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The Effect of Project Based Learning Model based on 3D Media on Creative Thinking Skill in Biology Learning

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ABSTRACT

Learning in the 21st century creates real changes in the world of education that focus on the learning process. One of the skills that students must have in the 21st century is the skill to think creatively. However, the results of the measurement of creative thinking skills that researchers conducted at SMAN 16 Semarang in August 2023 using human circulatory system material showed that students at SMAN 16 Semarang had low creative thinking skills as evidenced by the results of the creative thinking skills test on 3 indicators, including fluency indicators had a percentage of 40%, flexibility indicators had a percentage of 38%, and originality indicators had a percentage of 22%. The learning model that can develop creative thinking skills is the Project Based Learning model based on 3D media. The purpose of this study is to analyze the effect of Project Based Learning model based on 3D media on creative thinking skills in biology learning. The novelty in this research is using the 3D media-based Project Based Learning model. The type of research used in this study is quasi-experiment with Nonequivalent Control Group Design. The sampling technique used was Random Sampling with samples of class XI.1 as the experimental class and class XI.3 as the control class. The data collection techniques used in this study were interviews, observations, documentation, and pretest-posttest sheets about creative thinking skills. The results showed that there was an effect of 3D media-based Project Based Learning model on creative thinking skills in biology learning, this can be seen from the One Way Anacova test analysis of creative thinking skills with a significance value of 0.000 <0.05.

Keywords: creative thinking skill, 3D media, project based learning

INTRODUCTION

Learning in the 21st century creates real changes in the world of education, where learning is no longer focused on the results achieved, but on the learning process itself (Stemi and Evi, 2022). 21st century biology learning is closely related to C4, namely: 1) Creative Thinking, which means that the learning process is a space for students to innovate while the teacher acts as a facilitator; 2) Critical Thinking, which means learning is a stage that allows critical thinking by linking contextual problems and life problems; 3) Communication, which means teacher and student learning creates multi-directional communication, students explain their opinions based on experience; 4) Collaboration, which means learning is the stage of creating conditions where students can learn together or in groups (Amri and Muhajir, 2022).

One of the important 21st century skills that students have is the skill to think creatively. Creative is the skill of students to develop their imagination about new things, unite ideas and the skill to develop ideas from previous ideas (Sari and Manurung, 2021). Creative thinking skill is a stage that is able to dissect certain ideas that arise from students, which then become a new thought or information that answers the questions that arise (Lestari and Ilhami, 2022). The most crucial component of pupils' skill to solve issues, generate a variety of ideas, and be open to differing points of view is their capacity for creative thought. Students should practice creative thinking since it can help them become more adept at extending their efforts and coming up with original ideas and innovations (Widia et al., 2020). Creative thinking skills are important in changing students' mindset towards problem solving, so that learning can be successful in accordance with learning objectives (Purnamaningrum et al., 2012). The development of creative thinking skills is an important basis in forming a competent generation in overcoming challenges and changes in the era of globalization and increasing the skill to solve problems creatively (Muliardi, 2023).

The results of research on the creative thinking skills of Indonesian students are still low, this is evidenced by a number of research results, namely in the research of Rinia and Irwandi (2021), which states that students at SMAN 1 Lebong are still lacking in creative thinking, seen in the results of student pretests on fluency indicators by 24%, flexibility indicators by 29%, and originality indicators by 21%. Putri and Alberida's research (2022) also stated that the creative thinking skill of students at SMAN 1 Pariaman was low, which was seen in the results of student pretests on fluency indicators of 48.2%, flexibility indicators of 27.4%, and originality indicators of 12.9%. The low level of creative thinking skill is because in the learning process, teachers rarely apply an interactive learning process, teachers only use the lecture method and students only listen, causing unexplored creativity in students (Putri and Alberida, 2022).

The results of the measurement of creative thinking skills that

researchers conducted at SMAN 16 Semarang in August 2023 using human circulatory system material showed that students at SMAN 16 Semarang had low creative thinking skills as evidenced by the results of the creative thinking skills test on 3 indicators, including fluency indicators had a percentage of 40%, flexibility indicators had a percentage of 38%, and originality indicators had a percentage of 22%. Based on the measurement data, it can be concluded that the creative thinking skill of students at SMAN 16 Semarang still needs to be improved.

The low skill of creative thinking is due to a factor, namely the learning model (Sari et al., 2019). The results of interviews with biology teachers at SMAN 16 Semarang stated that in the biology learning process teachers usually use the Small Group Discussion model. The teacher uses the Small Group Discussion model by using student worksheets and making mind mapping. The teacher grouped the students into 4 groups. Each group consists of 8 students. The teacher directs students in the process of working on student worksheets and making mind mapping. The results of working on student worksheets and mind mapping are presented to other groups, then the results are evaluated and concluded.

The observation results show that learning using the Small Group Discussion model carried out by the teacher has things that must be improved, including 1) giving careful instructions to students needs to be improved, 2) the concept of implementing the learning process with the Small Group Discussion model does not emphasize students' skill to think creatively, 3) supervision of the course of learning needs to be improved, so that all students can be active in group work.

Solutions that can be done to develop creative thinking skills are project-based learning. Project-based learning can train students in developing creative thinking skills (Putri and Alberida, 2022). The Project Based Learning (PjBL) model uses projects as the core of learning, making students the center and providing meaningful learning to them. The project to be implemented can be a group or individual project that is carried out systematically and focuses on solving real problems to create a product whose results can be displayed (Stemi and Evi, 2022). The PjBL model is important to apply in the learning process because it can train students in solving real-world problems and challenges by developing creative thinking skills. This learning model encourages students to be creative thinkers and also motivates them to learn (Stemi and Evi, 2022).

The skill to think creatively in students can be realized in a project to make three-dimensional (3D) media, where students are trained in creative thinking to produce products in the form of 3D media, where this media is media that has physical characteristics and shapes of length, thickness, height, and can be observed from any direction, so that it can be known from any angle. 3D media also includes artificial learning process media because it can form real objects again with different sizes (Arifudin et al., 2019). The advantages of 3D media are 1) providing direct

experience; 2) presenting objects concretely and preventing verbalism; 3) showing the shape of the whole object; 4) showing the organizational structure clearly; 5) seeing the real object in detail (Sutiono et al., 2021; Fatasya et al., 2023; Kristina, 2023). Previous research shows that 3D media can improve students' creative thinking skills in biology learning (Vari and Bramastia, 2021; Panjaitan et al., 2023).

The PjBL model can be applied to learning materials that aim to facilitate students in solving problems that can develop creative thinking skills in students. One of the materials that can be used is circulatory system material which has learning outcomes, namely analyzing the relationship between organ structure in the organ system with functions and disorders that arise in organs. The results of the analysis of the learning process achievements in the circulatory system material are very compatible with PjBL and can be realized in the form of 3D media in developing students' creative thinking skills.

A number of previous studies have shown that the PjBL model can develop creative thinking skills (Erlinawati, 2018; Nasution et al., 2021; Handoko et al., 2022). Based on a number of previous studies, the PjBL model can develop creative thinking skills. The novelty in this research is to use a 3D media-based PjBL model. The difference between this research and previous research is different in terms of material and research location.

Based on the description of the problem, it is necessary to carry out research to hone 21st century skills, so this study aims to determine the effect of the 3D media-based PjBL model on creative thinking skills in biology learning.

METHOD

Research on the effect of 3D media-based Project Based Learning model on creative thinking skills in biology learning was conducted at SMAN 16 Semarang in December 2023 - February 2024. This research is quantitative in nature using the Quasi Experiment method and the research design of Nonequivalent Control Group Design, which is research that applies an unequal form of learning process in two groups or classes. The sampling technique in this study was based on the data of UTS scores of XI MIPA class students totaling 177 students and obtained homogeneous data variance, so that random sampling technique was applied. The results of sample selection using random sampling technique obtained a sample of 2 classes, namely class XI.1 as the experimental class and class XI.3 as the control class.

Learning in both classes was carried out on circulatory system material that has learning outcomes suitable for measuring creative

thinking skills. The control class received instruction using the Small Group Discussion (SGD) model, which is the typical method used by teachers, whereas the experimental class received instruction using the Project Based Learning model based on 3D media. The stage before treatment is a pretest given to both classes as a measurement of initial creative thinking skills. The creative thinking test questions are in the form of essays that refer to the Busyairi and Sinaga (2021) indicators which can be seen in Table 1. The questions have been tested constructively, validity, reliability, difficulty level, and differentiating power.

Table 1. Indicators of Creative Thinking Skill

Indicator	**Description**
	Creative Thinking Skill in Problem Finding
Fluency	Able to find a variety of correct problems accompanied by correct reasoning
Flexibility	Able to look for various problems from different points of view with correct reasoning
Originality	Able to find a variety of unique and relevant problems with correct reasoning
	Creative Thinking Skill in Solution Finding
Fluency	Able to find a variety of correct problem solutions accompanied by correct reasoning
Flexibility	Able to find various solutions to problems from different points of view with correct reasoning
Originality	Able to find a variety of unique and relevant problem solutions with correct reasoning

(Source: Busyairi and Sinaga, 2021)

Biology learning in the experimental class was conducted for 6 meetings with each face-to-face meeting consisting of 2 hours of learning and project time was carried out at home in groups for 2 meetings. Biology learning in the control class was conducted for 6 meetings with each face-to-face meeting consisting of 2 hours of learning. The implementation of learning was observed by a biology teacher and a fellow student to ensure that learning went according to the existing syntax. The observation results showed that the learning went well according to the syntax. The experimental class learning output results in the form of 3D media products, while the control class learning output results in the form of student worksheets that have been answered.

The posttest was given to both classes when the treatment was completed. The posttest was used to measure the final results of the treatment that had been applied to the experimental and control classes.

RESULTS AND DISCUSSION

The One Way Anacova test results in Table 2. has a significance value of 0.000> 0.05, this shows that there is a significant effect of the Project Based Learning model based on 3D media on creative thinking skills in biology learning. These results are also supported by the research of Nurfaturrohmah et al., 2020; Siskawati et al., 2020; Fitriyah and Ramadani, 2021; Lestari et al., 2021; Mokambu, 2021; Amri and Muhajir, 2022; Handoko et al., 2022; Riak and Hananto, 2023; Altatri, 2024 which explains that the Project Based Learning model can affect creative thinking skills in biology learning.

Table 2. Results of One Way Anacova Test on Creative Thinking Abilities

Tests of Between-Subjects Effects					
Dependent Variable: Posttest					
Source	***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	1703.123[a]	2	851.561	74.703	.000
Intercept	2741.321	1	2741.321	240.483	.000
Kelas	1486.503	1	1486.503	130.404	.000
Pretest	2.766	1	2.766	.243	.624
Error	763.748	67	11.399		
Total	388307.000	70			
Corrected Total	2466.871	69			

R Squared = .690 (Adjusted R Squared = .681)

The LSD test results in Table 3. show that there is a real difference in the application of the 3D media-based Project Based Learning model to creative thinking skills in biology learning with a corrected average value of 79.105 compared to the application of the Small Group Discussion model with a corrected average value of 69.381. These results are also supported by the research of Insyasiska et al., 2017; Wahyuni, 2019 which explains that there is a significant difference in the application of the Project Based Learning model in the experimental class compared to the application of the conventional model in the control class on creative thinking skills in biology learning.

Table 3. LSD Test Results about Creative Thinking Skill

Class	**Average Difference**	**Corrected Average**	**LSD Notatiom**
Eksperiment	9,723*	79,105	a
Control	-9,273*	69,381	b

Creative thinking skills in each indicator can be improved by using the Project Based Learning model, this is because the Project Based Learning model emphasizes students in developing the skill to find problems and developing new ideas or ideas in solving biological problems (Amri and Muhajir, 2022).

The experimental class's skill to think creatively has been enhanced by the application of the project-based learning paradigm using 3D media and syntax. The Project Based Learning model's syntax consists of the following steps: 1) choosing the project; 2) organizing the steps needed to finish it; 3) creating a schedule for its implementation; 4) completing the project with the help of teachers and monitoring; 5) creating reports and presenting the project results for publication; and 6) project evaluation (Anggraini and Wulandari, 2020).

The first syntax is determining the project. The teacher and students determine the project in the form of making 3D media related to the circulatory system that will be done by students. The project to be done is listed on the student worksheet that the teacher has prepared which contains the problem of human circulatory system disorders. This syntax encourages students to develop fluency thinking skills, namely students can get a variety of problems and solutions to problems that are appropriate with the right reasons (Riyadi et al., 2018). Project determination syntax has an effect in improving fluency indicators. The fluency indicator in the experimental class has a higher increase of 11% (85% to 96%) which can be seen in Figure 1. compared to the increase in fluency indicators in the control class which is 1% (89% to 90%) which can be seen in Figure 2. According to Afriana et al. (2016), the increase in fluency indicators occurred due to the determination of projects that were arranged through taking topics based on real-world realities and starting from an in-depth investigation that gave students direction in making projects that could train students to come up with diverse ideas or ideas.

Figure 1. Diagram of Creative Thinking Skill of Experiment Class

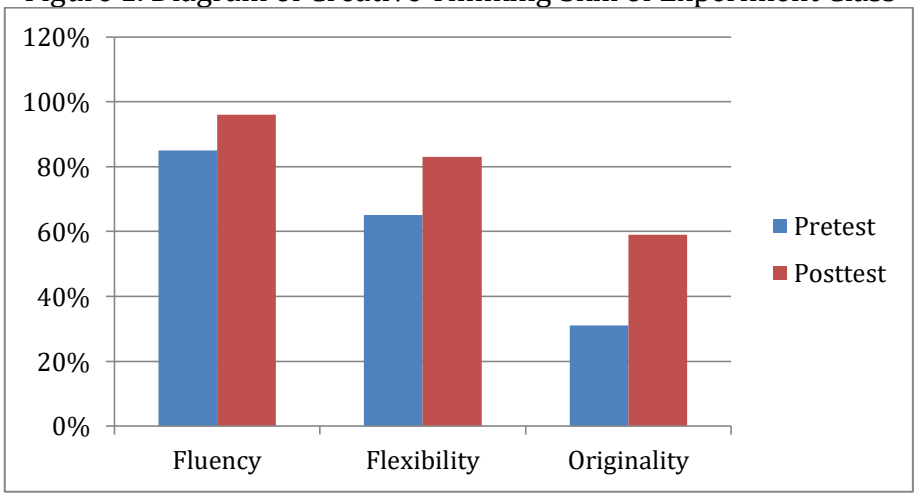
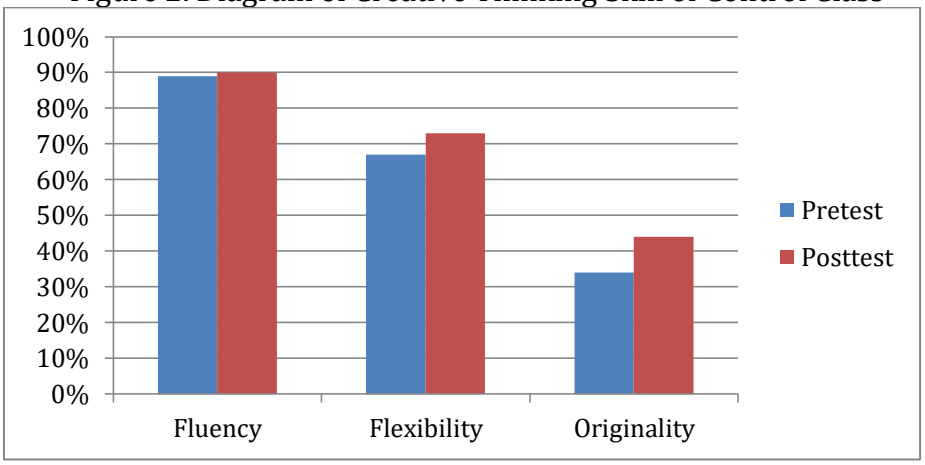


Figure 2. Diagram of Creative Thinking Skill of Control Class



The second syntax is planning the steps of project completion to facilitate students in starting thinking about problem solving and solutions in solving it (Handoko et al., 2022). This syntax encourages students to develop flexibility thinking skills, namely students can get several problems and problem solutions from different perspectives accompanied by correct reasons (Widiawati et al., 2019). The syntax of planning the steps of project completion has an effect in increasing the flexibility indicator. The flexibility indicator in the experimental class has a higher increase of 18% (65% to 83%) which can be seen in Figure 1. compared to the increase in flexibility indicators in the control class which is 6% (67% to 73%) which can be seen in Figure 2. According to Saputri et al. (2023), the increase in flexibility indicators is due to the syntax of planning the steps of project completion, students can provide problem identification and explain opinions from the results of students' initial understanding. Understanding the concept is not the same in each student, so the skill of flexibility has a different increase.

The third syntax is preparing a project implementation schedule, where teachers and students make a project implementation schedule (Widiawati et al., 2019). The project completion agreement schedule made by students includes a schedule of activities, time, and activity targets. The fourth syntax is completing the project through teacher facilities and monitoring. This syntax encourages students to think originality, namely students find several unique problems and problem solutions through appropriate reasons (Yuliani et al., 2018). The syntax of project completion through teacher facilitation and monitoring is influential in efforts to improve the originality indicator. The originality indicator in the experimental class has a higher increase of 28% (31% to 59%) which can

be seen in Figure 1. compared to the increase in the originality indicator in the control class which is 10% (34% to 44%) which can be seen in Figure 2. According to Ulfa et al. (2018), the increase in the originality indicator is due to students collecting data and applying their own experiments to the manufacture of a product, so that they can find a variety of unique ideas or ideas.

The fifth syntax is preparing a report and presentation of the publication of project results. Students present the results of the project that has been prepared. The project presented by students is in the form of 3D media, while the publication report is in the form of scientific articles related to disorders in the human circulatory system. The sixth syntax is project evaluation, where the teacher evaluates the project results that have been presented by students (Niswah et al., 2024).

Factors that influence the high and low increase in each indicator of creative thinking skill (fluency, flexibility, and originality) are the limited perspective of students on a matter that can inhibit creative thinking skill (Firdaus et al., 2018). Creative thinking skills are also supported by internal student factors, this is because students who get high creative thinking test scores are students who also have good achievement in learning biology in their class. Creative achievement is supported by three prerequisites, namely adequate intellectual skill , motivation, and intelligence. Some other factors for improving creative thinking skills include teachers providing support to students in the form of appreciation, giving awards, and praise (Amtiningsih et al., 2016).

CONCLUSION

The conclusion of this study is that there is a significant effect of Project Based Learning model based on 3D media on creative thinking skills in biology learning. Suggestions that can be given by researchers are that further research needs to be carried out to improve and compare the results of research related to the effect of the 3D media-based Project Based Learning model on creative thinking skills in biology learning by combining the Project Based Learning model with certain media and carried out for a long time, so that students' creative thinking skills in biology learning increase better.

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