

Designs of learning environment for effective pbl in engineering school

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Abstract- This paper investigated the effectiveness of the newly designed learning environments and examined the ways to improve the PBL activities to adequately applicate the learning system of PBL to enhance creative problem solving skills on learners. With study's principal focused on improving the learning environment, the procedures of the study included: stages presented, assignments, learning management, learning activities, support and reflection. The results shown over the two semesters showed significantly high satisfactions of the participants on the newly improved and implemented learning environments (stages presented (94.44%), assignments (97.22%), learning managements (100%), learning activities (100%), support (97.22%), and reflection (91.66%)). Furthermore requests were made by other professions who planned on introducing the PBL activity system for uses in their lectures. Such implications give arise in achieving the ultimate educational goal of School of Engineering of training a professional intellectuals with creative problem solving abilities.

Keywords- PBL (Problem-Based Learning), Creative Problem Solving, Learning Environment, Learning Operating, Learning Activities.

1. Introduction

1.1. Research necessity and aim

In our knowledge based society, creativity is a foremost required skill of every individuals. It furthermore contributes as a fundamental basis in bringing innovative developments and therefore is being recognized as a survival requirement in this 21st century. The long practiced Socratic Method in current school education system poses difficulties in training creative intellectual human resources required by the knowledge based society. Therefore it is necessary to provide new learning environments where creativeness can be developed [1]. The teaching strategy of repetitive learning or one time training where the learners obtain one or two abilities, should be avoided and changed learning environment where creativeness can be developed should be provided to the learners [2]. Information technology showed promising results in achieving cognitive improvements in higher order thinking skills of the learner. This is due to information technology's nature of allowing multiple and various expression, time-space compression, unlimited access to information, and eased interactions. Therefore usage of information technology, such as Internet, can contribute in the transition from the traditional educational environment to a new innovative learning environment. This research was aimed to develop a learning environment where the Problem

Based Learning (PBL) strategy can be effectively implemented in order to improve the creative problem solving skills in relation to the learning curriculums. Furthermore to investigate its practicality by applying it on learners with the intention of engaging other professors of Engineering School of implementing PBL in their own classes [3-4].

2. Body

2.1. Development of learning environment principles for PBL

The development of learning environment principles for PBL deduced from previous theoretical studies of creativity education, PBL and creativity in relation to learning curriculum are as follows. Firstly, in the procedures presentation stage, a navigation system should be provided to support the sequential activities of creative problem solving module for an effective process of creative problem solving. Secondly, the acceleration principle of convergent and divergent thinking states that balanced usage of convergent and divergent thinking is the key aspect in enhancing creativity [5]. Thirdly, in the principles of metacognition, a feature which supports the metacognition should be planned. Through reviews and controlling the progression of problem solving, learners are engaged to actively select adequate procedures and tools that can be placidly used to support the metacognition [6]. Fourthly, in reflection principles, engagement, satisfaction, interest and other internal motives are elements of creativity production and its importance is being recognized by many researchers [7]. Fifthly, in the principles of information provision, when utilizing the creative learning style, it is important that the learner is familiarized with the usage methods of the tools given and that they are able to select and use the tools without the conscious thinking and rather routinely [8]. Sixthly, in the principle of management style, effective learning systems such as online or blended learning systems were incorporated in when the learning environment was designed to help the progression of creative problem solving [5]. Seventhly, in the principles of learning approach, many researchers have emphasized that in developing creativity, cooperative environments where learners are engaged in a group as a team, is very important [9]. Eighthly, in the principles of support system, systems that can aid in creative problem solving such as websites, web based supporting tools or supporting systems should be developed and provided [5]. Lastly, in the principle of assessment styles, practical and realistic assessments are to be developed to provide a creative thinking experience [11-15].

2.2. Procedures in developing a learning environment for PBL

This study aimed to develop a learning environment for an effective PBL activities in solving creative problems. To achieve this purpose, previous studies on creative problem solving modules were analyzed. Supporting Learning environment for creative problem solving and effective PBL activities were designed, implemented on learners and its effects were tested. The effects of learning environment were taken into the consideration and six out of the stated principles were used mainly. Such development principles were implemented in real university classes and feedbacks were collected from the learners to examine its effectiveness.

2.2.1. Areas of improvement identifications of developed principles based on learner feedbacks

Creative problem solving development principles were built based on previous literature reviews and it was implemented in real university classes. Areas for improvements were identified by reviewing the feedbacks given by the learners.

2.2.2. Participants

The participants of the field application research were composed of first year students enrolled in a course offered only in second semester, Introduction to Designs. 77 participants were enrolled in this course in 2012. Also from 77 participants, 36 students further partook in the study and enrolled into Engineering Designs 1 course that was offered to second year students in the first semester of 2013. In the Introduction to Designs course, most of the students comprised of first year students except for few second to fourth year students and foreign students. In the Engineering Designs 1 course, most of the students were of second year students except for few third or fourth year students and foreign students. Furthermore most of the participants were majoring in Computer Engineering except for few students of other majors.

2.2.3. Class Implementation

The Introduction to Designs and Engineering Designs 1 courses were delivered for 15 weeks by the researcher of this paper and it was comprised of lectures and PBL system based creative problem solving. The lectures were given in combination of theory and practical. Class procedures started by dividing the participants in teams for PBL activities. In PBL activities one PBL problem was carried out in three weeks. In the first phase of activities, participants confirmed the problem and were tasked to make, present and submit an assessment plan. In the second phase, individuals were engaged in an individual activities and after, team members gathered and combined the individually collected data to produce and present their report. In third phase, problem solution was made by each teams and presented it in a PowerPoint format. Self-reflection was completed at the end of each PBL problems and participants were required to write about what they learned and what they felt and application method. Lastly, at the end of the semester's course, participants were to submit a class evaluation.

2.2.4. Data collection and analysis

Self-reflections, submitted at the end of each PBL problems, and class evaluations, submitted at the end of the course,

were analyzed, used and further data was collected through researcher observation.

2.3. Field Application

2.3.1. Presentation of stages

In the principles of stage presentation, a PBL model, that can effectively support the progress of creative problem solving, should be presented. In this study, Dick & Carey's proposed model in 2001 and Trop & Sage's model were based in development of PBL instructional designs to produce (Figure 1) [10].

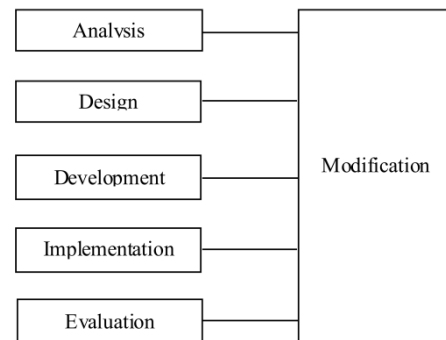


Fig 1. PBL Instructional design model

2.3.2. Assessment Style

In the principle of assessment style, the most important element in creative problem solving is to properly recognize the problem. In the first semester, the problem was printed and given as an offline format and in the second semester, problem was given as multimedia format through online.

2.3.3. Learning Management Approach

Management principle is developed to aid in creative problem solving process and learning environments such as online, blended learning or other effective environments are designed. Learning environment is a very important element in maximizing the abilities learnt through the PBL activities. Through discussions learners developed the communication and presentation skills. Through questions and answers, learners developed a sharp judgment skills and analytic skills. Lastly blended learning environment was used in adequate learning stages to develop evaluation skills.

2.3.4. Learning Activities Approach

In principles of learning approach, resource sharing and communication space were provided that each team can work cooperatively to creatively solve the given problem. In the first semester the discussions were held in a regular laboratory room. In the second semester, improvements were made for the learning environment and discussions were held in a lecture room designated only for PBL activities. Away from the school premises, the learners were able to communicate and continue their discussions through social media network such as Kakaotalk and Band.

2.3.5. Support System

The principles of the support system was to design a web based supporting tools and systems to assist in the creative

problem solving. One of the important objectives in PBL activities is to improve individual learning abilities. Through the support of web based applications, Cyber Campus, provided by the school, learners were able to engage oneself in preparing and researching to improve their ability in problem solving. Furthermore, students were allowed the usage of laptops in lectures to engage them in the learning activities. At out of school premises, students were encouraged to make full use of their smartphones.

2.3.6. Reflection

In the principle of self-reflection support, a review system where students were able to look back on their experiences and ideas in PBL problem solving activities was designed. Self-reflection is an important element where individual learning ability can be developed through the usage of learnt contents. Students were asked to complete the reflection after they had given a solution to each of the PBL problems.

3. Conclusions

This paper aimed to design learning environments where learning curriculum and PBL, a teaching technique that has shown to improve creative problem solving abilities, are incorporated to apply it on actual students to investigate its effectiveness. Furthermore it aimed in invigorating the usage of PBL. The designed learning environments were inspired by previous researches of past papers and the designed environment was applied to real classes. Improvements to the designs were made through feedbacks given by the participants. The applied principles were focused on improving learning environments and they were procedures presentation stage, assessment, learning management, support system, and self-reflection. Through many years of conducting PBL system based classes, further improvements were made through the self-reflections of the participants and researcher observations. Evaluations on improved learning environments that were made through two semesters of self-reflections showed significantly high satisfactory levels (Stage presentation (94.44%), assessment (97.22%), learning management (100%), learning activities (100%), support (97.22%), and reflection (91.66%)). Moreover, usage requests were made by other professors who have been planning to use PBL activities in their own lectures. This implications help achieve Engineering School's educations ultimate goal to train professional intellectuals with creative problem solving abilities.

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