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Effectiveness of PjBL Based E-module Supported by Learning Journals in improving Students' Critical and Creative Thinking Skills

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ABSTRACT

Effort to develop critical and creative thinking skills that 21st century students needs remain limited. Learning activities to practice these skills have not been implemented optimally and the teaching materials used also do not have indicators of these skills. Through PjBL-based electronic modules and with the help of learning journals, it is believed that students' critical thinking and creative thinking skills can be improved. This study uses two research groups, held on november till december 2022 the control class and the experimental class. The tool used includes essay questions tailored to the indicators. The ANOVA test shows that E module has a significant impact on students' critical thinking skills (α=0.00) and creative thinking (α=0.00). The e-module based on PjBL and supported by a learning journals is effective in improving both skills and is useful in teaching and learning process.

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1. INTRODUCTION

It is very important to have critical thinking skills, especially when studying biology. Students learn with a contextual approach that provides authentic learning experiences so students are trained to solve everyday problems through scientific work. But the reality is that many students still lack critical thinking skills (Agnafia, 2019; Agustine et al., 2020; Hidayati et al., 2021). Mou, (2023)assert that critical thinking skills have a synergistic effect with creative thinking abilities, evidenced by the fact that creative performance stems from the ability to correctly identify and define problems. Creative thinking generates unique ideas, perspectives, and perspectives to solve problems and tends to think critically to come up with logical ideas based on diverse perspectives (Ulger, 2016). Biology students need to have creative thinking skills. The study of biological sciences in the national curriculum is essential to understand, overcome and manage challenges related to natural resources, environmental quality, health and disease, and prevention. and disease control and the use of biotechnology facing societies around the world. This is related to Ramalingam et al. (2020) argue that creative thinking skills are necessary to enhance the learning process so that students can implement their ideas and thoughts to deal with the challenges they will encounter, thinking think systematically and solve problems. Students must have critical and creative thinking skills to develop themselves, their education, and their economy so they can survive in an ever-changing world (Tsai, 2013). The study conducted by Usman et al. (2020) concluded that students' poor creative and critical thinking skills in biology classes prevent them from accurately solving biological problems and from coming up with unique ideas and unique solutions.

Based on the analysis needs of teachers', it is known that in general, 2/6 teachers do not train students' critical thinking skills. Teachers said students still lack critical thinking skills. Overall, teachers said they rarely measure students' critical and creative thinking skills. Indeed, teachers are forced to develop criteria, assessment, and develop the questions that force students to think critically. Teachers and students believe that students must have critical thinking and creative thinking skills in learning procces. Therefore, teacher still trying their best to improve learning activities are necessary to train and improve students' critical thinking skills as well as ainstrument to measure their thinking skills. Efforts to practice this skill include using appropriate learning tools and learning activities. Nurhayani et al., (2018) In general, teachers experience difficulties that arise because of the complexity in developing students' higher-order thinking skills, including critical and creative thinking.

One of the teaching materials that meets the criteria for teaching materials needed by students in learning is a module. Modules are learning materials that are prepared and written to enable readers to understand the reading independently. As many as three out of six teachers stated that the teaching materials and media used were still inadequate in increasing students' learning motivation. As many as 30% of students stated that the teaching materials used did not help students understand the material, did not increase learning motivation, and did not help students learn independently. According to students, the shortcomings of the teaching materials and learning media that teachers usually use are boring presentations, difficulty learning independently, less attractive appearance, less interesting supporting videos, difficult-to-understand the activity steps, and less clear pictures, and other shortcomings. Students prefer educational materials that can be accessed via smartphones because they believe that these educational materials can be easily accessed anytime, anywhere, are more convenient, more accessible, and more effective and suitable for their learning style. The preferred learning style of students using today's technology allows teachers to create computer and electronic teaching materials and media, including electronic modules (electronic modules).

The preparation of electronic modules cannot be separated from the assessments that measure the learning objectives to be achieved. The recommended learning method in the Merdeka Curriculum is project-based learning. Various studies have demonstrated that PjBL affects students' critical thinking and creative thinking skills, for example in the study of Insyasiska et al. (2015) concluded that PjBL affects students' learning motivation, critical thinking skills, creative thinking skills and cognitive abilities in studying Biology. Based on similar PBL learning project models recommended in the curriculum. In fact, the implementation of the PjBL model still seems to have problems in tracking student progress, so a solution is needed to evaluate this process. In the learning activities of the PjBL model, there are activities to evaluate results and evaluate experimental phases to evaluate the results of the project and experiment or the project's working processes. However, from an evaluation perspective, the PjBL model typically only evaluates outcomes. of the project being developed without reviewing the process (Gao et al., 2020). Assessment is often thought of as taking tests and displaying the results as scores (Torres, 2019). This study aims to determine the influence of electronic modules on students' critical thinking and creative thinking skills supported by learning journals.

2. RESEARCH METHOD

This study is a step in evaluating the electronic module development model currently being developed, specifically the Lee & Owens model. The electronic module has gone through the stages of analysis, design, development and implementation with very valuable and practical results from materials experts, communication experts and education practitioners. The research design used a quasi-experimental method with simple random sampling technique. The control class and experimental class have the same number of students, that is 35 students. The detailed study design is presented in Table 1.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment Group (X MIPA 1)	O_1	X	O_2
Control Group (X MIPA 4)	O_1	-	O_1

The students used in this study are Class X students of SMAN 1 Wates, Kediri Regency, academic year 2022/2023. The pre-test was administered before learning and the post-test was administered after learning. The control class used textbooks to study while the experimental class used electronic modules. Both classes use the PjBL model. Data were collected using pretest and posttest questions on critical and creative thinking skills developed from Ennis, (2011) and creative thinking by Treffinger et al., (2002). The data analysis technique used was ANOVA with preliminary testing in terms of normality and homogeneity of the Kolmogorov-Smirnov association using Levene's error equality test. ANOVA hypothesis testing was used to analyze significant differences in the means of the two groups. The e-module was tested for validity and practicality before implementation and use to determine its effectiveness on students' critical thinking and creative thinking skills.

3. RESULT AND DISCUSSION

The ANOVA test was carried out after passing the prerequisite test stage. Data normality and homogeneity test The results of the data normality and homogeneity test can be seen in Table 2. The significance value of normality and homogeneity of each data is $\alpha \geq 0.05$ this case shows that the students' pretest and posttest results are normally and homogeneously distributed. Furthermore, the ANOVA results of the student's critical thinking and Creative Thinking tests are presented in detail in Table 5 and Table 6.

The results of the ANOVA critical thinking skills and creative thinking skills test show that the values are significant(0.000) < (0.05) so there are differences in students' critical thinking skills and creative thinking skills between the experimental class and the control class. The significant value of critical thinking skills $\alpha = 0.000$ $\alpha \leq 0.05$ means that the electronic module has a significant effect on students' critical thinking skills, but the covariates

show value $\alpha = 0.072$ $\alpha \leq 0.05$, meaning that certain factors significantly influence the improvement of students' critical thinking skills. These factors come from covariates, specifically students' pretest scores. Based on the ANOVA test results, it shows that the electronic module has a clear effect in improving students' creative thinking skills. Significance value $\alpha = 0.000$ $\alpha \leq 0.05$ means that the electronic module has a clear influence on creative thinking skills.

Table 2. Normality and Homogenity Test on Student Critical and Creative Thinking Skills

Variable	Significance		Information
	Pretest	Posttest	
Critical thinking skils	0.200	0.200	Normal
Creative thinking skills	0.090	0.200	Normal
Critical thinking skils	0.714	0.435	Homogeneous
Creative thinking skills	0.343	0.443	Homogeneous

Table 3. Result of ANOVA on Student's,Critical Thinking Skills

	Sum of Squares	df	Mean Square	F	Sig.	Sig.
Between Groups	2880.014	1	2880.014	68.173	**0.000**	**7.49E-12**
Within Groups	2872.686	68	42.245			
Total	5752.700	69				

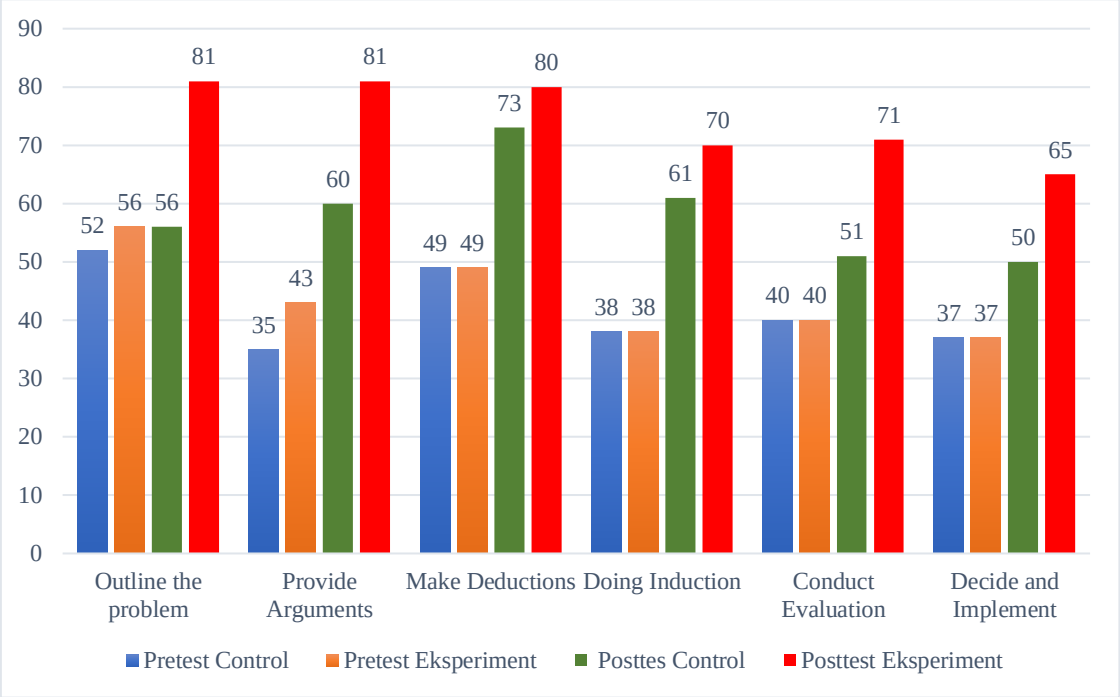

Figure 1. Result of Pretest-Posttest of Each Indicators of Critical Thinking Skills

Table 6. Result of ANOVA on students, Critical Thinking Skills

	Sum of Squares	df	Mean Square	F	Sig.	Sig.
Between Groups	2117.500	1	2117.500	70.384	**0.000**	**4.30E-12**
Within Groups	2045.771	68	30.085			
Total	4163.271	69				

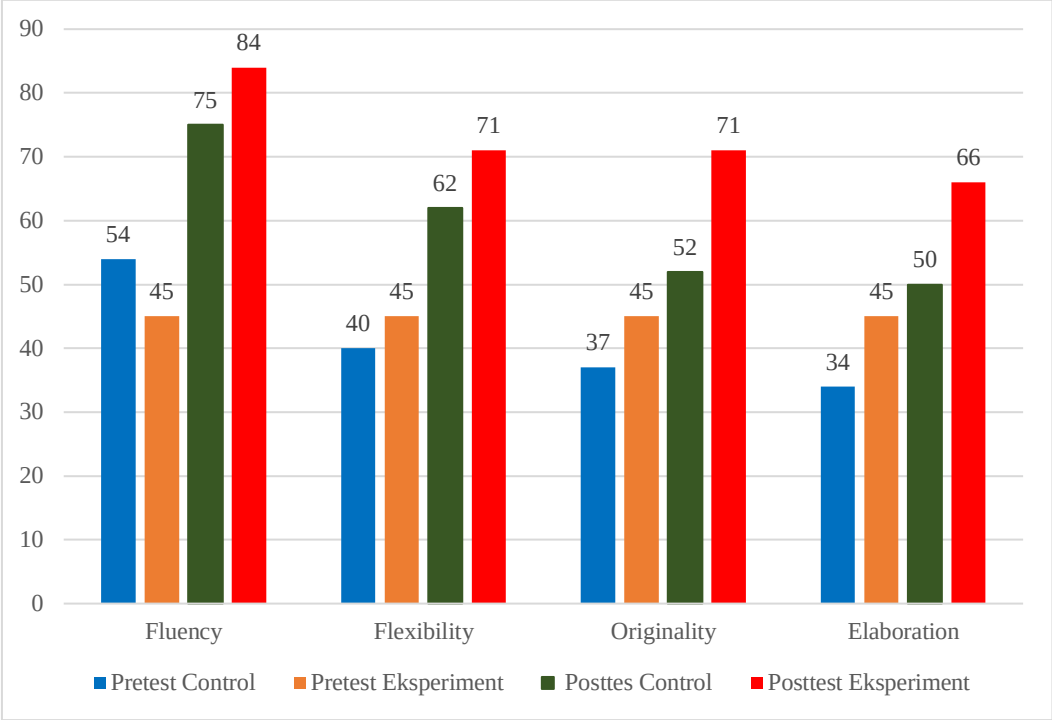

Figure 2. Result of Pretest-Posttest of Each Indicators of Creative Thinking Skills

The difference in the increase in critical thinking skills was due to the use of the biology module developed. Efforts to develop students' critical thinking can be found right from the beginning of the biology module, that is, starting with basic questions. Then, students analyze videos and articles, ask questions, make arguments, infer (describe something), make inductions (conclude), evaluate (give some alternative solution) and decide which solution is possible in this article. road. Let them get used to it. perform on all indicators of critical thinking skills. The assessment questions section of the module also contains questions tailored to the critical thinking indicators. This is consistent with the study of Nugroho et al., (2017) who suggested that this module is effective in strengthening students' critical thinking skills and can train them to think critically, directly or indirectly.

PjBL syntax in a journal-supported learning module was found to be associated with improving students' critical thinking skills. The main goal of the PjBL model is to facilitate deeper learning and help students develop knowledge, solve problems and acquire 21st century thinking skills, for example like critical thinking skills (Condliffe et al., 2017). Involving students in projects can support the development of their critical thinking skills because teachers can demonstrate their thinking processes, use effective questioning techniques, and provide guidance. guide students' critical thinking process. Students participating in projects will learn by collaborating and using critical thinking. The PjBL model is often used to train students to solve problems, think critically, master scientific and technological principles, and learn to collaborate and communicate (Tiantong & Siksen, 2013). This model provides students with the opportunity to consider ideas from different perspectives and develop critical thinking about the problems they encounter (Sastrika et al., 2013). (Uziak, 2016) suggests that this model aims to strengthen students' active learning, critical thinking, and problem-solving skills through a learning process that focuses on practical problems. The PjBL model uses problem-based learning tasks as the context and motivator for efforts to develop critical thinking skills.

Efforts to cultivate students' creative thinking skills are demonstrated in the biology module supported by a learning journals part of the project design and implementation activities. Student-led projects are free to produce educational products about viruses and the monera kingdom. In addition, the practice section also teaches students to come up with many ideas (mastery), write ideas from different perspectives (flexibility), come up with unique ideas (originality), and express their ideas. themselves in a detailed (constructive) way so that they get used to implementing thinking skills indicators. creative. The assessment questions part of the module also includes questions designed in accordance with indicators of creative thinking skills.

The PjBL-based biology module, supported by a learning journal, has a relationship with students' acquisition of creative thinking skills. This is supported by several research findings, including that learning using the PjBL model affects creative thinking skills (Izzati, 2014). Applying the PjBL model can improve students' creative thinking skills (Lindawati et al., 2017) Based on many different research results, it can be concluded that

the PjBL model has influences and can improve students' creative thinking skills. student. This happens because creative thinking skills can be integrated into project-based learning (Lai et al., 2015). Learning gives students the opportunity to complete projects over a period of time that can encourage their creative thinking skills (Hadzigeorgiou et al., 2012). Creative thinking skills can be developed in learning environments that allow new ideas to arise, such as when teachers let students do projects and make their own mistakes, so students can come up with more ideas. different ideas to realize in practice.

4. CONCLUSION

The electronic module supported by learning journals following the PjBL model that integrate critical thinking and creative thinking skills that affect skills. critical thinking and reflective ability. The optimal use of electronic modules accompanied by appropriate tools will develop students' critical thinking and creative thinking skills in the learning process. The urgency of these two skills is to help students face the challenges of 21st century life. Through PjBL learning activities with a learning journal, students' critical and creative thinking skills on virus and kingdom monera material are well trained so that the e-module is effective in increasing indicators in both skills

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