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Critical Thinking Ability Using STEAM-Based PBL Learning at Junior High School Students

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ABSTRACT

This research aims to determine whether there are differences in students' critical thinking abilities using STEAM-based Problem Based Learning (PBL) in science learning at SMP Negeri 14 Bengkulu City. The population of this study were all students in class VIII of SMP Negeri 14 Bengkulu City. The sampling technique used Simple Random Sampling with a total sampling of 62 people from 2 classes consisting of 32 students in class VIII.2 and 30 students in class III.4. The type of research used is quasi-experimental. Data collection was carried out using an essay test to measure critical thinking abilities. Data were analyzed using the ANOVA test. The research results show that 1) there are differences in critical thinking abilities using the STEAM-based PBL learning model. Judging from the ANOVA test where a significant value of 0.000 was obtained, it can be concluded that sig <0.05. 2) STEAM-based PjBL learning is more effective in improving students' critical thinking skills compared to conventional ones. Judging from the ANOVA test value, it obtained a significant value of 0.000, so it can be concluded that sig < 0.05 on the BNT test obtained a value of 0.132 > 0.05.

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INTRODUCTION

Entering the era of industrial revolution 4.0 in the 21st century, all human activities are dominated by high-tech products, as if every human being cannot live without technology. This proves that science and technology are developing very rapidly, so their impacts cannot be avoided but must be faced and mastered. In the 21st century, job demands require workers who have various skills that must be mastered (Zubaidah, 2019) (Zubaidah, 2019). These 21st century skills include: critical thinking skills, problem solving, creativity and innovation, collaboration, communication, information literacy, media literacy, technological literacy, flexibility and adaptability, leadership and responsibility, initiative, productivity, accountability, and interaction social and cross-cultural (Hadinugrahaningsih et al., 2017) (Hadinugrahaningsih, 2017).

PBL is a learning model that focuses on training students to have the ability to solve problems, either through case studies or direct practicums, so that the PBL learning model can be

compared with STEAM which involves more components, science, technology, engineering. arts and mathematics as an effort to complete the learning process and help students meet learning achievement indicators

Efforts to instill and train students' thinking skills are very important to pay attention to in the school curriculum. However, in reality, there are still very few learning processes in Indonesia that deliberately direct students to improve their high-level thinking abilities. As a result, the quality of education in Indonesia is still quite low. One part of the ability to think at a higher level is the student's critical thinking ability. Students' abilities in critical thinking have two different variations, namely students who have high critical thinking abilities and those who have low critical thinking abilities. Students' high critical thinking ability can be interpreted as a student's ability to solve their own problems independently so that the teacher only acts as a facilitator. Meanwhile, low level critical thinking abilities can mean that students' abilities cannot solve problems and that they cannot solve their own problems (Nurhayati et al., 2019) (Nuryanti et al, 2019).

Based on the results of observations that have been carried out 3 times at SMP Negeri 14 Bengkulu City, during the learning process teachers still use conventional learning models, scientific learning models, cooperative learning strategies and learning methods using lectures and teacher-centered questions and answers. So the role of students is only to listen and memorize without being fully involved in the learning process.

Based on the results of the UTS and UAS for the 2022/2023 academic year, odd semester, science subjects for class VIII students at SMP N 14, Bengkulu City, there are still many students who get scores below the KKM, around 65%. The low student learning outcomes are influenced by a lack of motivation to learn. This can be seen that there are still some students who do not pay attention during the learning process. The facilities and infrastructure owned by SMP N 14 Kota Bengkulu are quite adequate, both in terms of learning resources and learning media, but these media have not been utilized optimally, this certainly affects the level of students' critical thinking.

Based on the results of research conducted by (Farcis, 2019) ,the results of his analysis show that the average value of students' critical thinking skills is still very low, namely 25.8%. This is in line with research conducted by (Nurhayati et al., 2019) Nuryanti Lilis et al, (2019), showing that overall the critical thinking abilities of junior high school students are still low. The low critical thinking skills of students are caused by students not being used to being presented with active learning that maximizes students' thinking potential.

The low average of students' critical thinking skills is partly because the learning implemented in schools is still dominated by teachers so that they do not train students' critical thinking skills. So that schools have not been effective in developing students' critical thinking skills, including some teachers who have not implemented teaching techniques to develop students' critical thinking skills (Irwandi, 2020) (Irwandi, 2020). To overcome this, one of the efforts to improve critical thinking skills needs to be the application of learning models, namely STEAM-based learning models and PBL (Problem Based Learning). The application of the STEAM-based PBL (Problem Based Learning) learning model can improve students' critical thinking abilities and learning motivation during the learning process (Fitriyah & Ramadani, 2021)(Fitriyahanis et al, 2021).

PBL (Problem Based Learning) learning can be an alternative in an effort to improve students' critical thinking skills. According to (Hadinugrahaningsih et al., 2017) Hadinugrahaningsih (2017) PBL (Problem Based Learning) learning is also a learning approach that uses real world problems as a context for students to learn about critical thinking and problem solving skills, as well as to gain essential knowledge and concepts from the subject matter. By using the PBL learning model, students are expected to play an active role in the learning process because this model is a learning model that involves students in solving a problem so that students

gain direct experience of the process of discovering the concepts they are studying. So that students can think critically in solving problems.

Based on the background of the problem above, it is necessary to select a learning model that can influence and improve critical thinking skills. The author is interested in conducting research with the title "Critical Thinking Abilities Using STEAM-Based Problem Based Learning (PBL) Learning Models in SMP Negeri 14 Bengkulu City".

RESEARCH METHODOLOGY

This research was carried out in February 22 – March 23 2023. The population of this research was all students of SMP Negeri 14 Bengkulu City. The sampling technique used in this research was simple random sampling. The sample used consisted of 2 classes, namely 1 experimental class and 1 control class.

Quasi-experimental research design. Data collection in this research was carried out by giving tests to students, both for the experimental class (PBL) and the control class (Conventional). Critical thinking skills are obtained using an instrument in the form of essay questions totaling 5 (five) questions to measure students' critical thinking abilities.

Data analysis uses prerequisite tests in the form of normality tests and homogeneity tests. In this study, the normality test used Kolmogorov-Smirnov and the homogeneity test was carried out using the Levene test at a significance level of 5%. The hypothesis was tested using One-Way Analysis of Variance (ANOVA) using the SPSS 26 program.

This type of research is a quasi-experimental design used in the research, namely Non-Equivalent Pretest-Posttest Group Design with two types of treatment. In this design, the research uses two groups, namely the experimental group and the comparison group (Control), which consists of one class. The research began with an original test (Pretest) given to two groups, then they were given treatment (Treatment). The research then ended with a final test (Posttest) given to the two groups. The research design used by the author is described in the following table:

Table 1. Research desain

Group	*Pretest*	Treatment	*Posttest*
A (Experiment)	Y1	X1	Y2
K	Y1	-	Y2

(Reference: Gay dkk, 2012)

The preparatory stages for the activities carried out were research planning, making lesson plans and worksheet. The stages of implementing the activities carried out are determining the learning group. Groups for control and experimental classes. After that, a pretest was carried out to see the students' initial abilities. Next, implement the STEAM-based PBL learning model. Next, a posttest was carried out to see students' critical thinking abilities. The evaluation stage is an activity carried out to analyze and manage data from pretest and posttest results in the control class and experimental class. The report preparation stage is an activity carried out to compile and report the results of research that has been carried out.

The data collection technique in this research uses test techniques to measure Critical Thinking Ability. The test used is an initial test (Pretest) and after learning a final test (Posttest) is given. The data analysis technique used in this research is analysis of variance (ANOVA). Before carrying out the ANOVA test, prerequisite tests will first be carried out, namely the normality test and homogeneity test.

RESULTS AND DISCUSSIONS

Data collection on critical thinking skills uses essay questions totaling 5 questions with scoring guidelines for each from 0 to 20 consisting of 5 critical thinking indicators, namely providing basic

explanations, building basic skills in concluding, providing further explanations and organizing strategies and tactics. The following is pretest and posttest data on critical thinking abilities of students at SMP Negeri 14 Bengkulu city from a sample of 62 students from class VIII.

Critical Thinking Ability

Table 2. Distribution of critical thinking ability pretest score results for class VIII students

Statistik	PBL	Konvensional
The number of students	32	30
Average	42,21	44,26
Standard deviation	6,56	7.57
Variance	43,14	57,44
The highest score	56	55
Lowest value	28	25

Based on table 2, it can be seen that the average critical thinking ability of students before being given treatment in the experimental class was 42.21 with the highest score being 56 and the lowest score being 28, while in the control class the average critical thinking ability of students was 44.26 with the highest score. 55 and the lowest score was 25. Based on these data it can be concluded that the average critical thinking of the experimental class which used the STEAM-based PBL learning model was lower than the control class which used the conventional learning model.

Table 3. Distribution of posttest results for critical thinking ability

Statistics	PBL	Conventional
The number of students	32	30
Average	78,94	70,93
Standard deviation	5,69	5,50
Variance	32,38	30,27
The highest score	86	79
Lowest value	65	55

Based on table 3, it can be seen that the average critical thinking ability of students after being given treatment in the experimental class was 78.94 with the highest score being 86 and the lowest score being 65, while in the control class the average critical thinking ability of students was 70.93 with the highest score. 79 and the lowest score was 55. Based on this data, it can be concluded that the average critical thinking of the experimental class using the STEAM-based PBL learning model was higher compared to the control class using the conventional learning model.

Table 4. One way anova test posttest critical thinking ability

Source of differences	Sum of Squares	Df	Square Mean	F	Sig.
Between groups	1720,000	2	860,000	31,011	0,000
Inter Group	2523,617	91	27,732		
Total	4243,617	93			

Based on Table 4, the value F = 31.011 is obtained with a significance of 0.000, which means it is smaller than 0.05 (0.000<0.05), so H^o is rejected and H^1 is accepted so that from the Posttest results it can be concluded that the results of the Posttest measurement of students' critical thinking abilities using PjBL and conventional STEAM-based learning is significantly different.

STEAM-based PBL learning is good for improving students' critical thinking skills compared to conventional learning. This can be seen from the posttest scores of PBL and conventional class students. This is in line with research conducted by Orcito et al (2021) that PBL learning can improve students' critical thinking abilities. The STEAM approach is recommended to be implemented in schools (Irawan et al., 2021) (Irawan, 2021). (Damayanti et al., 2023) Damayanti

(2023) The STEAM approach motivates students to learn to explore their own skills in terms of science, technology, engineering, art and mathematics. (Hasanah, n.d.) Hasanah (2023) students have positive perceptions, produce creativity, innovate, and are able to solve problems as a result of the stimulus obtained from STEAM-based practicum activities. STEAM-based e module to improve student learning outcomes and students' science process skills (Mabsutsah & Yushardi, 2022) (Mabsutsa, 2022).

According to the explanation of (Sari & Afriansyah, 2022) Sari et al (2022), STEAM-based Problem Based Learning (PBL) learning is a learning process that links problems from the real world in the world and is incorporated into student-centered PBL learning using real (authentic), unstructured problems. , and is open as a context for students to develop problem solving and critical thinking skills and build new knowledge. Models and approaches both have a good influence on the problem solving process, so STEAM and PBL can be an alternative solution when combined. Integrating the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach into the Problem Based Learning (PBL) model becomes a learning innovation called the Problem Based On STEAM Learning Model (PBL-STEAM). PBL-STEAM is a learning model that exposes students to problem-solving activities in the context of science, technology, engineering, arts and mathematics. This model provides students with the opportunity to explore topics in more depth where the learning material is designed to be problem-based material with a STEAM nuance. The integration of STEAM in learning provides new opportunities for students to develop good creativity and problem solving abilities (Katz-Buonincontro, 2018) Buinicontro (2017). In line with this, the results of the post test on the critical thinking abilities of students who studied with STEAM-based Problem Based Learning had a significant difference to the critical thinking abilities of control class students.

STEAM-based PBL learning has a positive influence on the process of understanding concepts and students' creative thinking. Providing problems with STEAM nuances using a collaborative setting through LKPD allows students to develop skills, collaborate and in the fourth phase of learning, namely developing and presenting discussion results, provides opportunities for students to practice their communication skills. (Budiyono et al., 2020)Budiyono et al (2020). This is confirmed by research by (Niam & Asikin, 2021) Niam (2021) where learning with integrated STEAM-based PBL teaching materials can improve students' connection and communication skills, where the research shows that previous STEAM-based PBL learning has been able to have a positive effect on the development of student achievement, so that by adding art in the nuances of the problem it becomes STEAM-based PBL It is hoped that it can provide additional positive energy to students in participating in learning and increase their resilience in facing difficulties in learning. According to (Palennari et al., 2018) Palennari (2018), PBL is learning that can prepare students to be problem solvers, critical and creative thinkers in facing complex challenges. This shows that there is a positive influence on students' STEAM-based PBL learning where students will think more at a higher level to solve every challenge given.

In research conducted by (Wulandari, 2015), PBL prepares students to think critically about the problems and challenges presented, requiring students' ability to explore various learning sources to collect evidence, facts and data related to the proposed hypothesis. According to (Wiek, 2013), learning carried out using conventional methods has not been able to develop students' critical thinking skills, so there is a need for creativity in learning models. Students' critical thinking abilities can be trained according to (Orcito et al., 2021) (Diana & Saputri, 2021). Students' critical thinking abilities can be trained to prepare students to become critical thinkers, able to solve problems so that they can face life and be able to make decisions appropriately and responsibly.

(Khoiri et al., 2023) This means that the learning model has an influence on students' collaborative abilities, especially on increasing students' creative thinking and collaboration abilities. (Saban et al., 2023) STEAM-which is integrated with a problem-based learning model,

provides students with learning challenges and helps them acquire 21st century skills. On the other hand (Adriyawati et al., 2020) the integration of STEAM with the learning model provides encouragement for teachers to be able to innovate in creatively organizing learning so that students can increase learning motivation, provide meaningful learning, and provide opportunities for students to develop their scientific literacy.

A STEM (Science, Technology, Engineering, and Mathematics) based learning approach with the Based Learning method using digital media can bridge the gap between theoretical concepts and practical application in learning. (Hanum et al., 2023), (Pramasdyahsari, 2023) positive relationship between collaboration skills and students' critical thinking. Keywords: Project Based Learning; STEAM; Collaboration; Critical Thinking (Anisa, 2023) STEM-integrated PBL-based learning can improve students' critical thinking abilities to understand problems and solve them, especially during the science learning process (Hanum et al., 2023).

The STEAM approach is more effective in students' critical thinking abilities (May, 2023). (Diana & Saputri, 2021) The emotional intelligence of students through STEAM-based learning is higher than students who receive direct learning model treatment. The application of the PjBL-STEAM model is effective in improving critical and self-thinking abilities -student efficacy. (Rusmansyah et al., 2023) So it is important for a teacher to explore related models, learning methods with new innovations. One way is to integrate STEAM learning into learning models and methods (Anisa, 2023) (Ratna et al., 2023) STEAM has a positive effect on 21st century skills (Rahmadana & Agnesa, 2022) (Rahmadana, 2022). The application of the STEAM model in biology learning has a positive effect on students' critical thinking skills, creative thinking abilities and learning outcomes (Nurwahyunani et al., 2023) (Nurwahyuni, 2023)

CONCLUSION

The quasi-experiment carried out in this research shows that the results of STEAM-based PjBL learning are more effective in improving students' critical thinking skills compared to conventional learning. Judging from the ANOVA test value, a significant value of 0.000 was obtained, so it can be concluded that sig < 0.05 in the BNT test obtained a value of 0.132 > 0.05. The researcher hopes that future researchers can develop STEAM-based PBL in other subjects considering that this research only touches on biology learning material.

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