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The effectiveness of the STEAM-based PjBL model on students' creative thinking skills and cognitive load in terms of self-efficacy

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Abstract
This study aims to (1) analyze the effectiveness of the STEAM-based PjBL model on students' creative thinking skills and cognitive load on light and optical devices (2) analyze the effect of self-efficacy on students' creative thinking skills and cognitive load on light and optical devices (3) investigate the interaction of STEAM-based PJBL models and self-efficacy on students' creative thinking skills and cognitive load on light and optical devices. This research is quasi-experimental research with a pretest-posttest control group design. The population of this study was VIII grade students at one public junior high school in Blora Regency for the 2022/2023 academic year, totaling 252 students. The sample was determined using the cluster random sampling technique; the experimental class consisted of 32 students using the PjBL STEAM learning model, and the control class consisted of 31 students using the Discovery learning model. Data collection was carried out using test techniques in the form of creative thinking skills essay questions and non-tests in the form of cognitive load and self-efficacy questionnaires. The validity test technique used is content validity. The data analysis used was the MANOVA test. The conclusions obtained are (1) the learning model has an effect on creative thinking skills with the STEAM PjBL model, which has a better effect than discovery learning, (2) the learning model has an effect on students' cognitive load scores with the STEAM-PjBL model which can minimize cognitive load values which is better than the discovery learning model, (3) self-efficacy does not affect creative thinking skills but affects students' cognitive load, (4) and there is no interaction between learning models and self-efficacy on students' creative thinking skills and cognitive load. The research results can be used as study material and references for similar research on the effectiveness of STEAM-based PjBL learning models to improve students' creative thinking skills and minimize cognitive load scores in terms of self-efficacy levels for different materials.

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1. Introduction

Currently, the world of education is faced with global challenges in the 21st century. There are 4 21st-century skills that students must have, namely critical thinking, creativity skills, communication skills, and collaboration skills (Karim et al., 2022). One of the skills that is important and needs to be prepared before entering the world of work is creative thinking skills. Creative thinking skills are an ability to provide solutions in solving a problem, to create something new or something different from the others. Indicators of creative thinking skills according to Torrance (1966), namely creative thinking skills include fluency, flexibility, originality, and elaboration. The application of creative thinking skills has a very important role in science learning. Currently, in science learning activities, creative thinking skills are still lacking attention. Whereas creativity can optimize understanding and support students' cognitive growth when students pay attention to the learning process (Sari et al., 2018). Students must use their creativity to handle various contextual challenges that require skills in logic, reasoning, and creative thinking (Sukmawijaya et al., 2019).

In Indonesia, students' creative thinking skills tend to be lacking. Indonesia ranks 115 out of 139 countries in the world based on Global Creativity Index (GCI) research in 2015. Another fact that supports the low creative thinking of students is the results of international mathematics and science competencies, namely the Program for International Student Assessment (PISA) in 2018, Indonesia

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ranked 73rd in mathematics, 74th in reading and 71st in science out of 79 assessed countries and territories. The low level of students' creative thinking skills is because some schools still favor the teacher's lecture technique in class (Yolanda et al., 2021). Whereas the teaching techniques used by the teacher will affect the level of students' cognitive load.

Cooper (1990) says cognitive load theory is a hypothesis that describes how hard individual working memory works to process data over a period of time (Sari et al., 2020). Knowledge acquisition is highly dependent on cognitive resources (Lingga et al., 2022). Knowledge acquisition will be successful if the cognitive load imposed is less than the capacity of the available cognitive resources. However, if the cognitive load applied is greater than the capacity of the available cognitive resources, the acquisition of information will be hampered (Sari, 2022). The theory of cognitive load according to Falah et al. (2022), divides cognitive load into three categories, namely intrinsic cognitive load, extraneous cognitive load and germane cognitive load. To achieve effective learning, interactive media must be able to reduce extraneous cognitive load, regulate intrinsic cognitive load, and help develop germane cognitive load (Afidah, 2015).

The level of student cognitive load in Indonesia is high. This is evidenced in research Ratnasari & Sutirna (2023) where the percentage of students' cognitive load in the high category was 45.4%, the medium category was 36.4% and the low category was 18.2%. Other studies have also found that most students' cognitive load is in the high category (Awanis et al., 2023; Rumasoreng, 2021). The level of cognitive load that students have affects their abilities. Students with high cognitive load have low information analysis skills, and vice versa if the cognitive load is low, the student's information analysis skills are high (Rahmat et al., 2014). In addition, the lower the student's cognitive load, the higher the problem-solving ability (Yuniar et al., 2019). The high or low level of student cognitive load is influenced by self-efficacy (Rochmayanti, 2021).

Self-efficacy is a psychological factor that significantly affects students' ability to complete tasks and answer questions that can improve their achievement (Jatisunda, 2017). (Bandura, 1999) says that self-efficacy is related to self-confidence in completing work until it is said to be successful, which can be said to be the level of performance. Self-efficacy is very important for success in education because it has an impact on students' actions, cognitive processes, and achievement (Yolantia et al., 2021). Student learning achievement can be improved by choosing an innovative approach such as the STEAM approach.

The STEAM approach is a multidisciplinary approach that builds on the STEM approach by incorporating the element of "art" into learning (Mu'minah, 2020). Teaching and learning activities with STEAM as the approach require students to be active, through practical activities, and directed at real-world situations (Nurwulan, 2020). STEAM learning is carried out through innovative and interesting activities, so that it can provide deep meaning for students. The STEAM approach can help students manage and improve their ability to generate ideas and concepts to be more creative (Fitriyah & Ramadani, 2021). One of the learning models suitable for the STEAM approach is the PjBL learning model.

The PjBL model is a learning model that requires students to create original products, which is strongly related to creative thinking skills (Rahman et al., 2019). This PjBL model emphasizes contextual learning by giving students the freedom to explore and develop learning activities, work on projects together and ultimately produce a product. The PjBL model with a STEAM approach means incorporating each STEAM component into project-based learning (Annisa et al., 2018). Fatmah (2021) stated that the application of PjBL STEAM in biotechnology material can increase student creativity. Biotechnology material is closely related to everyday life. Apart from biotechnology materials, other materials that are close to everyday life are light and optical devices.

Light and optical devices are materials that are familiar to students. However, there are still frequent misconceptions experienced by students in understanding the material of light and optical devices (Rahmawati et al., 2021). These misconceptions include the characteristics of light, reflection and refraction and about the human eye and vision (Wahyuni, 2018). According to research conducted by (Jones & Zollman, 2014), pre-learning students tend to use knowledge based on experience, but post-learning students use a lot of knowledge from the textbooks they have. Thus,

educators need to raise real problems from the life around students that are used to spark students' curiosity which can then be poured into the form of real projects or products. Besides being able to make it easier for students to understand concepts, it can also improve their creative thinking skills.

Based on the background that has been presented, many studies only prove the effect of the PjBL STEAM learning model on creative thinking skills, critical thinking skills, learning outcomes, and others separately. There is little research related to the effect of STEAM on student cognitive load. Where self-efficacy is one of the factors that influence students' cognitive load. Therefore, researchers try to find out the effectiveness of the STEAM PjBL model in improving creative thinking skills and minimizing cognitive load with regard to self-efficacy in light and optical devices.

2. Method

This research is quasi-experimental with a pretest-posttest control group design. This research involves 2 classes where one class will act as a control class with a discovery learning model and the other as an experimental class applying the STEAM PjBL model. This research was conducted at one public junior high school in Blora Regency, Central Java. The population of this study was the VIII grade, with a total of 252 students. The sample used was 2 classes taken with cluster random sampling technique. The experimental class consisted of 32 students while the control class consisted of 31 students.

The data collection techniques used are test and non-test techniques. The test instrument is pretest essay questions before the treatment of the learning model and post-test creative thinking skills given after the treatment. This is done to see the difference in data on students' creative thinking skills before and after applying the STEAM PjBL model and discovery learning. The non-test is a questionnaire with an instrument in the form of a self-efficacy questionnaire and student cognitive load. The instrument was validated by two supervisors. After the content validity test, all instruments get a score of 1 which means the level of validity is very high. Then the instrument is tested and checked for reliability with the help of SPSS 25. The creative thinking skills essay instrument gets a significance value of 0.674 and the posttest is 0.679 so it is considered reliable. Meanwhile, the self-efficacy questionnaire gets a significance value of 0.721 and the cognitive load questionnaire gets a significance value of 0.636 so both questionnaires are reliable. This is because the instrument can be considered reliable if the reliability coefficient of Alfa Cronbach is more than 0.60 (ri> 0.60) (Ghozali, 2011). The creative thinking skills instrument also tested the difficulty level and distinguishing power.

At the beginning of the meeting, students were given a creative thinking skills pretest, a cognitive load questionnaire pretest, and a self-efficacy questionnaire. After that, at the next meeting, the application of the STEAM PjBL model and discovery learning was carried out. In the experimental class with the STEAM PjBL model, students will be divided into groups and given the task of making a project with elements of art in it related to the material discussed, namely light and optical devices. Project materials must utilize used and unused items in the environment around students. The projects in this study were periscope and wall decoration. While in the control class with the discovery learning model, students in groups were asked to design and conduct simple experiments to analyze what are the properties of light and examples in everyday life as well as experiments with virtual laboratories on mirror and lens sub materials. After the learning model treatment, the creative thinking skills posttest and cognitive load questionnaire were conducted to obtain research data.

Data analysis techniques using MANOVA two-way unequal cells. The test was conducted with a significance level of 5% (Rahmatullah et al., 2017). The determination of hypothesis test conclusions in the MANOVA technique is based on the significance value obtained in each initial hypothesis (H_{0A}, H_{0B}, H_{0AB}). Because there was a rejected null hy, a further test was carried out, namely the ANOVA test on each dependent variable. After further testing, it was found that the null hypothesis was rejected in ANOVA, so multiple comparisons were carried out using the Scheffé method. Further post-ANOVA test by comparing the mean values.

3. Results and Discussion 3

The research data that will be presented are pretest and posttest creative thinking skills data in classes with STEAM-based PjBL learning models and classes with discovery learning models, pretest and posttest cognitive load questionnaires, and self-efficacy questionnaire data in both classes before the treatment of learning models. The pretest results of creative thinking skills with a maximum score of 100, the average value obtained by the experimental class (PjBL STEAM) is 32.5. While for the control class (discovery learning) the average value obtained is 31.4. The posttest score data obtained by the class with the STEAM PjBL model gets an average of 59.6, while the class with the discovery learning model gets an average of 47.7. This means that the value of students' creative thinking skills in the class with the PjBL STEAM model is higher than the class with the discovery learning model. The level of distribution of pretest-posttest Creative Thinking Skill students per category can be seen in Figure 1.

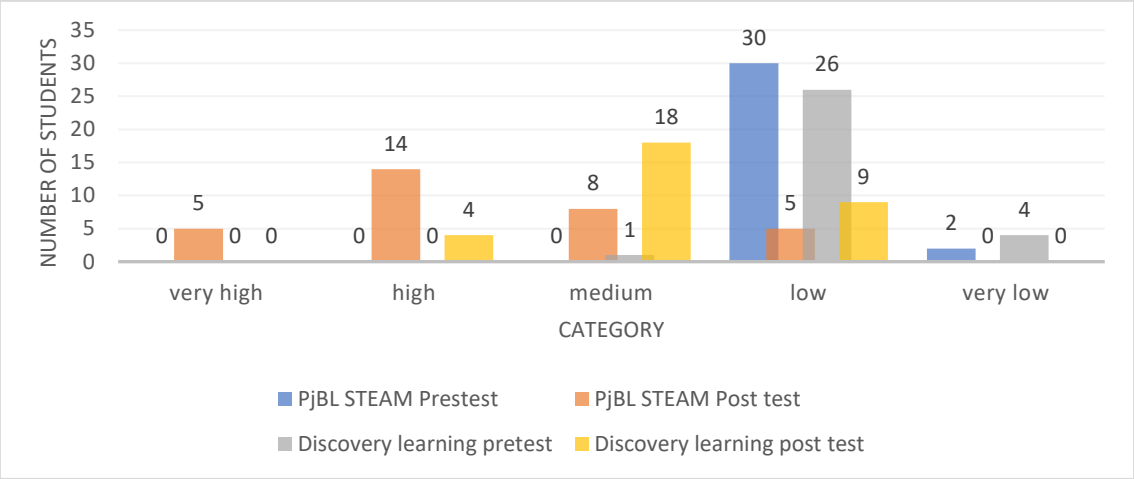

Figure 1. The total value of creative thinking skills for each category

Based on Figure 1, it was found that the value of creative thinking skills between pretest and posttest students increased in both classes, PjBL STEAM class and discovery learning class. The frequency distribution of the highest posttest value of creative thinking skills in the PjBL STEAM class is in the high category. While in the discovery learning class the highest distribution is in the medium category.

Cognitive load is categorized into 3 namely high, medium, and low. In the pretest cognitive load questionnaire data, the average value of the cognitive load level between the experimental class and the control class is almost the same where in the experimental class (STEAM-based PjBL) 31.7 while in the control class (discovery learning) 31.1. After the treatment of the learning model, a cognitive load questionnaire posttest was conducted and the results of the average posttest value of the class with the PjBL STEAM learning model were lower than the class using the discovery learning model. Where the average value of the class with the PjBL STEAM learning model is 24 while the discovery learning class is 25.2. This means that after the application of the two learning models in each class, the class with the PjBL STEAM learning model makes students' cognitive load low. The level of distribution the pretest-post test cognitive load of students per category can be seen in Figure 2.

Based on Figure 2, with data from the Likert scale which was originally ordinal transformed into an interval scale with MSI, the results of the cognitive load value between the pretest and post-test decreased both in the experimental and control classes. The frequency distribution of the most cognitive load posttest values in the discovery learning class and the PjBL STEAM class is in the medium category.

Self-efficacy in this study is a moderator variable. The division of self-efficacy categories is divided into 3 namely high, medium, and low. The data from the self-efficacy questionnaire results obtained the level of student self-efficacy between the experimental class and the control class has an average that is not much different where the experimental class is 0.6 higher where the

experimental class gets an average of 97.6 while the control class gets an average of 97. However, the control class has a maximum value for higher self-efficacy (132.5) compared to the experimental class (118.9). The frequency distribution of students' self-efficacy level can be seen in Figure 3

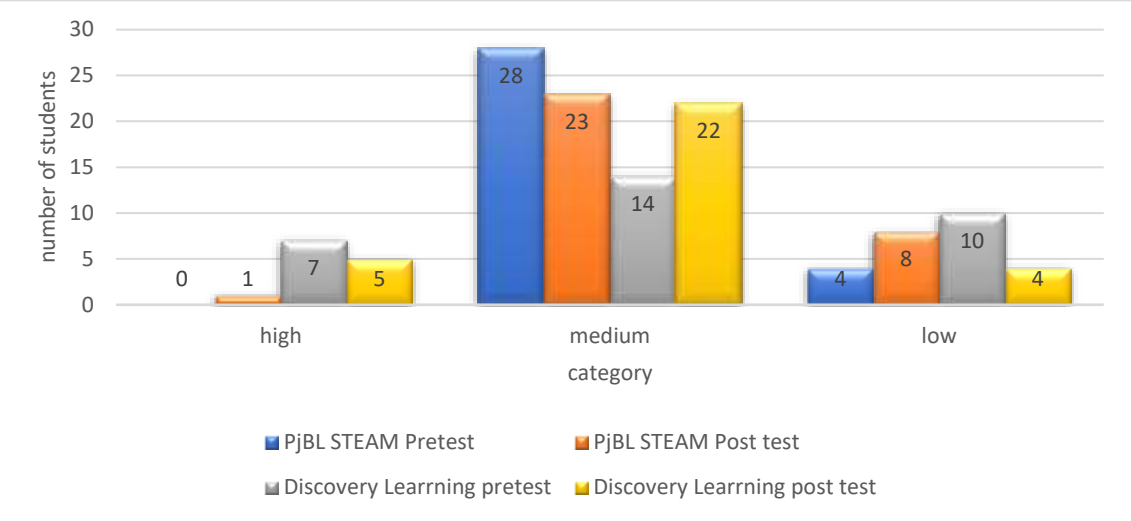

Figure 2. Total cognitive load scores pretest – post-test for each category

Figure 3. Total student self-efficacy scores for each category

Before conducting hypothesis testing with MANOVA, a pre-requisite test was carried out first. Prerequisite tests include normality test, homogeneity test and Box's M test. Because the prerequisite test is fulfilled, it continues with hypothesis testing.

Table 1. Results of Manova research data

Description	Significance level	Test Decision
Learning Model	0,002	H_{0A} rejected
Self Efficacy	0,001	H_{0B} rejected
Model*SE	0,139	$H0_{AB}$ accepted

Based on the results of the MANOVA test of two-way unequal cells, the decision was obtained that H0A was rejected, H0B was rejected, and H0AB was accepted. Because there is a rejected H0, it is necessary to conduct further tests to see the effect on each dependent variable. The further test used is the ANOVA test on each dependent variable.

Table 2. Summary of Post-MANOVA Follow-up Tests

Dependent Variable	Source	Sig.	Test Decision
Creative Thinking Skills	Factor A	0,001	H_{0A} rejected

	Factor B	0,094	H_{0B} accepted
	Interaction	0,393	H_{0AB} accepted
Cognitive Load	Factor A	0,017	H_{0A} rejected
	Factor B	0,000	H_{0B} rejected
	Interaction	0,079	H_{0AB} accepted

Based on the results of the ANOVA two-way test of unequal cells, H0A was rejected on creative thinking skills and H0A and H0B were rejected on cognitive load. Therefore, further post-ANOVA test is needed, namely the comparison of means.

Table 3. Results of further tests after ANOVA on Learning Model - Creative Thinking Skills

Dependent Variable	Class	Mean
Creative Thinking Skills	Discovery Learning	46,8
	PjBL STEAM	60,3

Based on the results above, the class with the STEAM PJBL Model has a higher average than the class with the discovery learning model. Classes with the STEAM PPABL Model get an average score of 60.3 while classes with the discovery learning model get an average score of 46.8. So it can be concluded that the PjBL STEAM learning model provides better creative thinking skills compared to the discovery learning model.

Table 4. Post-ANOVA post-test results of Learning Model – Cognitive load

Dependent Variable	Class	Mean
Cognitive Load	Discovery Learning	26,3
	PjBL STEAM	23,6

In the post-ANOVA further test table, it can be seen that there is a significant difference in the effect of the learning model on cognitive load where the class with the PjBL STEAM learning model treatment has a lower level of cognitive load (23.6) than the class with the discovery learning model (26.6).

Table 5. Further test results after ANOVA Self Efficacy – Cognitive Load

Dependent Variable	Self Efficacy	Mean
Cognitive load	High	21,4
	Medium	24,6
	Low	28,9

In the post-ANOVA further test table for the level of self-efficacy on cognitive load, it can be seen that there is a significant difference between the level of self-efficacy on the average value of student cognitive load. Students with a high level of self-efficacy get a smaller average value of cognitive load than other levels. This means that the higher the level of student self-efficacy, the smaller the cognitive load value.

Effect of Learning Model on Creative Thinking Skills and Cognitive Load

Based on hypothesis testing with MANOVA calculation, the result shows that H0A is rejected. This means that there is an influence of the learning model on creative thinking skills and cognitive load. Then continued with ANOVA further test for each dependent variable, namely creative thinking skills and cognitive load.

Effect of STEAM PjBL Model and Discovery Learning on Creative Thinking Skills

In the results of the ANOVA two-way test of unequal cells, the results of H_0 were rejected, meaning that there was a significant effect between the STEAM and discovery learning PJBL models on creative thinking skills. Because H_0 is rejected, the post-ANOVA test is continued, namely the comparison of means. Based on the results of the comparison of the average value of creative thinking skills with the PjBL STEAM learning model is higher than the class with the discovery learning model. So it can be concluded that the PjBL STEAM model provides better creative thinking skills than the

discovery learning model. These results are in accordance with the research of Pramesti et al. (2022) which states that there are differences between PjBL-STEM and discovery learning classes. Further research that obtained the same results was from Fitriyah & Ramadani (2021) researchers where in their research there were differences in the average students' creative thinking skills between the control class and the experimental class (STEAM-based PjBL) where the experimental class had a higher average than the control class. In teaching and learning activities in experimental classes with the PjBL STEAM learning model, students are trained to always be active during learning, making projects to solve the problems presented by integrating the five aspects of STEAM. With PjBL STEAM learning, students can also generate many ideas and proposals to solve problems in the form of group projects so that their creativity develops (Capraro et al., 2013).

At the start of the essential question stage with the integration of science aspects of STEAM related to aspects of fluency, flexibility, and originality in formulating problem formulations. At the design project and create schedule stages, students will look for relevant information with the help of technology so that it can improve students' creative thinking skills in the aspects of fluency, flexibility and originality which are characterized by the many varied ideas given by students as solutions to problems. In addition, there is also an elaborate aspect where ideas between students will be re-evaluated in detail in the group. The second and third syntax of the PjBL STEAM learning model are related to the technology, engineering and mathematic aspects of STEAM. The integration of PjBL STEAM at this stage can improve students' creative thinking skills. The existence of technology helps students to find many references related to the project to be made and then developed many times because of the engineering aspect that allows students to improve the design until the best design is produced by paying attention to the size and amount of materials used (mathematics). The next STEAM PjBL syntax is monitoring the students and the progress of projects with the integration of arts in STEAM because in making it is required to add elements of art so that the resulting project is interesting and has characteristics, so at this stage the teacher will see the progress of student projects, provide input and and help students if there are obstacles in project work (improvement). At this stage, students have started working on projects and students learn to connect between fields in STEAM. The addition of art aspects can increase student creativity because of the variety of art types so that students can freely choose what type of art is suitable for their project. The last syntax is assessing the outcomes and evaluating the experience where at this stage students will make presentations to be assessed for the results of their projects. The aspects of creative thinking skills related to this stage are all aspects. Fluency and originality aspects are seen from the ability of students to provide many reasons for the rebuttals submitted by other groups quickly and uniquely. Flexibility and elaborate are seen from the ability of students to answer well and correctly and in detail to questions asked by teachers and students from other groups. So the STEAM-based PjBL learning model has high potential to improve creative thinking skills, as supported by the research of Santi (2022), the STEAM approach to PjBL increases student creativity.

Effect of STEAM PjBL Model and Discovery Learning on Cognitive Load

In the ANOVA further test results, it was found that H_0 was rejected, which means that there is a significant effect between the STEAM and discovery learning PJBL models on cognitive load. Because H_0 is rejected, the post-ANOVA test is continued, namely the comparison of means. Based on the average value there is a difference between the STEAM PjBL class and the discovery learning class. In addition, the posttest value obtained decreased compared to the initial value of student cognitive load before treatment (pretest). This means that the PjBL STEAM learning model is able to minimize student cognitive load compared to the discovery learning model. This is in line with the research of Chen & Huang (2023) which resulted in the value of the cognitive load produced by the experimental group in learning activities being lower than the control group. Other research states that STEAM learning has a significant negative direct effect on cognitive load, which means STEAM learning can minimize students' cognitive load (Wu et al., 2022).

The STEAM-based PjBL learning model is carried out by students making projects with elements of art as a form of applying the material discussed in a real form. So that students can enjoy every process of making and understanding the concepts in their projects in a fun way so as to reduce their extrinsic cognitive load which also has an impact on germane cognitive load. This is in accordance with the research of Nurwanda et al. (2020) where high extrinsic cognitive load makes germane cognitive load high. So if the extrinsic cognitive load is low (down) due to the application of the PjBL

STEAM learning model, the germane cognitive load is also low which results in the overall value of student cognitive load.

The Effect of Self-Efficacy on Creative Thinking Skills and Cognitive Load

Based on hypothesis testing with MANOVA calculations, the results show that H0B is rejected. This means that there is an influence of self-efficacy on creative thinking skills and cognitive load.

The Effect of Self-Efficacy Level on Creative Thinking Skills

The results of hypothesis testing concluded that the level of self-efficacy has no effect on creative thinking skills. The average value of creative thinking skills of students with high self-efficacy is 59.6, the value of creative thinking skills of students with moderate self-efficacy is 53.1, while the average value of creative thinking skills of students with low self-efficacy is 48.1. Based on this, it can be seen if there is no significant difference between high, medium, and low levels of self-efficacy on students' creative thinking skills. These results contradict research of Suciawati (2019) which states that there is an influence of self-efficacy on students' creative thinking skills. Further research by Nugroho et al. (2018) found that the existence of different levels of student self-efficacy triggered a gap in the development of their creative thinking skills. This shows that students' capacity to think creatively is influenced by their level of self-efficacy. One of the factors that can encourage students' original thinking is self-efficacy (Afrilianti et al., 2022).

Other factors may influence so that the research results produce self-efficacy has no effect on creative thinking skills. These factors include students' lack of understanding of learning materials because the material is difficult. This is supported by Pajares (2002) in (Suciawati, 2019) namely Students may have a high sense of self-efficacy, but they lack knowledge and ability in the subject matter. However, if students' abilities are the same but their self-efficacy is not the same, it is expected that they will show different skills. Students who have a high sense of self-efficacy will be more energetic and eager to learn new things. So that students may have more skills than other students, including creative thinking skills.

Effect of Self-Efficacy Level on Cognitive Load

Hypothesis testing that has been carried out obtained the results of the level of self-efficacy that affects cognitive load. Then the post ANOVA further test is carried out which results in a significant difference between the level of self efficacy on the average value of student cognitive load. Students with a high level of self-efficacy get a smaller average value of cognitive load than other levels. This means that the higher the level of student self-efficacy, the smaller the cognitive load value. This is in accordance with research of Rochmayanti (2021) which says that self-efficacy affects students' cognitive load. Another study states that self-efficacy and feedback affect students' cognitive load (Redifer et al., 2021).

Self-efficacy plays a significant role in cognitive load and academic stress (Thahura & Tutdin, 2021). Putwain et al. (2013) found that self-efficacy can positively predict pleasure and negatively predict unhappiness among participants in learning subject matter. Another study showed that self-efficacy predicts anger, anxiety, and boredom negatively while pleasure positively (Pekrun et al., 2018).

Self-efficacy is very important for students in undergoing the learning process. Learning activities certainly cannot be separated from the thinking process that occurs in the cognitive system of the human brain. Working memory will be used by someone who thinks while doing a task. The number of activities that need to be completed by working memory will produce a load known as cognitive load. The relationship with self-efficacy is that self-efficacy can affect how hard a person tries to overcome difficulties. Furthermore, self-efficacy determines the style of behavior, how hard effort is made to overcome problems or complete tasks, and how long it will be faced with unfavorable obstacles (Pudjiastuti, 2012). Thus, self-efficacy can be considered to predict or influence students' cognitive load (Sunawan et al., 2017).

A person with high self-efficacy will put out his best effort when doing a job or task. Whereas someone with a low level of self-efficacy will only make a little effort to complete the job or task

(Cervone, 2000).This is in accordance with the data from the results of research that has been conducted where students with high self-efficacy get a lower cognitive load. This is because students feel challenged to complete tasks even though they are difficult and do new things. Students do not depend on friends. Conversely, if the student's level of self-efficacy is low, the student tends to avoid finding difficult tasks and is less interested in new things in learning and instead considers it a burden. So that when the teacher uses a new learning model with difficult tasks students will feel depressed and increase the perceived cognitive load. Therefore, it can be concluded that self-efficacy affects students' cognitive load.

Interaction of Learning Model and Self-Efficacy on Creative Thinking Skills and Cognitive Load

Based on hypothesis testing with MANOVA calculation, the result is H_{0AB} is accepted. This means that there is no interaction of learning models and self-efficacy on creative thinking skills and cognitive load. Lestari et al. (2020) in his research found that the results between the learning model in the experimental and control classes with the level of student self-efficacy (low and high) did not produce lines that crossed or did not intersect so that there were no interaction between the learning model and self-efficacy in influencing the results of students' creative thinking skills. Other research that is in line is research conducted by Chotima et al. (2019) where there is no correlation between the learning model and the level of self-efficacy on students' abilities. Between learning models and self-efficacy are not interconnected to students' problem solving skills (Endah et al., 2019). This is because there may be differences in the initial value of creative thinking skills and cognitive load in the student self-efficacy grouping which causes no interaction between learning models and self efficacy (Aulia et al., 2020). In addition, it could also be due to other influencing factors because not all variables can be controlled by researchers.

In the comparison of the average interaction of learning models and self-efficacy on creative thinking skills, it was found that the average value difference between the PjBL STEAM learning model and discovery learning. In the experimental class (PjBL STEAM) with a high level of self-efficacy, the average score for creative thinking skills is higher than the control class with a high level of self efficacy. Likewise for moderate and low levels of self-efficacy where classes with the PjBL STEAM model get a higher average score than the discovery learning model with the same level of self-efficacy, namely moderate and low.

In the comparison of the average interaction of learning models and self-efficacy on cognitive load, it is found that the average value difference between the PjBL STEAM learning model and discovery learning. In the experimental class (PjBL STEAM) with a high level of self-efficacy, the average value for cognitive load is lower than the control class with a high level of self-efficacy. In the category of moderate self-efficacy levels, the average value of cognitive load is almost the same between classes with the PjBL STEAM learning model, namely 24.6 and classes with the discovery learning model, namely 24.5. Likewise, for low self-efficacy levels, classes with the PjBL STEAM model get a lower average score than the discovery learning model with the same level of self-efficacy.

4. Conclusion

There is an effect of learning models on students' creative thinking skills and cognitive load. The STEAM-based PjBL learning model produces better creative thinking skills than the discovery learning model. In addition, there was an increase in the average value of creative thinking skills from pretest to posttest. However, there was no significant effect between the STEAM-based PjBL model and discovery learning on cognitive load. The application of both models is equally good for minimizing student cognitive load. This is indicated by the value of cognitive load which decreases from pretest to post-test in both experimental and control classes. Self-efficacy has an effect on students' creative thinking skills and cognitive load. The level of student self-efficacy does not affect the value of creative thinking skills. However, the level of student self-efficacy affects the value of cognitive load. The higher the student's self-efficacy, the lower the cognitive load value. There is no interaction between learning model and self-efficacy on students' creative thinking skills and cognitive load. Based on this, researchers suggest using the STEAM-based PjBL learning model to improve creative thinking skills and minimize student cognitive load.

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