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Problem based learning in mechanical engineering to train student's creativity

I Setyowidodo*, Sutanto, A D Handayani and H Mahmudi

Universitas Nusantara PGRI Kediri, Kediri, Indonesia

*Corresponding author's email: irwan.setyowidodo@gmail.com

Abstract. Creative thinking skills is highly significant thinking skills that will be increasingly necessary because of the increase in complex problems caused by the rapid development of technology and social movements worldwide. Therefore, educators should train the creativity to their students in order to enable their success as future citizens. Student creativity is very important in the teaching and learning, its because every student are unique, so they are always have their own creativity. PBL should be implemented in various disciplines, such as in Mechanical engineering Programs. Using a problem-based learning approach is an alternative and effective way to introduce, discuss, and learn about a given (creativity) topic or concept. The purpose of this learning model develops high-level thinking skills in problem-oriented situations and integrates new knowledge to train student's creativity, providing authentic issues and meaningfully emphasized real time data from websites. This type of research is a quasi-experimental research with Pre-Test - Post Test Experimental design. Implementation of development procedures in this study include (1) research and information collection; (2) planning; (3) development of initial product form; (4) field test and product revision; (5) revision of the final product; and (6) dissemination and implementation. Data collection using test, observation, documentation and interview techniques. The quantitative data analyse with one sample t test. Real time data is information delivered immediately after the observation or data collection, various real time data can be collected through the address of the website in the internet. The module product in this study is a learning model device that integrates real time data to train student's creativity. This study shows that the implementation of Problem Based Learning can enhancing the creativity of Mechanical Engineering Students Program in Universitas Nusantara PGRI Kediri.

1. Introduction

Mechanical Engineering Lessons generally require Physics as the basis of science. Students argue that physics lessons are difficult because they encounter many mathematical equations so that physics is also identified with numbers and formulas such as physics. As a result, the expected learning objectives become difficult to achieve, both in terms of motivation and learning achievement. In reality today, lecturers dominate learning activities. This can be seen from the way lecturers teach that is by explaining the material in front of the class, without involving students to participate actively in the learning process. This causes real intelligent students to experience difficulties in expressing their ideas or ideas. To be able to overcome this, an effective way to increase the independence of learning and the development of ideas is through the learning process.



Each educators want to acquire the student to be creative and have the critical thinking skills. So, during the learning activitie, the lecturer must give them with the complex problems like the problems in everyday lives that usually they know [1]. Problem-based learning (PBL) is an ideal learning approach that can used by the teacher to help students for solving the nonroutine problems [2]. In PBL process, all the students find solutions to complex problems by discussing with their classmates [3]. PBL involves active student learning as opposed to traditional passive learning methods. Based on the There are many researchh that shows that the students seems enjoy discussing with their friend in a group, and it is very different with the conventional learning just like when they are only listen the teacher explanations [4].

Engineering Physics is one of the topics that aims to develop scientific skills, attitudes and values. For this reason, students are required to be competent in using language to understand, develop, and coordinate ideas from information in order to interact with others. The active role of students in teaching activities can be observed through the characteristics [5]; (1) Each student shows his role as 'main character' in learning activities. (2) The large number of students who ask critical questions. (3) The large number of students who answer questions raised by their opponents in a good and systematic language. (4) The number of students who respond to questions and answers from their opponents. (5) There is an attitude that shows respect for the opinions of others.

Self-Regulated Learning is an effort to regulate oneself in learning by including metacognition, motivation and active behaviour. Students who have Self-Regulated Learning will actively engage in learning activities [6]. So, if students feel that a lesson or discussion is not understood by students, then students will be more active to be able to learn it. Such as planning what will be studied again, monitoring the learning outcomes, evaluating learning outcomes that are learned, repeating, organizing learning, trying to achieve optimal performance, and including seeking help from friends, lecturers or people who are considered more understanding. The use of Self-Regulated Learning as a form of student effort in motivating themselves to achieve optimal results in learning. So, it can be said that the better Self-Regulated Learning, the better the results of achievement can be achieved. Conversely, if students have low Self-Regulated Learning, they are less able to plan, monitor, evaluate learning well, are less able to manage good potential and resources and so on, so that the results of their learning are not optimal, in accordance with their own potential. it has.

The novelty of this research is the implementation of PBL is by added with real time data and website. PBL uses real time data and the website is a realization of the view of constructivist teaching. Vigotsky in Arends explained that constructivist theory is the basic foundation for PBL to emphasize that students conduct investigations in their environment and build meaningful personal knowledge [5]. PBL uses real time data if applied consistently in the classroom can develop problem solving skills, creativity, and self-confidence [7]. PBL can also help students gain independence and professional skills in dealing with complex problems, interdisciplinary and real problem situations, and able to foster creative ideas to find solutions [8]. The implementation of real time data and websites through PBL makes the role of students able to reach the layers of society in various parts of the world.

2. Methods

This type of research is a quasi-experimental research with Pre-Test – Post-Test Experimental design. This research takes one class in Mechanical engineering in Universitas Nusantara PGRI Kediri that get the course of machine Physics. There are 26 students such a sample of this research. Activities in this study can be specified in stages (1) reviewing some literature to study learning theories related to student learning independence. (2) formulating learning methods to train learning independence based on students. (3) validate learning methods and devices through Focus Group Discussion (FGD) activities. (4) implementing the learning method to train student learning independence. This Data analyse with one sample t test.

3. Results and Discussion

The learning outcomes of applying PBL using real time data on the website in the course of Physics Engineering shows that the student learning independence was increase with the implementation of PBL using real time data on the website in Physics Engineering learning. In this study, students are given problems about real time data that they can learn through the internet. The problems presented in PBL are problems related to real problems or daily life problems that are often encountered by students. The problems presented in each meeting are adjusted to the topics studied at each meeting. In each learning, students are required to be active in solving the problems presented to them, this is in accordance with PBL's characteristics as student centered learning. In each meeting presented through PBL, lecturers do not dominate learning, but students must be active in discovering new knowledge themselves that they will learn. The role of the lecturer in PBL is as a facilitator and provides guidance and direction that is necessary.

Problem Based Learning (PBL) provides students with the opportunity to gain content theory and knowledge and understanding [8]. PBL meets Four Essential Rules Of 21st Century Learning containing (1) instruction should be student-centred; (2) education should be collaborative; (3) learning should have context; and (4) schools should be integrated with society. The principle of Learning should have context is almost the same as one of the characteristics of PBL which is to present authentic problems in learning [5]. Learning is not very meaningful for students if it does not affect their lives outside the place of study. Therefore, subject matter needs to be linked to students' daily lives. Lecturers develop learning methods that enable students to connect with the real word, helping students find values, meanings and beliefs about what they are learning, and can apply in their daily lives [9]. Considering that problems in daily life always develop in the direction of information and technology advancement, the learning process using PBL is also required to experience changes, among them the presentation of authentic problems can be integrated with technology. Authentic problems today are not enough in the environment around students, but from all problems around the world can be easily known thanks to the advancement of information technology.

Therefore, the presentation of authentic problems in PBL can use real time data which is a collection of data information that is delivered immediately after making observations or collecting data [7]. Implementing real-time data in learning makes the problem more unstructured. Students are allowed to feel real-world problem solving using real-time data in the same way that scientists do. Various real time data that will be used must be effective and efficient in supporting the learning process. Given that most of the learning process is carried out in the classroom, various real time data related to subject matter can be collected in website addresses that provide real-time data on the internet [9]. As observed values are constantly updated, sometimes the numbers consist of only the present value [10].

4. Conclusion

This research shows that PBL with real time data on the website in the course of Physics Engineering can be implemented by integrating steps of PBL but we use the authentic problems based on real time data on the website. This study shows that the creative thinking skill of student that get the course of Physic Engineering that implemented by PBL was increase.

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