



The Influence of STEAM-Based Learning Application on Students' Critical Thinking Ability

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ABSTRACT

The learning process in Indonesia has not directed students to be able to think at a high level which resulted in the quality of education in Indonesia is still quite low. This study aims to determine the effect of the application of STEAM-based learning on students' critical thinking skills. This research is a "pre-experimental design with one group pretest-posttest design" study. The population of this study were all students of class XI IPA, totaling 3 classes. Sampling was done by means of simple random sampling so that the students of class XI IPA 1 SMAN 1 Baitussalam were obtained. The data collection technique used is a test question (pretest and posttest). The results showed that the Pre-test score obtained was a minimum of 5 and a maximum value of 50, while the Post-test score of at least 60 and a maximum value of 95, the average improvement of students on the final test was more than the average score of the pretest. The results of data analysis showed the value of Sig. (2-tailed) value $0.000 < 0.05$. This shows that H_0 is rejected which indicates that there are differences in students' critical thinking results. This shows an increase in students' critical thinking through the application of a STEAM-based learning approach. These differences can be caused by differences in the learning approaches used, where in the post-test using the STEAM approach, during the learning process students are faced with a problem that must be solved with their respective group friends. In addition, students must be able to connect science concepts with concepts found in everyday life. Based on the results of the research obtained, it shows that there is a significant effect of implementing STEAM-based learning on students' critical thinking skills.

Keywords: STEAM Based Learning, Critical Thinking

INTRODUCTION

Education is an important aspect in the development of a country. Education is an effort made to prepare students through learning activities that aim to help students actively develop their potential, abilities and talents. This is in accordance with the objectives of national education as stated in Law Number 20 of 2003 concerning the national education system "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble character, as well as the skills needed for themselves, society, nation and state".

In the 21st century the demands of work want workers who have a variety of skills that must be mastered. 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 social and cross-cultural interactions (Fitriyah, 2021).

The 21st century and the 4.0 revolution have changed paradigms in various fields, including the world of education. The expected learning is the emergence of various student skills that can be applied in real life, to realize it requires the competence of the teacher characterized by learning skills. As stated by Zubaidah (2019) that 21st century skills consist of communication skills (Communication), collaboration (Collaboration), critical thinking (Critical Thinking), and creativity (Creativity) or what is known as 4C.

Education in Indonesia is still dominated by the view that knowledge is a fact that must be memorized and learning in the classroom still focuses on the teacher as the main source of knowledge (teacher center). In this kind of learning, the teacher plays a more active role, while the students only listen to what the teacher conveys. Learning activities like this make students not play an active role during the learning process.

In fact the learning process in Indonesia has not directed students to be able to think at a high level which results in the quality of education in Indonesia is still quite low. Based on several survey results that have been conducted previously, it proves that the results of PISA (*Programme for International Student Assessment*) in 2015 show that Indonesia is in the 63rd position out of 72 countries in the fields of science and mathematics (Mu'minah, 2020).

The 21st century learning paradigm emphasizes learners to be able to think critically, be able to connect science with real life, communicate and collaborate. Critical thinking is an ability that greatly affects a person's life. This is because the ability to think critically can make a person a good decision maker. Critical thinking skills can help learning success.

The ability to think critically is basically the ability to consider relevant or irrelevant information with the aim of being able to make decisions about what it will do (Diana, 2021). Therefore, the ability to think critically is an important aspect that students need to have because it is very useful in solving the problems faced and as a provision in facing the present and future life.

One way to improve students' critical thinking skills is that a supportive learning model is needed so that students' critical thinking skills can be improved. The Industrial Revolution 4.0 demands that all be able to develop a science and technology-based economy, one of the efforts to be achieved through education is by implementing STEAM (Science, Technology, Arts, and Mathematics) learning.

STEAM learning emerged in response to the need to increase students' interest and skills in *science, technology, engineering, and mathematics* (STEM) fields (Marmon, 2019; Quigley, et al, 2017). STEAM combines "arts" with STEM learning aimed at improving student engagement, creativity, innovation, problem-solving skills, and other cognitive benefits (Liao, 2016), and to improve the work skills (e.g. teamwork, communication, adaptability) necessary for career and economic advancement. STEAM is a teaching method

that involves children as the person in charge, learning mathematical arts and science for children, and learning that introduces children to nature (Naili. S, 2021).

According to Sari (2020) STEAM learning in addition to strengthening student learning in all disciplines, also through these disciplines students get the opportunity to explore and make connections between art, music, science, and others. In addition, with STEAM students feel more motivated and more effective in learning.

A learning model that can integrate the components of science, technology, engineering, art and mathematics is Project Based Learning. The PjBL learning model emphasizes contextual learning through complex activities such as giving students the freedom to explore planning learning activities, implementing projects collaboratively and ultimately producing a product.

According to Rahayu (2017) PjBL learning is a thinking activity that can improve higher-order thinking skills. The PjBL learning model has advantages in improving study habits and motivating students to think originally in solving a problem in real life. In project learning, teachers as facilitators, collaborate with students in making useful questions and meaningful assignments, so as to develop knowledge and social skills and assess students from their learning experiences.

So far, research on the effect of the application of STEAM-based learning on students' critical thinking ability in physics learning is still rarely used. Previous research conducted by Annisa et al (2018) revealed the application of the STEAM-based PjBL model in improving creative thinking skills and learning outcomes in Chemistry materials. Therefore, the study of steam implementation through PjBL on critical thinking in physics learning is very important and interesting to be studied further. Thus, clearer information will be obtained accompanied by more detailed data about the learning potential of STEAM-based PjBL in improving students' critical thinking skills in physics learning.

Problem of Research

Based on preliminary observations at SMAN 1 Baitussalam, teaching and learning activities are still in the form of delivering material from educators to students. The teacher delivers the subject matter from beginning to end, on the contrary, the learners only pay attention to the description of the information conveyed by the teacher. In other words, teachers are still used as a source of information and a source of knowledge in teaching and learning activities.

Based on the results of an interview that has been conducted with one of the physics teachers at SMAN 1 Baitussalam, it is known that there has never been a critical thinking skills test and there has been no learning carried out by students leading to critical thinking skills in the school. In addition, at SMAN 1 Baitussalam, physics teachers have never applied STEAM-based learning to physics learning.

In a study conducted by Priantari, et al (2020) "STEAM-PjBL Learning for Improving Critical Thinking" The results of the study concluded that there was a significant

influence on students' critical thinking ability. The use of these approaches and models makes students have better critical thinking skills.

Research Focus

Based on the description of the problem above, the author conducted a study entitled "The Influence of the Application of STEAM-Based Learning on the Critical Thinking Ability of Students of SMAN 1 Baitussalam.

METHODOLOGY OF RESEARCH

General Background of Research

The place chosen to conduct this research was SMAN 1 Baitussalam. Meanwhile, the research time was carried out in February-March 2022

The research method used in this study is a quantitative research method. Quantitative research is whose data is in the form of numbers and analysis using statistics (Sugiyono, 2016: 7). The research design in this study is Pree Experimental Design with the type of *one group pretest-posttest design*.

Subject of Research

The population in this study was all students of class XI MIA SMAN 1 Baitussalam which consisted of 3 (three) classes. The samples in this study are class XI IPA 1 and XI IPA 2. With the number of students in each class, it is 22 people. The samples in this study were taken by researchers using *simple random sampling*, where sample members from the population were randomly selected regardless of the strata present in the population

Instrument and Procedures

The instrument used in this study is a critical thinking ability test. The test is a method or procedure in the context of measurement and assessment in the field of education, which is in the form of giving assignments or a series of tasks in the form of questions or commands that must be done. This study used two types of tests, namely *pretest* and *posttest*. *Pretest* (initial test) is a test that is carried out before the learning process begins, while *the posttest* (final test) test is carried out after being given treatment / after the application of STEAM-based learning.

The test given is in the form of a written test in the form of a description of 5 questions. Test questions (pretest and posttest) critical thinking ability are presented based on critical thinking indicators, namely: (1) providing simple explanations, (2) building basic skills, (3) concluding, (4) providing further explanations, and (5) developing strategies and tactics.

Data Analysis

The stages of data analysis are: 1) N-Gain test, 2) Normality test using Shapiro Wilk Test. The normality test in this study used the IBM SPSS *Statistics Subscription* program.

The criteria for the normality test if significance > 0.05 then the data has a normal variant, 3) Hypothesis Test, to test the hypothesis using *the Paired Sample T-Test* using the IBM SPSS *Statistics Subscription* program. This test aims to determine the difference in the average of two samples (two groups) that are paired or related to each other.

RESULTS AND DISCUSSION

This research was conducted in class XII science 1 which totaled 22 students. The results of the student's critical thinking ability test can be obtained through the *pretest* given at the beginning of learning and *the posttest* at the end of learning. The improvement of students' physics critical thinking skills before and after learning can be obtained with the N-gain test. The N-Gain score of the increase in critical thinking skills obtained by students was 0.69. Based on N-Gain data, it shows that there are differences in the improvement of students' critical thinking after being taught using STEAM-based learning.

Table 1. Pre-test and Post-test results

Descriptive	Statistic	
	Pre-test	Post-test
Maximum	50	95
Minimum	5	60
Average	25,23	76,36
Std. deviation	13,842	10,372

Table 1 shows that the minimum value of the Pre-test is 5 and the maximum value is 50, while the value of minimal Post-test is 60 and the maximum value is 95. It can be concluded that STEAM-based learning can improve students' critical thinking skills. The pre-test and *post-test* averages can be seen in the chart below:

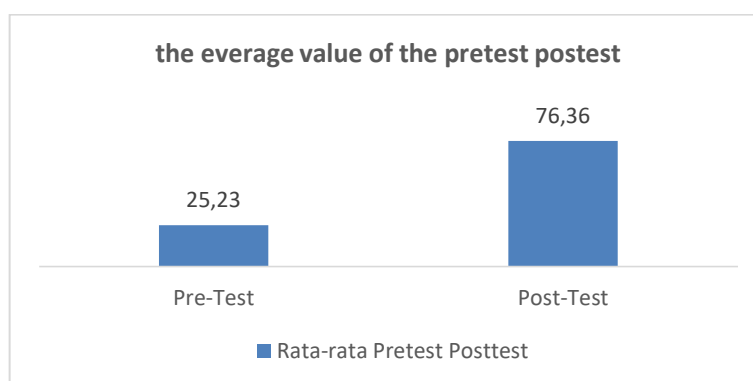


Figure 1. Graph of the average pretest posttest

Based on the data of the graph, it shows that the average score of students has increased, the average increase in students on *the posttest* is more increased than the average

score of *the pretest*. In this case, the interpretation of the obtained value indicates that the posttest value is higher than the interpretation of the pretest value.

The normality test is carried out to find out whether the research data is normally distributed or not. The data in this study were tested for normality using the *Shapiro-Wilk* Test using IBM SPSS *Statistics Subscription*. The results of the calculations obtained are as follows:

Table 2. Normality Test Results using IBM SPSS

	<i>Shapiro Wilk</i>			Conclusion
	<i>Statistic</i>	Df	Sig	
<i>Pre-Test</i>	,944	22	,242	Normal
<i>Post-Test</i>	,927	22	,108	Normal

After the normality test is carried out, a hypothesis test can be carried out, namely the t test which is used to determine whether there is a significant difference between the *pre-test* value and *the post-test* value. The hypothesis test used in this study is a parametric statistical test, which is a *paired sample T-test*. This test is used to make decision on whether a hypothesis is accepted or rejected. The hypotheses in this study are as follows.

Table 3. Hypothesis Test Results using IBM SPSS

		<i>Paired Difference</i>		Conclusion
<i>Pre-Test</i>	<i>Post Test</i>	T test	Sig. (2 tailed)	
25,23	76,36	-25,578	,000	H ₀ rejected

Based on table 4.4 it can be seen that the value of t-test is -24.501 with a significance of $0.000 < 0.05$ so that H₀ is rejected and H_a is accepted. This is also supported by the mean value on *the posttest* which is 76,36 greater than the *pretest* value of 25,23. Based on these data, it can be concluded that there are differences in the improvement of students' critical thinking before they are taught using STEAM-based learning.

These differences can be caused by differences in the learning approach used, where in post-tests that use the STEAM approach, during the learning process students are faced with a problem that must be solved with their respective group friends. In addition, students must be able to connect the concepts of science with the concepts contained in everyday life. This is in accordance with the statement of Hadinugrahaningsih (2017) The STEAM approach seeks students to create their understanding independently of the learning process by combining several aspects in real life so that they can hone and develop student skills. STEAM learning makes students become more active and take the initiative in developing their own knowledge. Experience in STEAM learning is able to increase students' self-confidence, encourage students to build a concept of knowledge through observation, investigation, and asking some questions they want to know (Wahyuningsih et al., 2020; Hasanah and Heryati, 2021).

This is in line with research that has been carried out by Cahyani and Sulastri (2021) that STEAM-based learning can be used to improve students' critical thinking skills, this is because the activities carried out in learning are oriented towards active involvement of students who are able to stimulate students to think critically so that students actively ask questions and answers, discuss and express opinions. The application of PjBL-based STEAM can be said to have developed students' creative and critical thinking skills because at each stage of learning students require cooperation, communication between friends and are skilled in solving problems and are responsible (Annisa, 2018).

This is in accordance with relevant research conducted by (Fitriyah, 2021) which states that PjBL-based STEAM learning has a significant effect on students' critical thinking ability. This is because the integration of STEAM PjBL can be a learning innovation that can come up with creative and critical ideas and solutions, making it easier to solve a problem.

CONCLUSIONS

Based on the results of the research obtained, it shows that there is a significant effect of implementing STEAM-based learning on students' critical thinking skills. The results of data analysis showed the value of Sig. (2-tailed) value $0.000 < 0.05$, this indicates that H_0 is rejected which indicates that there are differences in students' critical thinking outcomes. Based on the results of this study, researchers recommend suggestions for subsequent researchers to be able to conduct research using the STEAM approach because this research is still lacking and only limited to STEAM-based learning in improving critical thinking skills. Therefore, there needs to be other research with a wider and in-depth discussion

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