網路小組合作學習環境中學生互動歷程與問題解決之研究

Interactive Processes and Problem Based Solving in Cooperative E-learning Environments

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摘要

本研究旨在探究學生透過小組合作學習在網路問題解決平台中，學生互動歷程與學習態度之研究。研究採取質性言談分析調查高職電機科學生，研究進行五個禮拜之數位邏輯課程，參與學生共有33位。本研究主要發現為1.學生線上互動過程中仍有很高比率的非認知性言談，2.言談內容中以一般性言談與回應為最多，3.小組的問題解決過程以定義問題、蒐集相關資源與建構解決方案花最多時間，研究者最後針對後續研究提出結論與建議。

關鍵詞：網路學習、小組合作學習、互動歷程、問題導向學習

Abstract

This paper discusses the steps taken to set up a digital logic course problem through a problem-based learning (PBL) constructivist approach. PBL results from the process of working toward understanding and solving of a problem. The purpose of this study was to develop and implement problem-based learning in a digital logic course for a senior vocational industrial high school. Data collection included content analysis, and the level of PBL solving. Finally, some research conclusions and suggestions were also proposed.

Keywords: web-based learning, cooperative group learning, interactive process, PBL

1. Introduction

The propose of education should not only include the acquisition of knowledge, but also the development and improvement of higher-order thinking strategies for problem solving and creativity (Miller & Baccok, 1996). Problem based-learning (PBL) is a generally applied approach for learning in the areas of medical education, science curricula, and web-based learning projects including K-12 education. However, there were few relative studies that integrated problem based learning with research methods and teaching in engineering education. In instructional methodology, PBL is one constructive approach. Some studies found that the constructivist approach to instruction can help learners actively analyze problems in detail, and facilitate applying them to real life situations. The PBL learning strategy provides learners with an instructional mechanism that increases higher-order thinking skills and explores authentic and open ended problems. In addition, students take part in social interactions and receive coaching from peers and teachers; PBL is an useful and effective strategy (Albanese & Mitchell, 1993; BÜTÜN, 2005; Carlisle, & Ibbotson, 2005; Hmelo & Lin, 2000). An explanation for the attraction of PBL is that it provides an abled apportunity to enhance specific personal skills likes cooperational ability, gather correlative data and communication in the teamwork. As a result the student not only learns the topic and subject under study, but also gains a number of transferable and lifelong learning skills (Bechtel et al., 1999).

PBL is an approach that involves providing a task or project to a student group of 6–10 students. To appropriately solve a problem in a PBL environment, learners must reflect on their understanding of an issue, acquire new knowledge to help in developing a solution, and think about how their new knowledge can be used to address the problem situation (Song et al., 2006). Web-based PBL learning strategy is designed to encourage transferable skills, including problem-solving, team work, and to aid in forwarding knowledge transfer through the Platform. The teacher should set up rich web-based environments, experiences ,and learning activities for the learner by incorporating opportunities for collaborative work, problem definition, problem solving, real tasks, and shared knowledge. Carey and Whittaker (2002) also emphasize that team work and effective collaboration with peers is essential in any successful PBL activities. It is thought that the development of these skills during PBL learning can lead to the skills being transferred to different situations outside the PBL group. Beers, Boshuizen, Kirschner, and Gijselaers (2005) cited that the route from unshared knowledge in one participant's mind to newly constructed knowledge in a team goes through three intermediate forms (i.e., external knowledge, shared knowledge, and common ground) via four processes, namely externalization, internalization, negotiation and integration. All learning is rooted in conversation (Foster & Kaplan, 2001), a viewpoint that is supported by proponents of the community network model (Swan et al., 1999). It is however acknowledged that IT can play an important supporting role as a repository for the vast breadth and depth of information accumulated by the organization. The researchers believe that students may construct knowledge from each other through cooperative learning and promoting knowledge transfer from unshared knowledge to construct knowledge. For these reasons, researchers assume that learning activities should be designed to force the learners to think about a problem critically and then, respond to the problem.

2. Method

The study uses qualitative research method to gather data. The PBL platform was provided the function of students' learning records. Researchers explored students' participation and discussions on the PBL platform. The qualitative data includes the frequency and quality of dialogue, and the level of PBL. This section of the paper describes the study that has been undertaken in terms of the participants, settings, and instructional design of PBL. The measurement instrument and data analysis employed are also mentioned. First, the researchers used PBL theory to design a problem situation. Second, the problem was introduced to students who used PBL to solve the problem. Third, researchers analyzed the discussion messages and quality of dialogue using the platform, and the learning attitude survey. Finally, researchers reported the results and offered recommendations for future study.

2.1 Participants and settings

This study involved 33 students in a senior vocational industrial high school in Taiwan. Students in a compulsory electrical engineering course, digital logic, were organized into six heterogeneous groups. This pilot study was designed to explore students' interactive process and attitudes using a web-based PBL activity.

2.2 The Instructional Design of PBL

The instructional design the researchers adapted for the PBL process was the five-step ADDIE model (analyze, design, develop, implement, evaluation). Biggs (1999) suggested that a teaching process associated with a deep approach to learning should include at least one of the following four principles within the design of the PBL problem: 1) an appropriate motivational context; 2) a high degree of learner activity; 3) interaction with others, both peers and teachers; and (4) a well-structured knowledge base. The research problem for the PBL activity was based on the above principles. The instructional design steps were as follows: 1) analyze the instructional content and learners; 2) discuss and design the problem of PBL with a digital logic teacher; 3) confirm the problem for PBL; 4) provide the reward ploy; 5) ask Teaching Assistant (TA) to assist with and guide students on line; 6) students discuss and share their individual opinion; 7) present the results for the problem; 8)evaluate the results of student learning. Students had to remember their prior knowledge base in order to solve the problem. The researchers then explored how students collaborated with each other to solve the problem. The Mission Impossible case was designed as the PBL activity.

2.3 Measurement instrument

The data analysis consisted of two parts. The first part related to the interactive behavior within student groups. In order to analyze the interactive processes during students' discussions of the PBL problem, researchers designed the categories to determine dialogue quality. This allowed the analysis of the dialogue could be based upon the related research results (Bodzin & Park, 2000; Kkein & Doran, 1999; Liu & Yang, 2003; Sorensen & Takle, 1998). The nine dialogue categories are: general explanation, organization, question, analysis, elaboration, reaction, brainstorming, solving the problem, and reflection.

In order to analyze the the level of PBL, researchers cited Lavonen & Mattilattu (2003) categories of tasks in problem-solving activities. A survey was administered to examine students' learning attitudes and perceptions about the platform as a tool for PBL learning.

3.Analysis and Findings

3.1 Issue Messages of Students Category

The researcher counted the issue messages in the PBL platform. The total number of messages is 981. 624 messages of those are assumed to be cognitive messages (64%). The last 357 are non-cognitive and either have nothing to do with the issue topics or repeat the statement of others (36%). In the discussion issues, we have 80 messages (13%) in cognitive form delivered by the learners, 495 messages (79%) in cognitive form which aroused replies, and 49 messages (8 %) in cognitive messages which were delivered by the teaching assistants. The greatest amount of non-cognitive messages existed among the reactions. 8 % of the total messages were indifferent to the group issue topic, and nearly half of all the reponses replied to other messages. Most of the learners were excited to use or discuss on a web-based PBL platform for the first time.

Therefore, many unrelated or "nonsense" chats were registered. Furthermore, the teacher did not forward the notices to the learners. This could be the reason for the high percentage (36%) of non-cognitive messages.

3.2 The Results of Quantifying the Messages Category

The researcher analyzed the cognitive messages according to the categories of dialogue quality used in this study. "General explanation" (29%) registered the most while "Reaction" (28%), and "Question"(16%) came in second and third respectively. "Elaboration" and "Brainstorming" registered at only 2%. The researcher reasoned that it was the first time that the students had to do general statements and responses and therefore lacked experience in higher level dialogues or studies. Also, the dialogues among the groups were relatively identical in focusing on general explanation, reaction, and the question. Generally speaking, traditional Taiwanese students seldom raised questions in class. The web-based PBL platform promoted cooperation among the students, stimulated the questioning of doubts, and enhanced the identity of the group as one that was knowledge sharing. In addition, PBL also encouraged the group members to help each other and increased their ability to solve questions. The process of the students' discussion with each other through a web-based platform helped them construct newly shared knowledge from individual unshared knowledge. Finally, the groups constructed new PBL solving knowledge just as the Beers, Boshuizen, Kirschner, and Gijselaers (2005) research suggested.

3.3 The Level Results of Six Groups PBL Solving

The review of the purpose of this study preceded our data analysis. It was necessary to describe the students' collaborative problem-solving processes in order to explore the level of problem solving. Researchers quoted Lavonen, Meisalo, and Lattu (2002) all of whom defined these categories of tasks in problem-solving activities (see Appendix1). These include problem (P1), recognizing and finding (P2), planning (P3), alternatives (P4), constructing (P5), and evaluating (P6). The level results of all the groups' problem-solving are represented in Figure 1.

Based on the level results of the groups' problem-solving, researchers found that there are similarities in all the groups' online discussion. First, students needed to spend more time defining the problem and then confirming and discussing how to solve it. Second, all the students in the group spent more than one month gathering related resources and asking other groups or the teacher for help during the online disscussion process. Third, most groups spent little time planning alternatives to the problem-solving task. Researchers believe that most students do not know how to plan a project. Another reason could also be that this was the student's first time participating in a PBL activity. What's mose, the teacher separated the groups heterogeneously. Certain students in the groups always brought original and new ideas while others did not contribute as energetically. Fourth, all the groups spent the most time self-constructing their circuitry model. Researchers observed that students could develop a self-directed learning ability through this task. Finally, the six groups of students usually spent little time evaluating their results. Group 4 did not test or evaluate their product but instead spent more time constructing their circuitry. The results of these six groups' level of problem solving provide evidence that students mainly focus on the stages of problem (P1), recognizing and finding (P2), and constructing (P5) tasks during the PBL process.

4. Conclusions

The purpose of this study was to expose and understand the PBL process of first time participants in web-based PBL activities. The findings of this study provide evidence to suggest that followings conclusions.

4.1 The "peer-responses" category had the most messages

From the learners' points of view the researcher found that the discussions focused on the every topic. The messages were negative replies, though the non-negative messages were a high percentage (36%). The discussions among the group members seemed frequent, but most of them were daily chats, as it was the students first time using it.

4.2 The content of the messages focused on "general explanations" and "reactions"

The study revealed that high level thinking like— organization, analysis, elaboration, and brainstorming, solving the problem, reflection did not appear in the content of the dialogues. On the contrary, the content of the dialogues were general explanations and reactions while the secondary were questions. The students did not understand or were confused because it was their first time using the web-based platform. Researchers also found that studying through platform promoted reactions, questions, and the sharing of resources and knowledge in groups. Through the platform students were able to see the prejudices, the multiple points of view, and the contrast. Communicating, arguing, and interpreting developed the higher level dialogue. This helped students reflect and enhance the critical thinking.

4.3. The level results of all groups' problem-solving are similar

The findings provide evidence that students mainly focus on problem (P1), recognising and finding (P2), constructing (P5) tasks during this PBL process. Students spent a lot of time defining their problem and sharing their resourses/knowledge, and then constructing their model together. Researchers found that PBL activity design helped students enhance their ability to self-direct their learning and their ability to solve problems. If students can develop self-direction, it will help them have positive attitudes to lifelong learning in the future.

5. Suggestions

Using an online platform as an auxiliary tool for students' learning provides another way for teachers to teach. In the environment of web-based professional growth, TA's use the scaffolding theory to guide the depth of critical thinking and the quality of the students' reactions (Yang & Liu, 2004). Based on the pilot study, TA's do not have much experience or scaffolding support skills, so TA's do not provide sufficient guidance to promote the dialogues at a higher level. Therefore, TA's should take a training course and learn scaffolding theory in the hopes that TA's would come to the students' aid and encourage them to join the discussions through scaffolding theory,.Also, TA's will be better able to stimulate students desire to ask questions, solve problems, reflect, and engage in high quality discussions. Finally, web-based PBL platforms should provide multiple learning resources for students to command and access in order to solve problems and exchange knowledge.

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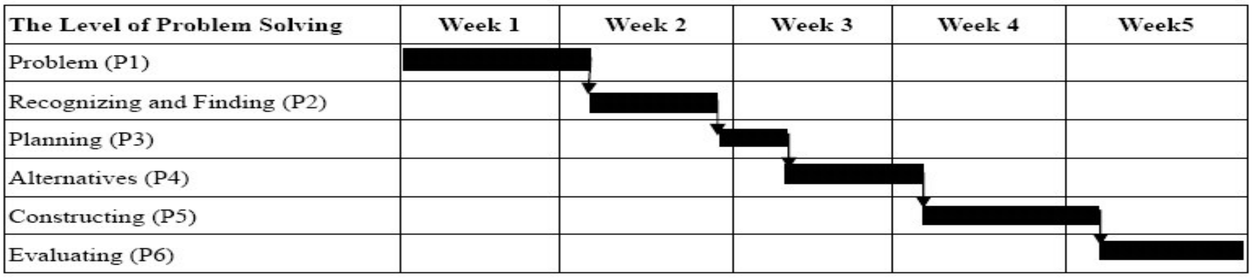

Figure 4. The level results of group 2 PBL solving

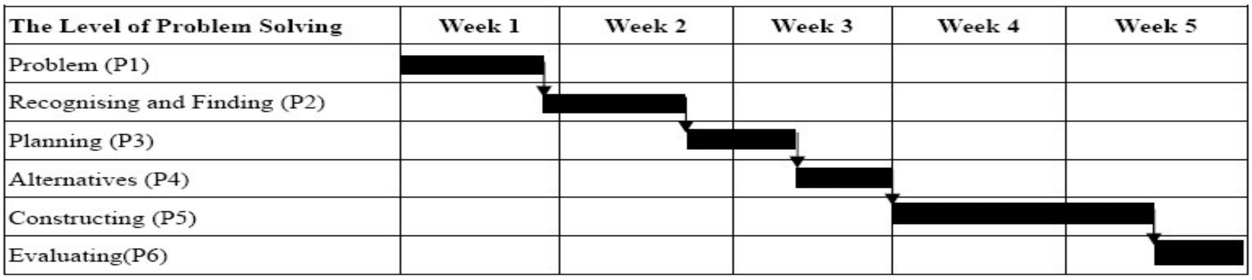

Figure 5. The level results of group 3 PBL solving

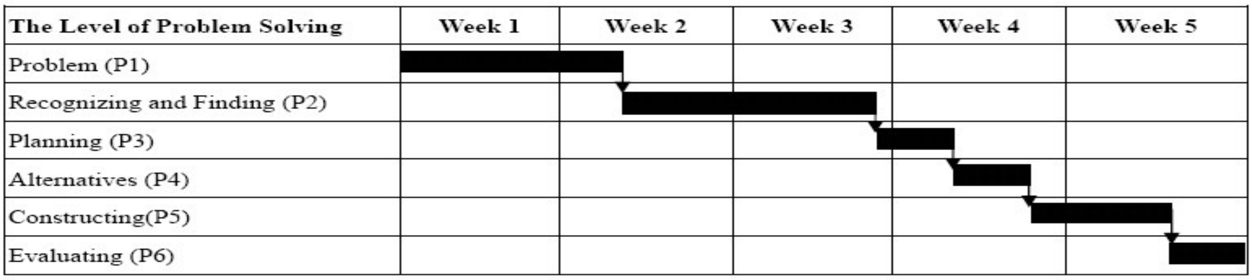

Figure 6. The level results of group 4 PBL solving

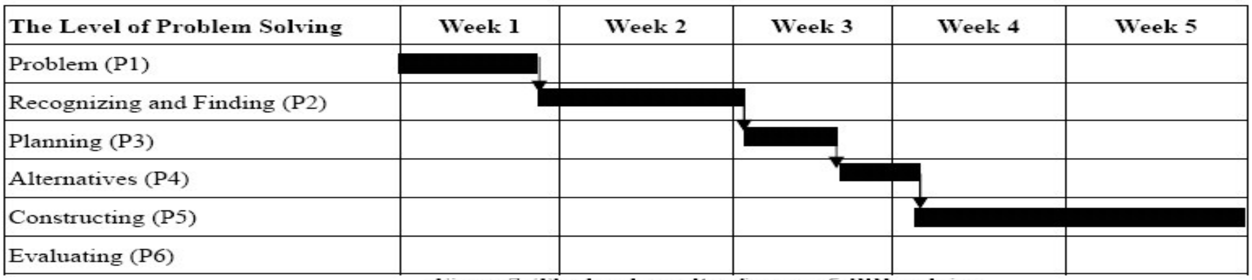

Figure7. The level results of group 5 PBL solving

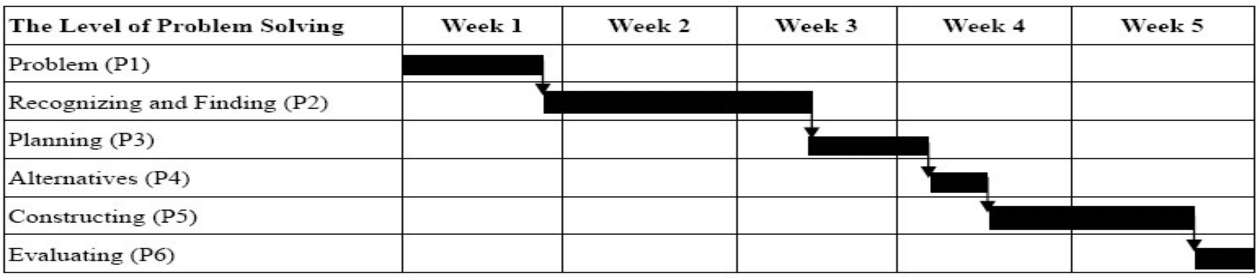

Figure 8. The level results of group 6 PBL solving

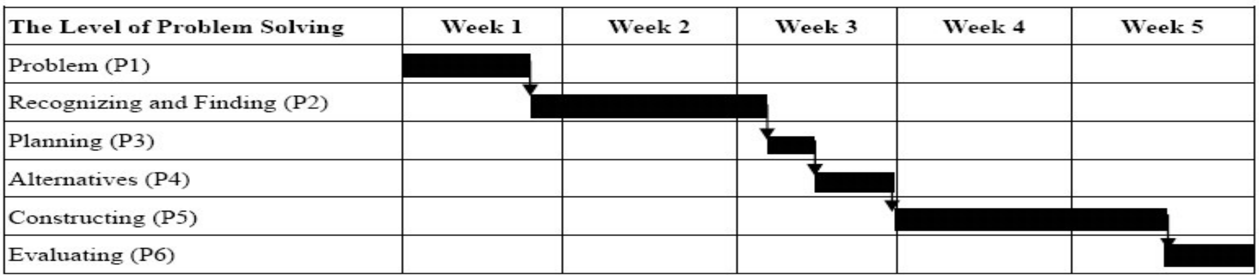

Figure 1. The Level Results of Six Groups' PBL Solving