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THE EFFECT OF PROJECT BASED LEARNING WITH VIRTUAL MEDIA ASSISTANCE ON STUDENT'S CREATIVITY IN PHYSICS

Gunawan*, Hairunnisyah Sahidu, Ahmad Harjono, and Ni Made Yeni Suranti
Faculty of Teaching and Education Sciences, Mataram University
email: gunawan@unram.ac.id

Abstract: Physics learning should be able to provide opportunities for learners to be creative in understanding the things that learned. One of the efforts made to improve the quality of physics learning was to apply the model of project based learning with virtual media. This study aimed to examine the effect of virtual media-aided model toward students' creativity. This quasi experimental study used pretest-posttest control group design. The research instrument used a verbal and figural creativity test which had been validated by experts. Hypothesis test used employed variance test. The increase in creativity was determined based on the results of the N-gain test. The results showed that there was an increase of students' creativity in both classes. The experiment class had a higher creativity increase than the control class. Verbal and figural creativity improved in both classes. Verbal creativity increased higher than figural creativity. This shows that the model of project based learning with virtual media that applied successfully improve the students' creativity in physics learning.

Key words: ***project based learning, virtual media, students' creativity***

EFEKTIVITAS PENERAPAN MODEL PROJECT BASED LEARNING BERBANTUAN MEDIA VIRTUAL TERHADAP KREATIVITAS FISIKA PESERTA DIDIK

Abstrak: Pembelajaran fisika seharusnya mampu memberikan peluang bagi peserta didik untuk berkreasi dalam memahami hal yang dipelajari. Salah satu upaya yang dilakukan untuk meningkatkan kualitas pembelajaran fisika adalah dengan menerapkan model project based learning berbantuan media virtual. Penelitian ini bertujuan menguji pengaruh model berbantuan media virtual terhadap kreativitas peserta didik. Penelitian kuasi eksperimen ini menggunakan pretest-posttest control group design. Instrumen penelitian menggunakan tes kreativitas verbal dan figural yang telah divalidasi oleh para ahli. Uji hipotesis menggunakan uji t polled varian. Peningkatan kreativitas ditentukan berdasarkan hasil uji N-gain. Hasil penelitian menunjukkan adanya peningkatan kreativitas peserta didik pada kedua kelas. Kelas eksperimen mengalami peningkatan kreativitas yang lebih tinggi dibandingkan kelas kontrol. Kreativitas verbal dan figural mengalami peningkatan pada kedua kelas. Kreativitas verbal meningkat lebih tinggi dibandingkan kreativitas figural. Hal ini menunjukkan bahwa model project based learning berbantuan media virtual yang diterapkan berhasil meningkatkan kreativitas peserta didik dalam pembelajaran fisika.

Kata kunci: ***project based learning, media virtual, kreativitas peserta didik***

INTRODUCTION

Essentially science encompasses process, product, and attitude. As a process, science focuses on how to gain knowledge. As a product, it stresses more on what can be the outcome of knowledge. While as an attitude, science pays attention more on the efforts of equipping, training, and infusing positive values to the students. Students studying science should be assisted in developing their potentials and also be equipped with needed skills in order that they are able to be creative in solving the problems they encounter. The role of teachers is essentially vital in assisting the students in all three aspects mentioned above.

During learning process teachers must be able to devise appropriate learning model and media in order to create encouraging atmosphere and to motivate students to actively participate in learning process. Various problems experienced by the students can in fact be coped by choosing

appropriate learning model (Luthvitasari & Linuwih, 2012:93). Employing inappropriate learning model will result in seemingly less optimal outcome. Learning model and media in use should be able to help teachers in building good interaction with the students so that they are able to comprehend learning materials and be creative in solving a problem. One of the models which can be potentially applied is project based learning.

Project based learning is a learning model which is capable to teach the students about the process in solving various problems (Thomas, 2000:2). Project based learning is able to guide students in conducting a group research of a project so that they can gain new insights and solve a problem with their knowledge (Bell, 2010:39). The effectiveness of project based learning is also conveyed by Amanda, Subagia & Tika (2014:6) who state that the model is suitable to be employed in science learning since it is capable to increase students' self efficacy, that is firm conviction and self-confidence in performing a task.

The application of project based learning in classes is based on the steps developed by The George Lucas Educational Foundation in 2007, which includes (1) starting with the essential question, a thorough investigation on the topic which is going to be studied. Questions are asked to encourage students to give response to the topic derived from their initial knowledge; (2) designing a plan for the project, planning project activity to answer the proposed questions; (3) creating a schedule, the teachers guide the students to arrange a timetable for the project accomplishment; (4) monitoring the students and the progress of the project. Teachers monitor students' performance in accomplishing a project assignment and guide them to develop their projects; (5) assessing the outcome. Teachers make assessment during students' working on a project and evaluate the progress as well as give necessary feedback; (6) evaluating the experience. Students are required to express their learning experience about the ongoing project and their understanding about the proposed topic by presenting in front of the class. Teachers carry out some reflection over the students' learning experience and the accomplished project. At this stage the reflection is directed toward each student and group.

Project task can be considered a form of contextual learning based on open activity, which signifies the process of a collaborative task, and is done in learning process of certain period (Hung & Wong, 2000:36). Trianto (2014:51) states that project based learning might stimulate learner's motivation, process, and increase students' learning achievement by employing problems related to particular subjects in real setting. Project based learning has great potential to create an attractive and meaningful learning experience for the students, particularly when they have to deal with real jobs in industry. The selection of the project should consider its nature and type in order that students are able to execute the project well and thus increase their knowledge. In carrying out project based learning, teachers should design the learning atmosphere in a way so that students are able to experience real situation with real problems, including material comprehension on certain topic of the subject, and accomplish other meaningful tasks.

This research was carried out by combining the use of model and virtual media. Virtual media is digital media using computer technology for virtual experiment. It was equipped with instruments and materials similar to those used in real experiment. Virtual media designed for experiment usage is commonly known as virtual laboratory. It is intended to give users the experience of using, obtaining, and increasing scientific process skills (Mutlu & Sesen, 2016:1). Students who use virtual media such as virtual laboratory as learning media have higher capability in comprehending and presenting the material they study (Aldrich, 2009:3). Similar conclusion is also conveyed by Magyar & Žáková (2010:3) in their research stating that students' motivation to more actively participate in learning and developing various skills can be increased by the use of virtual laboratory.

Creativity refers to students' ability to discover and employ new ideas which can be unconventional, bizarre, or even strange, but are still rational in the scope of learning. Creativity as a quality inherited by a gifted individual is assumed as something given by nature, some

people have it, while other do not, and is not a result of any form of education (Munandar, 2012:27). It has the power and potential to make an individual do better in most aspects, such as in career and in life as a whole. Creativity, in fact, is not genetic, but acquired through habit. In other word, it is a skill which can be trained. School task as an essential factor in creating good human resource should be able to generate students' creativity. Marisi (2007:170) states that one of the biggest problems in developing students' creativity in schools today is teachers'' inability to measure students' creativity during learning process. This happens because most teachers do not understand the type of creativity to be measured and the strategy used to measure it. Furthermore, the absence of concussive school environment and comprehensive system of assessment pose another obstacle for the development of students' creativity.

A result of creativity measurement of students majoring in science in one of senior high schools shows low score in all basic skill, processing skill, and investigative skill. This leads to the fact that teachers have not sufficiently developed students' creativity in science process skill (Subali, 2011:141). Teacher is the decisive factor in developing students' creativity. There is a demand for the teachers to employ appropriate model, strategy, and approach which can develop students' creativity in solving a problem. This is important because creativity is the ultimate goal of education around the world (Rawat, Qazi & Hamid, 2012:264).

Creativity reflects an individual's personality in the sense that positive creativity will certainly reflect positive personality potential. An individual's creativity can indeed be developed through learning process, and the result will reflect something new and valuable with the condition that he or she directly involve in the process (Wyse & Ferrari, 2015:33). In education, creativity includes how students undergo a process creatively and how they formulate and solve a problem, with cognitive thinking is involved in both processes. (Jausovec, 2011:54).

Contextually, creativity encompasses individual's key skill, and is a form of intentional effort, carried out in certain context, and it requires a new creative and useful product (Kampylis & Valtanen, 2010:198). In general, creativity is originated from scientific discoveries and comprises an integral part of problem solving. It includes fluency, flexibility, an ability to elaborate, and ability to evaluate (Rahayu, Susanto & Yulianti, 2011:108).

Creativity measurement cannot be separated from the basic concept stating that creativity is a process of detecting and observing the existence of a problem, proposing a hypothesis, assessing and testing the hypothesis, changing and reassessing the hypothesis, and finally presenting the result (Marisi, 2007:171). Thus, creativity process always results in something new, original, and meaningful. The goal of a creativity test is generally to measure students' creativity in solving a problem, both verbally and by writing.

Munandar (2012: 31) explains that test to measure creativity can be done for both aptitude traits or cognitive feature of creativity and non-aptitude traits or affective affective feature of creativity. The test can also be in the form of verbal or figural. Verbal test is useful to detect students' ability in creating and expressing ideas through writing related to the given topic. Meanwhile, figural test is used to measure students' ability in expressing ideas through certain figures and forms related to a given topic. Based on background of the problem explained above, the article will discuss the effect of project based learning with virtual media assistance toward students' creativity in physics learning.

METHODS

This quasi-experiment research was carried out to students of one of senior high schools in Mataram. The samples of the research were determined by cluster random sampling method and divided into two classes. The two classes of samples were then divided into experiment class and control class, with equal number of students, thirty students in each class. The research also employed pretest-posttest control group design.

There are two variables in this research; independent variable and dependent variable. The variable dependent is the model of project based learning with virtual media assistance.

The experiment class was given treatment using model with virtual media assistance, while the control class was given treatment conventional model using direct instruction. The dependent variable in this research was students' creativity, while the other control variable was kept in stable condition. Data on students' creativity were acquired through essay test which covered both verbal and figural test which had been validated by experts. Hypothesis test was done using t-test with polled variant. A test of data homogeneity and normality test was done before the hypothesis test was carried out.

In the execution of the research, students were introduced a project after being encountered with an essential question by taking a problem from real environment. After that, the virtual media was introduced to the students in planning the project execution. The next step was arranging a timetable for the entire project execution. This activity was done by teachers and students. The project was in the form of task sheet which should be accomplished by students by using virtual media. Teachers assessed students' work in the task sheet every meeting. In the end of learning activity, teachers gave assessment for students' task sheet/project in the form of portopholio. In the evaluation stage, teachers underwent a reflection on the accomplished project.

Learning activity in class using virtual media can be divided into four stages according to allocated time. Those four stages are introduction to the program (introduction), identification of design plan, obstacles, and data (brainstorming), designing and testing (design), and sharing and participating in discussion (share).

In introduction stage students were introduced to virtual media and given important guide on the function and use of the media. This stage also included the discussion about the planning and rules of project execution. In this stage students were instructed to identify and compare the data (brainstorming). The design stage was met on the supervising the progress of the project. Here, students began working on the project using virtual media which was then converted into simple product, testing the developed design and recording every datum acquired in work sheet. The last stage, the share stage, was met on the assessment of students' work. Students were asked to share their finished project and teachers gave assessment to the project both individually or in group.

Creativity test was given before and after the treatment. The increase in creativity in both classes was calculated, both in general aspects and in verbal and figural aspect. The increase in students' creativity was determined from the nominalized gained score (N-gain). This was done to avoid any mistake in interpreting students' acquirement of gain. To obtain N-gain score, the following formula was used (Cheng et al, 2004:1449).

$$\text{N - gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \text{ x } 100\%$$

Explanation:
N-gain > 70% (high); 30% ≤ N-gain ≤ 70% (average); and N-gain < 30% (low).

RESUL AND DISCUSION

Result

This research was aimed at testing the effect of project based learning model with virtual media assistance toward students' creativity in physics learning. Creativity measured in this researched included verbal and figural creativity. This research applied project based learning model with virtual media assistance for the experiment class and direct instruction model for the control class. Both classes were given a pre-test in order to identify the initial creativity before the treatment. A post-test was done after the treatment to find out the effect of the treatment on students' creativity. Figure 1 shows the average pre-test score, the average post-test score and N-gain for both classes.

The pre-test data shows that the initial creativity of both classes is relatively similar or at the same level, both gain low score. This similarity is also confirmed by the result of homogeneity test of both sample class that points to the fact that variant of both classes came from group with similar initial ability.

The post-test result shows that the treatment given to both classes has significant effect, which can be seen from the average score of the post-

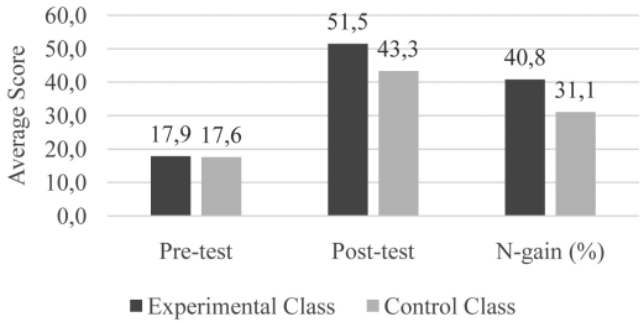

Figure 1. The Comparison of Creativity Test Result between Experiment Class and Control Class

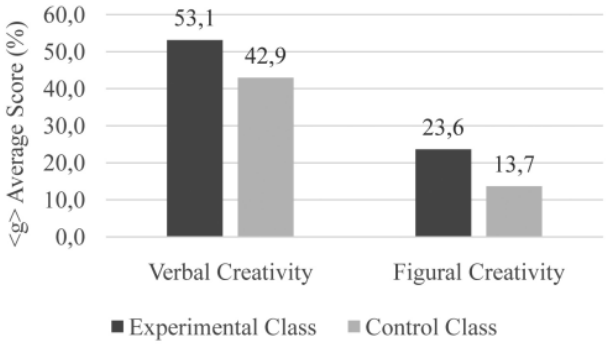

Figure 2. Comparison of the Increase in Verbal Creativity and Figural Creativity between Experiment Class and Control Class

test which is higher than that in pre-test. The data also shows that the experiment class gain higher average score than the control class. The increase of creativity in both classes can be seen from the N-gain, with both classes are in the average category.

Based on normality test it can be derived that the data of creativity test from both classes are normally distributed. Next, hypothesis test was carried out using t-test with polled variant. The result shows that the value of $t_{count} > t_{table}$ (3.21 > 2.00), so that it can be concluded that there are effect of project based learning model with virtual media assistance on students' creativity in learning physics. Project based learning model combined with virtual media gives positive effect on students' creativity from the experiment class. The increase in these two aspects was then compared in both classes as shown by Figure 2,

In both classes, the increase in verbal creativity is higher than that in figural creativity. This shows that the students have higher ability in thinking divergently to combine ideas verbally concerning a problem which is reflected in their fluency, flexibility, and originality in thinking than in negotiating their ideas in the form of figures or shapes.

Discussion

This section will explain several details related to the findings and analysis of the research. The result of the analysis will be discussed in general, from students' initial ability to the increase of creativity of both classes. This section will also give comprhensive review on aspects of creativity, verbal and figural, with reference of relevant studies.

Based on the acquired data, the initial ability of both classes are relatively at the same level and can be categorized as low. It is because students had not received explanation on material about optical devices so that they did not understand the

concept when they did the test. They only relied on their initial knowledge that they got from the previous level of education where they were not given any material or test on creativity.

In general students were not familiar with instrument of creativity measurement whether verbal or figural. The situation can be understood since in general students tended to adapt their learning method to instrument model used by their teachers. Conventionally test used by teachers in physics only measured students' ability in mathematical calculation from equation given during the class. Students were rarely given chance and challenge to answer questions with varied answers. With this condition, it took time and process to train students to get used to the new model. This happened to both classes.

After being given treatment, students in both classes showed significant increase in creativity. This can be seen from the average score in the post-test in both classes. The average result of creativity test in the experiment class using project based learning was higher than the control class using direct instruction. This proves the occurrence of effect of the treatment on students' creative ability. In project based learning, students tended to be more active and enthusiastic in working on the given project. This positive attitude helped them to produce better product in their projects. This too signifies a higher degree of creative ability. The increase of students' creative ability was also shown by the result of creativity test. This is in accordance to what Doppelt states (2003:55) about the advantage of project based learning. Project based learning is a well-known method to apply cognitive competence and to create flexible learning environment, and is able to excel students with low learning achievement, increase students' learning motivation and self-imaging in all levels to achieve significant effective learning.

Project based learning with constructivist findings is really helpful for students in in gaining deeper comprehension about the material when they are actively constructing their understanding by accomplishing a project using their own ideas (Krajcik & Blumenfeld, 2006:317). In his research Blumenfeld et al (1991:392) concludes that learning based project might significantly increases students' motivation and cognitive ability to perform better in class. In fact, when students are more active in learning process, they certainly gain better learning achievement.

From the research, there was significant increase in students' creativity in both classes. The amount of increase in creativity can be seen from average score of N-gain. The experiment class has average score of 40.8%, which is higher than the average score of the control class with 31.1%. The increase of creativity in both classes is categorized as average. Higher increase of creativity in experiment class is an implication of the treatment in the form of virtual media assistance. The result is consistent with other research combining learning model with computer technology in various forms. For example, Land & Greene (2000:45) in their research combining the use of hypermedia system in project based learning, conclude that project based learning combined with information technology contributes greatly in encouraging scientific research that directs students to the awareness of the problems in real life.

Another research by Chan Lin (2008:55) on the use of technology in project based learning also shows that all students participating in the project are able to achieve the goals of their projects which can be seen from their achievement related to their skill development and ability to synthesize and elaborate knowledge, their positive attitude to participate in scientific exploration, and their willingness to use technology to conduct and report their research. Husein, Herayanti & Gunawan (2015:224) also came to the same conclusion about this learning model stating learning model with interactive multimedia assistance could help students in mastering physic concepts and increase students' critical thinking ability.

Students participating in project based learning with media assistance achieved higher score in the post-test compared to those in the control class. This is also in line with Barak & Dori's research (2005: 117) which concludes that students' involvement in project based learning with computer technology assistance has significant effect in test result and was able to increase students' mentality and their understanding about concepts they learn.

Similar conclusion is also conveyed by Herayanti & Habibi (2015:66) stating that there is an increase in concept mastery and critical thinking ability of the students who learn physics, especially on concepts of static electricity. Romansky's research (2010:136) also confirms the conclusion stating that virtual laboratory is effective in a project accomplishment and provides students with complex knowledge. Harms (2000:1) states that virtual laboratory as a simulation in learning process might help us to solve complex problems, find new content, devise new assessment model for known information through discovery learning, transfer of conceptual and procedural knowledge, because it refers performance preparation and evaluation on laboratory experiment.

Virtual learning environment in this research gave positive effect to the students. They experienced exciting learning process because virtual media in some respects could be compared to physics games. This was very useful to reduce stress during learning physics. This condition encouraged students to ask questions and to be more creative in learning physics. This is in accordance with Byron, Khazanchi & Nazarian's research (2010:201) that discovered the impact of stress toward creative performance which is more complex than in previous environment. Although, there should be further research on what level and condition of stress that actually affects creativity.

Another conducted by Garaigordobil (2006:341) also points out verbal and figural creativity. Meanwhile, Jackson et al (2012:370) the players to predict all creative moves. Many experts believe that playing video games is related creativity without consideration to gender.

Çelik, Sari & Harwanto (2015:48) reveals that virtual environment with simulation program gives positive impact in increasing students' understanding. Furthermore, Evans, Yaron & Leinhardt (2008:208) also confirm the positive effect of the use of virtual laboratory media on students' post-test.

The combination of model and virtual media also helps students to increase their understanding about concept and also their creativity. This is supported by the findings of previous research. Nisrina, Gunawan & Harjono (2016:70) in their research found that students from the experiment class comprehend and evaluate learning better than do the control class because they conduct experiment using virtual media which helps them to identify required variables. (Kollöffel & Jong (2013:375) also conclude that learning model using virtual laboratory has the ability to increase students' learning achievement significantly, especially related to their understanding about concept and procedural ability in solving complex problems. Ismail, Permanasari & Setiawan (2016:245) also believe that STEM virtual laboratory could increase students' scientific literacy significantly based on the result of N-gain test.

Project based learning is an effective educational approach which focuses on creative thinking, problem solving, and students' peer interaction to create and make use new knowledge (Trianto, 2014:43). Project work with virtual media assistance generates students' enthusiasm to actively participate during learning process.

Learning process employing this model motivates students to gain best experience about a given task or a project. Students are given chance to freely and creatively design and choose the project. This is true for students who learn by using learning model with virtual media assistance. They were open to new ideas, input and information, including criticisms from their peers during presentation. Gunawan & Liliasari's research (2012:198) which points out that the disposition of students' critical thinking in learning physics with virtual laboratory is higher than that of students learning conventionally. With this learning model, disposition indicator of truth-seeking and open-mindedness can be increased. Truth-seeking refers to the habit of always seeking the best comprehension about certain situation based on related arguments and evidence. Open-mindedness indicator, on the other hand, is related to an open attitude toward new ideas and information derived through virtual experiment.

Current research not only tried to find out the increase of creativity in general, but also analyzed every aspect of creativity, both verbal and figural. Based on the data gained, it can be

concluded that there is an increase in verbal and figural creativity in various degree. In both classes, the increase of verbal creativity is higher than that of figural creativity. The increase of verbal creativity is at average level, while the increase of figural creativity is still considered low in both classes.

Many researches on science learning confirm the notion that the most effective learning happens when it is related to real life context because a deeper understanding occurs when a student actively constructs meaning based on his or her own experience and interaction (Krajcik, & Blumenfeld, 2006:319).

In general, creativity is seen as a work or an action, or even a creative product whose focus is on creative environment or creative process (Toivanen, Halkilahti, & Ruismäki, 2013: 1176). This proves the significance of learning environment to generate creativity, whether verbal creativity or figural creativity. In his research Garaigordobil (2006:329) found out that there is significant positive effects of the treatment on the increase of both verbal and figural creativity, especially related to three indicators; fluency, flexibility, and originality. Fluency is closely related to the ability to generate ideas; flexibility refers to ability to shift from one approach to another or one way of thinking to another; while originality concerns about the capacity to derive more tangible and acceptable new ideas or new solution.

The increase of figural creativity in both classes is categorized as low. This occurred because students were not familiar with the type and evaluation of creativity test questions, especially when they were asked to express their idea in the form of drawing or completing pictures from shapes and lines given to them. This fact is supported by the result of interview from several students and teachers saying that there had not been such evaluation before, whether in physics learning or in other science subjects. This is in line with what O'Reilly, Dunbar & Bentall (2001:1073) found that there is a difference in creativity, whether verbal or figural, between students from two different study programs, from students in literature students and students in creative art. Students in creative arts have higher average figural ability than students in literature. This shows the difference in training, habit, and learning environment applied to develop students' creativity. Research conducted by Wu, Cheng, Ip & Chang (2005:321) shows that students who have higher score in problems related to real life perform lower in figural tasks, while in verbal tasks all students perform almost similarly. The result is interpreted based on the interaction between task structure and students' knowledge. Knowledge increases one's performance in creativity tasks in which knowledge is dominant.

Although the increase in both class is low, the data shows significant margin of 9.9%, between pre-test and post-test with experiment class has higher score than the control class. It is partly because the experiment class was given project task, while the control class was not. The activities included in the project task drawing design, drawing objects, and drawing perspective. Students were also asked to draw several displays occurring on monitor during virtual experiment and then produced explanation for the images. These activities helped to motivate students to be more active in accomplishing the project given to them.

Students were asked not only to work on project tasks, but also to practice their ability to communicate. They were assigned to write a report on the project and then presented it in front of the class. In this occasion they were also asked to express their feeling and experience during the accomplishment of the project. In this way, students' creativity to convey an idea verbally can be well-developed. This is one of the factors that led to the increase of students' verbal creativity.

Both verbal and figural creativity can be increased in every collectively planned task. This is because the two creativities are highly related. It confirms Palaniappan's research (1998:381) which points out that verbal and figural creativity index are highly related one to another. Wechsler (2006:15) also believes that that verbal creativity and figural creativity are significantly related. In his research he found that the correlation between verbal and figural creativity highly depends on model of treatment given to the students and on the type of instrument used to measure every type of creativity.

In his research, Sternberg (2010:325) asserts that creativity is in general different from intelligence. Learning and teaching process that encourages and appreciates creativity may improve students' school performance so that they can make various decisions that will increase their creativity in learning process. The research of Sen & Hagtvet (1993:497) shows the significantly positive relation between creativity and personality dimension. In addition, Preckel, Holling & Wiese (2006:159) found positive correlation between intelligence and creativity, with the strongest correlation in verbal creativity.

Although there is a strong correlation between verbal and figural creativity, this research found significantly different increase in both creativities. It is probably caused by the treatment model, type of assignment, and exercises given to the students. This pattern is in fact also found in other research. For example, Yong (1994:739) found that the level of intelligence has a close correlation to verbal creativity, while it does not have significant correlation to figural creativity. Similar pattern is also found in a research conducted by Ekasari, Gunawan & Sahidu (2016:109) which concludes that direct learning model with virtual laboratory assistance is suitable to increase verbal creativity in the material of elasticity but not effective in increasing figural creativity.

Researches on creativity in other fields of study also confirm this conclusion. Wicaksono (2009:11) in his research concludes that creativity in music learning significantly increases students' interest in learning activity. This obviously deals with the freedom to express through musical instruments and songs. Webster (1974:227) asserts that musical achievement has significant correlation to all modes of creative behaviors and constitutes the best single predictor in each mode. Figural creativity correlates significantly with creativity improvisation and analysis and constitutes significant predictor. Verbal creativity significantly correlates with creativity in analysis, but does not constitute good predictor if it is not combined with other variables such as composition and improvisation ability.

The application of project based learning model with virtual media assistance is also capable of increasing students' mastery of concept in optical devices. Suranti, Gunawan & Sahidu (2016:78) in their research found that there is increase in students' mastery of concept in optical devices in project based learning model with virtual media assistance. The highest increase in concept mastery occurs in sub-concept of eye, while the lowest is sub-concept of camera. In this physic concept, concept mastery of the experiment class is higher than the control class. This result is in line with the research conducted by Gunawan, Setiawan & Widyantoro (2013:31) which points out that learning model with virtual experiment is able to increase the logic inference and physics concept building ability. Another research by Tüysüz, C. (2010:37) also shows that the application of virtual laboratory gives positive effect on students' attitude and achievement compared to traditional learning model.

CLOSING

Based on the findings and analysis of the research, it can be concluded that there are positive effects of project based learning model with virtual media assistance on students' creativity in physics learning. The experiment class which was given treatment gained higher average creativity score than the control class. Both classes achieved increase in creative ability at average degree. In general, the increase of creativity of experiment class is higher than the control class. Seen from every aspect, the increase of creativity, whether verbal or figural, occurred in both classes. In both classes, verbal creativity increased greater than figural creativity. Verbal and figural creativity in experiment class was higher than the control class. The increase of verbal creativity in both experiment and control class is at average category, while the increase of figural creativity in both classes is still at low category. This signifies the finding that students' ability in the experiment and control classes was higher in divergent thinking to combine ideas verbally than their ability to negotiate their ideas through shapes and pictures.

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