Analyse of creative thinking ability of vocational students after waste management project-based learning

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Abstract. One of the abilities that must be developed in 21st century learning is think creatively. The ability to think creatively is part of creativity that involves developing ideas and products the problems solve. This study aims to analyze the creative thinking skills of vocational students on waste treatment materials by applying project-based learning (PjBL). The study used weak experimental method by using one group pretest-posttest design. The subject of study was grade 10th students at one private high school in Cianjur. Data collection of students' creative thinking used essay test. Essay test of creative thinking ability consists of five indicators namely (1) fluency, (2) flexibility, (3) originality, (4) elaboration, and (5) sensitivity to problem. The result shows that the highest gain score was fluency, with gain score of 12 and the lowest gain score obtained by sensitivity to problem with gain score of 5. The effectiveness of PjBL was seen from index N-gain with a medium category (0.40). The finding revealed that PjBL is quite influential in improving the students creative thinking abilities, especially in contextual teaching material such as waste management learning.

1. Introduction

Twenty one Century Learning is a learning approach that was developed to global challenges in the 21st century. Among them are the ability to develop critical thinking skills, have the ability to communicate effectively, innovate and solve problems through negotiation and collaboration. The four global challenges require thinking skills which include logical, analytical, critical and creative thinking skills. The ability to think creatively is an important aspect of contextual learning to be able to successfully face a complex world.

The ability to creative thinking skill is the ability to create new ideas that can be relatively surprising and valuable in many ways, because the ability to think creatively is related to new things, the ability to create things, apply new forms and to produce a lot of imaginative skills and to make something that already exists new [1] [2]. The ability to think creatively can also be defined as a whole set of cognitive activities used by individuals following certain objects, problems and conditions, or types of efforts towards certain events and problems based on individual capacities [3].

Factor analysis have five traits characterize the creative thinking abilities including: a. smoothness (smoothness), b. flexibility (flexibility), c. originality (originality), d. decomposition (elaboration), and e. reform (redefinition) [5]. The five indicators of creative thinking ability are then updated by researcher which consists of: a. fluency, in which there are several aspects, namely the ability to produce ideas,
ways, suggestions, questions and various alternative answers smoothly within a certain time, b. flexibility, namely the ability to generate various ideas, answers or questions where ideas or answers are obtained from different points of view by changing the way of thinking and the various approaches used. c. originality, which is the ability to produce phrases, ways, or ideas to solve problems or make unusual or unique combinations of parts or elements that are not thought of by others. d. elaboration, namely the ability to enrich, develop, improve, describe or determine the details of objects, ideas, products or situations to make it interesting, and e. metaphorical thinking, namely the ability to use comparisons or analogies to create new networks [5]. The ability to think creatively is one of the important components in contextual learning to successfully challenge a complex world [6]. Based on a set of skills and aspects contained in it, that the ability to think creatively is different from analytical and practical thinking. The ability of creative thinking can integrate various kinds of problem settings and problem solving skills with meaningful solutions [7].

Improving students' creative thinking skills depend on the selection of teacher learning models in each biology material that will be delivered. Researcher explained that one of the learning models that can improve student performance in managing creative thinking skills is the project based learning (PjBL) learning model [8]. The PjBL model can make students more active because it can involve students to learn to develop problems and find answers by gathering information so students become more creative in answering various contextual problems [9].

Project-based learning model is a project-based learning model characterized by the design process in the form of sketches or drawings, containing complex tasks based on questions and problems that require students to work through a series of stages of the scientific method [10] [11]. The project based learning model (PjBL) can develop students' mindset so that they can bridge students to develop their creativity [12].

Project-based learning that is closely related to students' contextual issues is very suitable for Vocational High School students who aim to produce graduates who are competent in their fields so they can directly enter the workforce. Vocational High School aims to prepare competent human resources to enter the workforce, become a creative and productive workforce. Vocational High School graduates need to be equipped with the ability to think creatively as a provision when dealing with the world of work, so the ability to think creatively which is one aspect of learning in the 21st century can be mastered vocational students in facing global challenges in the 21st century.

2. Method
The research method used in this study was the type of weak experimental design research, it is because in this study there are no comparison groups or control groups and there are only experimental groups [12]. The research design applied in the study was a one-group pretest-posttest design, there was one group that was measured or observed before treatment (pretest) and after being given treatment (posttest). The table shows the research design used in the study.

| Class | Pretest | Treatment | Posttest |
|-------|---------|-----------|----------|
| A     | O1      | X         | O2       |

Population in this study consisted of grade X students in one of the Vocational High Schools in the city of Cianjur in the even semester 2019-2020. The research sample was chosen based on the use of purposive sampling technique so that the sample chosen in the study was a class based on the consideration of the researcher that could allow the research to be carried out. The data collected was obtained from the cognitive test sheets of students' creative thinking abilities that the researchers had modified according to contextual teaching material. Data analysis was obtained from the average results of students' pretest and posttest and N-Gain acquisition so that they could see the effectiveness of project-based learning in identifying students' creative thinking abilities. Criteria for students' creative thinking abilities and N-Gain criteria obtained can be seen in Table 2 and Table 3:
3. Result and Discussion

3.1. Acquiring Scores for Creative Thinking Aspects
The ability to think creatively consists of five aspects of assessment which consist of: 1) fluency, 2) flexibility, 3) originality, 4) elaboration and 5) sensitivity to problem. The five aspects are identified using the rubric of creative thinking ability from each question raised to students who have been grouped before in each aspect of creative thinking ability.

Five specs of creative thinking ability are known at the lowest average pretest score obtained by the aspect of fluency with an average score of 17 and the highest score obtained by the aspect of sensitivity to a problem with the acquisition of a score of 26. The aspect of fluency is an aspect of writing ideas compiled by students from the problem raised. On average before the project-based learning takes place each student can only propose one or two ideas in overcoming the proposed problem. The results are still relatively low because each student is expected to be able to write a contextual idea of each environmental problem so that the idea or idea can give birth to inspiration in the treatment of environmental waste [15]. Students still have difficulty in presenting ideas that are in accordance with the problem of waste raised from each question. The highest score on a student's pretest is obtained in the aspect of problem sensitivity, it is because each student on average can write two or three problems according to the discourse in the question asked. Research [16] explains that students have a high level of environmental awareness, but in general, students still have a low participatory attitude in efforts to protect and improve the quality of the environment. The students’ creative thinking score showed in figure 1.
The acquisition of the lowest average results in the post-test post-project learning is carried out in the aspects of flexibility and elaboration with a score of 26. In general, students have been able to write two to three waste recycling products, and the average student has been able to write tools and materials in full from filing waste products that will be recycled by students. These results are better than the previous pretest results, this is because in the project-based learning process several systematic learning steps must be applied to students, so students are trained to be able to infer ideas or ideas related to waste management problems. This is in line with research by [17] that the ability to develop students’ creative thinking abilities which consist of several stages such as research, technology, morals, and results can help improve logical thinking, enhance creative abilities more broadly and can encourage students to conduct scientific research. The process of elaboration and flexibility that requires students to be able to do the details of systematic work steps in writing the idea of waste recycling products can be encouraged by the process and stages of project-based learning that demands to work systematically and scientifically from each student. The highest score in the aspect of creative thinking ability in the post-test was obtained in the aspect of sensitivity to problems with a score of 31. Overall, of the five aspects of creative thinking ability, there was a significant increase in score. Research [18] explains that project-based learning can positively influence students’ attitudes towards the environment and can contribute to more effective environmental education. Students are expected to be sensitive to the environment and be able to produce creative ideas that can reduce environmental problems.

3.2. Increased Creative Thinking Ability

Improvement of students’ creative thinking skills is obtained from the average percentage scores obtained by all students before the project-based learning is carried out (pretest) and after the implementation of project-based learning is carried out (posttest). The pre-test results show that all students have good enough creative thinking skills, the pre-test results that show a score of 53 can be categorized that all students can think creatively. Increased student creativity by using project-based learning is due to the project-based learning model can increase student motivation so that it can directly identify day-to-day contextual problems through the development of projects and the process of discussion between student groups effectively [19] [20] [21] [22].

| Table 4. Average pre-test, post-test and score N-gain |
|------------------------------------------------------|
| **Average Percentage (%)**                          |
| **Pretest** | **Posttest** | **N-Gain** |
|-------------|--------------|------------|
| 53          | 72           | 0.40       |

Project-based learning that emphasizes student activities in designing project planning and manufacturing waste products can improve student ability scores in developing creative thinking skills. The average score obtained by all students when implementing project-based learning has been carried out by 72. That is because according to Bell (2010) [23] learning by making teaching aids that are done collaboratively can train students’ skills in communication, critical thinking and active learning.

4. Conclusion

From the research results obtained there are several conclusions, namely: The percentage of overall student scores has an increase in scores of 19% with an N-Gain score of 0.40 and can be categorized as having a moderate increase. Teacher preparation and performance in providing project-based learning largely determine changes in vocational student learning outcomes in understanding and developing creative thinking skills that consist of five aspects such as fluency, flexibility, originality, elaboration, and sensitivity problems. Project-based learning on waste material also aims to enable students to increase their sensitivity and care towards the school environment, to create a clean and comfortable environment for learning that will affect student learning outcomes as a whole.
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