept of online purchasing with internet dating. This shows that the student already has a prior concept on this issue even before he/she took this class. These concept or knowledge might be from his/her past experience that made him/her believed that purpose of internet dating also includes online purchasing behaviors.

Through the course design of this study, orientation, elicitation, restructure and application of idea, this study let the students reintegrate the concept and create a
scientific concept based on their experience from the class and their prior concept. From the post-test concept mapping (Figure 3) of research sample S, the results showed that aside from deleting the prior misconceptions, the student even added significant concepts and the prior concepts were reorganized (for example: safety regulations of internet dating to prevent the traps of internet dating). The concept map also got hold of the actual essential examples on the safety precautions of internet (the area with red dotted lines in Figure 3). This result conforms to the learning perspective of constructivism [14]. The students can promote their learning performance by restructuring their own meaningful concept through the unification of old experience and new information.

Furthermore, in the post-test concept mapping (Figure 3), research sample S showed a simple comparison between the difference of “traditional dating” and “internet dating”(the area with green dotted lines in Figure 3) and provide meaningful conceptual cross links on the potential risks of the anonymous characteristics of internet dating.

This result conforms to the 3 modes of conceptual change proposed by Chiu (2000) and Rumelhart and Norman (1981), which can begin through tuning and restructuring and after revising the knowledge module, reorganize the knowledge to obtain a deeper understanding on the concept [15]-[16].

4.2. The in-depth interview analysis

To further understand viewpoints and feelings of the students, this study conducted in-depth interviews to control the learning condition of the students. Based from the analysis of the concept maps above, the researcher recorded the interviews with research sample S and T represents the teacher.

From the record of the interview with the research sample S shown below, it can make students analyze and reorganize concepts. Moreover, the student also confirms that this type of teaching method is very helpful in learning. The content of the in-depth interview is shown below:

<table>
<thead>
<tr>
<th>T:</th>
<th>Do you think that drawing concept maps can promote your learning in the main concepts of information technology and society? S:</th>
<th>Yes. You can further understand the content of the topic by drawing concept maps and you will know how to construct the concepts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T:</td>
<td>Do you think that concept mapping is helpful to your learning process? S:</td>
<td>Yes. It is like I’m organizing key points.</td>
</tr>
<tr>
<td>T:</td>
<td>Why would it be clearer the second time? S:</td>
<td>Because I can’t draw it like the way my teacher did during the first time although it was explained clearly. But before I draw the second one, I searched in internet and with the help of my teacher’s deeper explanation, I know how to draw it better and I can write down the content. Also, the whole concept became a lot clearer.</td>
</tr>
</tbody>
</table>

Analysis of the interview:

The viewpoint of S believed that concept mapping can help students notice the blind spot in learning concepts and can develop the function of concept mapping cognition. The feelings of S are fitted the conclusions of Mintzes et al. (2001) pointed out that concept mapping can really show the cognitive structure of the learner, assist students in showing their thinking process and can expose the main conceptual framework of the course [11]. Furthermore, Lin (2004) also pointed out that students can effectively organize the main concepts through concept map construction [12].
5. Conclusions

This study mainly explores the conceptual change before and after teaching concept mapping on technical and vocational university students in the course “information technology and society” and whether the teaching activities of this study will cause the students to have tuning, revision and reorganization in their prior concept.

The eight issues discussed in this course were online shopping, internet dating, internet addiction, privacy, internet crime, internet etiquette, digital divide and intellectual property rights. Aside from having misconception, it was also discovered that students tend to have insufficient prior concepts. For example, the student might just write simple information like basic definition of terms and did not further construct the depth and broadness of the concept.

In the post-test concept mapping, it was found that the students did not only reintegrate the concept and create a scientific concept based on their experience from the class and their prior concept, the depth and broadness of the students on the concept was also promoted. Aside from the increase in the points of the concepts and the topics between concepts, meaningful conceptual cross links were also shown.

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