Enhancing senior high school students’ creative thinking skills using project based e-learning

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Abstract. This study is aimed to identify the effectiveness of project based e-learning to enhance creative thinking skills in high school students. The students were asked to build magnetic car and rocket car from recycled materials. These projects were used to study Newton’s laws of motion. The used method was quasi experiment with pretest-posttest control groups design. This research was conducted at SMA Negeri 5 Purwokerto. The population in this research were all students of the 10th grade of science major (N=250). There were two sample classes, i.e. one experimental class (N=30) and one control class (N=30) selected with random sampling technique. The data used creative thinking skills test and were analyzed by using Independent Sample t-test. The data result shows that the significance level is below 0.05 and also shows that N-gain score of students’ creative thinking skills in experiment class is higher than control class. This indicated that project based e-learning is effective to enhance the students’ creative thinking skills in Newton’s laws of motion.

1. Introduction

One of the capabilities that high school students is necessary to have is creative thinking skills [1]. Creativity becomes the focus of preparing students and prospective citizens to face uncertainty and to adapt to constant change both personally and professionally [2]. Many industries rely on the creative thinking skills of their workers to keep the industry running and is able to compete with other industries [3]. Creative thinking skills of human resources of a nation can also be a determinant of the nation’s superiority [4]. However, creative thinking skills of students is still in the low category [5]. Creative thinking skills is difficult to develop when the learning process does not involve students actively in concept formation [6].

In the learning process, teachers still use teacher-oriented learning methods; thus, the interaction in the learning process is less effective in involving the creative thinking skills of students [5]. Creative thinking skills is the ability to think that begins with a person’s sensitivity to the problems faced and give new ideas to the individual or express ideas that are diverse to solve the problems [7][8][9]. In addition, [10] argues that students need open exercises and activities that lead to different thoughts and perspectives. Furthermore, students have the freedom to choose the means and tools to achieve the answers [11]. The characteristics of creative thinking skills according to Torrance are fluency, flexibility, originality, and elaboration. Creative thinking skills is difficult to develop when the learning process does not involve students actively in the concept formation [6]. The project learning model that involves student activity during learning is
characterized by the autonomy of students, constructive investigation, goal setting, collaboration, communication, and reflection in real-world practice [12].

The project based learning is a suitable learning model used in the implementation of XXI century skills because during the learning process, the students engage in a collaborative learning in real learning situations [13]. Project based learning provides opportunities for students to work in collaboration. Creativity assessment can be done through project based learning in specific areas, such as problem solving and design. With the opportunity given by the students in project learning, it can grow creative thinking skills of the students [14].

Project based learning is a learning that centers on the student activity in designing, planning, and executing projects, and producing projects that are published or presented to solve real-world problems [12][15][16][17]. Distinctive characteristic of project based learning is that it is project-centered [18]. During the problem-solving process, students go through the stages of questioning and filtering questions, debating ideas, making predictions, collecting and analyzing data, drawing conclusions, and communicating findings with the other groups [19]. Throughout the project, teachers should continue to assess the progress of their students, provide feedback, and appreciate the achievement and success. It is very important to recognize and encourage students’ creative thinking skills [20].

On the other hand, one of the principle of learning is utilizing information and communication technology to improve the efficiency and effectiveness of learning [21] and forcing the society to be able to participate in the mainstream of development [22]. E-learning is a general term for the use of electronic technology in learning [23]. The use of LMS like Edmodo can be a delivery systems of material and connect teachers and students in working on projects [20]. Edmodo is one of the social networks that have some features and can support learning [24]. It is one of the applications in which teachers are able to distribute and share the teaching materials, so that students can learn and communicate via computer anytime and anywhere without being limited by space and time [25][26][27][28]. Edmodo can be used as a technology aid that is integrated with e-learning-assisted project based learning model or project based e-learning.

Activities carried out by students are in the form of initial assignments through quiz feature, management of reference sources in the backpack feature, working on project creation procedure through the assignment feature, and communicating the project.

2. Methods

This research is aimed to identify the effectiveness of the project based e-learning to enhance the creative thinking skills in high school students. This research was conducted at SMA Negeri 5 Purwokerto on even semester of 2017/2018 academic year. The population were all students of 10th grade of science major (N=250). There were two sample classes, i.e. one experimental class (N=30) and one control class (N=30) selected with random sampling technique. This research focus on Newton’s Law of Motion subject material. The research design was pretest-posttest control group design as showed by Fig. 1 below.

The enhancement of students in creative thinking skills data collecting by the scores of pretest-posttest. The pretest was given at the beginning of learning to students both in experimental class and control class. After given the pretest, the students of experimental class used project based e-learning while students in the control class used conventional learning by teachers. At the end of learning, the posttest was given to student in experimental class and control class.

| Experiment | O1 | X | O2 |
|------------|----|---|----|
| Control    | O1 | X | O2 |

Figure 1. Experimental design
The learning used project based e-learning with blended learning method, which combined online learning by using Edmodo and interface. The project learning syntax used is according to [29] by integrating the use of e-learning. The syntax of learning is shown in Table 1.

| Syntax of Project Based Learning                  | Activities     |
|--------------------------------------------------|----------------|
| start with the essential question                | online         |
| design a plan for the project                    | online         |
| create a schedule                                | online         |
| monitor the students and the progress of the project | online        |
| assess the outcome                               | interface      |
| evaluate the experience                          | interface and online |

In the experimental class, students were assigned to create two projects such as magnetic cars and rocket cars based on recycled waste. The tasks of this project was done in groups. The magnetic car was used to study Newton's first law and Newton's second law. Meanwhile, the rocket cars were used to study Newton's second law and Newton's third law. The students were given freedom in designing the project. During project creation, the students also used student worksheets provided by the teacher. In the control class, students used discussion lessons led by teachers.

The instrument to measure student’s creative thinking skills was a test consisting of eight essay questions which are related to Newton’s laws of motion. The creative thinking skills questions indicator were fluency, flexibility, originality, and elaboration. These items had been tested to 34 students of the 11th grade to determine their validity and reliability. This test results were analyzed by QUEST program. Infit mean square showed that the item fitted with the rasch model if the value is in the interval of 0.77 to 1.30. Infit t indicates item’s acceptability (valid) if the value is in the interval of -2.0 to + 2.0. All items fitted with rasch model and valid. The test reliability was 0.77 with accepted category.

2.1. Analysis of Creative Thinking Skills Achievement

Normality Test was used to determine the normal distribution of data. Normality test was done with the Shapiro-Wilk test. The data result is normal distribution because the probability is less than 0.05. Homogeneity test was used to know the research population is homogeneous or not. Homogeneity test carried out by the homogeneity of variance through SPSS Program. The samples come from a homogeneous population because the probability calculation is greater than 0.05. Hypothesis in this research include:

H₀: Project based e-learning doesn’t significantly influence students’ creative thinking skills
H₁: Project based e-learning does significantly students’ creative thinking skills

Calculation was done to answer this hypothesis by using test Independent Sample t-test by SPSS. The test criteria is H₀ is rejected if significance level is below 0.05.

3. Result and Discussion

3.1. Result

The data analysis technique consisted of descriptive analysis and statistical analysis. In the descriptive analysis, the data were explained based on average, standard deviation, maximum score, and minimum score. Meanwhile, in the statistical analysis, the data were elaborated based on Independent Sample t-test. The data in statistical analysis is the result from students’ score of the pretest and posttest. The significance level used was 0.05. The result of creative thinking skills test are shown in Table 2.
Table 2. Result of creative thinking skills test

|                           | Control class | Experimental Class |
|---------------------------|---------------|--------------------|
|                           | Pretest       | Posttest           | Pretest | Posttest |
| Max score                 | 45.00         | 47.50              | 45.00   | 55.00    |
| Min score                 | 17.50         | 80.00              | 17.50   | 92.50    |
| Average                   | 31.67         | 61.83              | 32.67   | 71.58    |
| Std Dev                   | 6.41          | 7.93               | 6.88    | 7.73     |
| Sig-value in normality test | 0.792       | 0.211              | 0.715   | 0.814    |
| Sig-value in normality test of N-gain | 0.130       | 0.319              |         |          |
| N-Gain                    | 0.438         | 0.578              |         |          |

The calculation result of Independent Sample t-test showed that sig value is 0.000. This score is below than 0.05, thus H₀ is rejected. The result is project based e-learning does significantly students’ creative thinking skills. Furthermore, the N-gain score of experimental class is higher than N-gain score of control class. These results indicate that students’ creative thinking skills in experimental class is better than the students’ creative thinking skills in control class.

3.2. Discussion

Physics learning using project based e-learning is blended learning in which the learning is carried out online and by interface. This online learning is assisted by Edmodo. Edmodo is an application that appeals to teachers and students with social elements that resemble Facebook, but there is actually a greater value in this social-based educational application [30]. The learning stages of the project in this study consist of starting with the essential question (online), designing a plan for the project (online), creating a schedule (online), monitoring the students and the progress of the project (online), assessing the outcome (interface), and evaluating the experience (interface and online). By using e-learning, teachers and students can communicate all the time. In addition, teachers can also monitor the progress of the tasks assigned to students and students can also see the progress of their own learning. This is in line with the results of [31] research that physics e-learning is effective because the students can see the progress of their own learning and it is not limited by teachers or other students. Using e-learning can facilitate the limitations of space and time between students with teachers, students with students, and students with materials [32].

Projects assigned to the students on learning using project based e-learning are magnetic cars and rocket cars. This project making was done at home in group. During the project development, the teacher monitored the progress of the group project and asked about the obstacles that the students faced when making the project through Edmodo. In addition to that the students can see the reference through the search engines, they can also see several references that teachers give to Edmodo. This project was given to study Newton's laws of motion. The projects that students make were used to study Newton's first law, Newton's second law, and Newton's third law. Through a magnet car, students can learn the concept of inertia associated with Newton's laws, what factors influence the inertia, and some examples of inertia phenomena that can be seen through the use of projects. In addition, by using magnetic cars, students can also experiment with variations in mass and style variations to be able to see their effect on acceleration.

In a rocket car, students can study the effect of object acceleration on the angle of the field or the angle of force applied to an object. In addition, through a rocket car, students can learn examples of the direct application of Newton's third law of action-reaction force in everyday life. Assessing the outcome or trial of project results was carried out in interface activities in the classroom. Each group tested the project that had been made, then experimented with the project that had been created and answered the questions in the student worksheet. The group then communicated the results of the experiment in interface and communicate the report online using Edmodo. Using Edmodo during online learning (project-based e-
learning) can be an alternative in overcoming the time needed by students during project creation. The use of online features in project learning can increase students’ preparedness and shorten the time required for learning [33]. The use of Edmodo facilitates and supports the learning process and improves the effectiveness of learning communication [34].

The analysis of the enhancement of creative thinking skills of students in both experiment class and control class was done by using pretest and posttest value. Based on Table II, the enhancement of creative thinking skills in the experimental class is higher than the control class. Learning with project based e-learning can enhance the students' creative thinking skills [35] [36] [37] [38]. In the result of the students’ answers on the creative thinking test of the experimental class, there are still more than 50% of the total students answered less precisely about the Newton’s third law. This question asked the students on how Newton’s third law explains the action-reaction force to the collision between the bus and the pedestrian. Some students still had difficulty in connecting Newton’s third law principle to the magnitude of the force that bus give to pedestrian and the magnitude of force that pedestrian give to bus. Students can mention Newton’s third law principle, but the answers from some students explained that the bus’ force given to pedestrian is greater than the pedestrian’s force given to the bus. The students concluded that since in reality, when there are pedestrian hit by buses, the pedestrian will appear to be bouncing. On the other hand, the bus masses is larger than pedestrian, so the bus’s force to pedestrian is larger than pedestrian’s force to bus. From these results, it explained that students see that the larger the mass can result in the greater force. In this case, students are expected to see a comparison of the force that the bus gives to pedestrian and the pedestrian gives the bus is equal, but in different directions. This is in accordance with the principle of Newton’s third law, that is, to every action there is always opposed to equal: and the mutual actions of two bodies upon each other are equal, and directed to contrary parts [18]. Therefore, it is necessary to emphasize the concept in teaching Newton’s third law principles so that the students can understand it thoroughly.

4. Conclusion

Based on the results of research and discussion, it can be concluded that project based e-learning is effective to enhance the students' creative thinking skills in Newton's laws of motion significantly. The implication of the result of this study is that it is necessary for teacher in emphasizing more attention in teaching and explaining the principle of Newton's third law to the students so that they can gain deep understanding and can be used in looking at the phenomena that occur in daily life.

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