International Conference on Education 2024
Hybrid Conference
ICoE 2024

PROCEEDINGS 2024
The 2nd International Conference on Education
E-ISSN: 3025-6828
Volume 02, Tahun 2024

Implementation of STEM (Science Technology Engineering and Mathematics) Learning Model Based on Local Wisdom on Student Learning Outcomes

Ardiana Fatma Dewi[1], Fina Alya Nur Wakhidah[2], Dwi Ratna Sari[3], Hasna Nisa Arifinta[4], Naila Lutfiatun Ni'amahah[5], Siti Mazro'atul Ilmia[6], Tri Eva Sholihah[7]
[1]State Islamic Institute of Kediri; [2]State Islamic Institute of Kediri
[3]State Islamic Institute of Kediri; [4]State Islamic Institute of Kediri
[5]State Islamic Institute of Kediri; [6]State Islamic Institute of Kediri
[7]State Islamic Institute of Kediri
Correspondence e-mail: ardianafatmad@iainkediri.ac.id

Abstract:
The rapid development of science and technology has given rise to various innovations in the field of technology that are created to facilitate activities, especially in the field of education. Creative thinking and critical thinking skills are very much needed following the demands of 21st-century skills, namely so that students have various abilities, including critical thinking, creative thinking, communication and collaboration. STEM is an integrative learning approach that combines Knowledge (Science), Technology (Technology), Engineering (Engineering), and Mathematics (Mathematics). Several studies have shown that the STEM approach positively affects student learning, so this study tries to implement STEM based on local wisdom on learning outcomes. This study aims to determine how student learning outcomes are before and after providing a STEM learning model based on local wisdom. The type of research used is quantitative with an experimental method. Sample selection uses a simple random sampling technique, with research subjects being grade IX students of SMP Muhammadiyah Kediri. The results of the study showed that the average student learning outcomes before the action were relatively low; after being given treatment, the average student learning outcomes increased. The results obtained using the paired t-test were that the significance value of learning outcomes was 0.000 <0.05, meaning that there was a difference in the average learning outcomes of students before and after the local wisdom-based STEM learning model provision.
Keywords: Local Wisdom, STEM Learning, Student Creativity

Article History:
Received : 09 August 2024
Revised : 06 October 2024
Accepted : 26 October 2024
**editors will fill up the article history*

Introduction

Mathematics is taught from Elementary School (SD) to College (PT). Most students consider it a difficult subject (Haerunnisa and Imami 2022; Huzaimah and Amelia 2021). However, mathematics is important in facilitating the development of science, engineering, business, and technology (Hasanah, 2020). This shows how important mathematics is in education and the development of technology today. The rapid development of science and technology, as a result of the modern era, has given rise to various innovations in the field of technology that were created to facilitate human activities (Hulwani, Pujiastuti, and Rafianti 2021).

The rapid and dynamic changes in the world of education require the ability to generate new ideas so that teachers and students can overcome the complexity of unexpected problems. The ability to provide new, unusual ideas, examine problems from various perspectives, and produce many ideas that are different from others is known as creative thinking skills (Widana and Septiari, 2021). On the other hand, information that is abundant and easily accessible from various sources requires critical thinking to filter which information can be accepted as true. So, the ability to think creatively and the ability to think critically is very much needed under the demands of 21st Century skills, namely so that students have various abilities, including critical thinking, creative thinking, communication and collaboration (Purnamasari, Handayani, and Formen 2020; Wulandari 2019). Therefore, STEM (Science, Technology, Engineering, Mathematics) is present. STEM is an integrative learning approach that combines Knowledge (Science), Technology (Technology), Engineering (Engineering), and Mathematics (Mathematics) (Ama, Syutaridho, and Wardani 2023). STEM learning is an educational approach where science, technology, engineering, and mathematics are integrated with the educational process, which is focused on solving problems in real everyday life and in professional life. STEM learning shows students how concepts, principles, and techniques from science, technology, engineering, and mathematics (STEM) are integrated to develop products, processes, and systems that benefit human life (Suwardi 2021).

Through STEM learning, students learn theory and are invited to apply knowledge directly in real projects. Thus, students can develop computational thinking, problem-solving, and design skills. In addition, STEM also fosters a high level of self-confidence and curiosity in students, motivating them to continue learning and innovating (Khairiyah 2019). In order to encourage students to be active and responsible, the learning process must be carried out in a meaningful context and related to the real world.

Based on the explanation above, research is necessary to implement the STEM learning model in mathematics learning and integrate it with the culture and local wisdom of the surrounding environment. This study provides an overview of the application of the STEM learning model, with the aspects studied being whether or not it influences learning outcomes.

Method

This type of research is quantitative with an experimental method using a one-group pretest-posttest design, namely comparing pretest scores with posttest scores in one class. In this design, the sample will be given an initial test (pretest) and a final test (posttest) after treatment. The subjects of this study were 26 students of grade IX of SMP Muhammadiyah 2 Kediri. To determine the sample for this study, the researcher used a simple random sampling technique, namely random sampling, without considering the strata in the population (Hermawan 2019).

The stages of the implementation process are first, giving pretest questions to determine students' initial abilities; second, applying the STEM learning model by making eco prints; and third, giving post-test questions. The research instrument used was a test question used to measure students' abilities in the pretest and posttest. The data analysis techniques used were 1) Calculating the average, minimum and maximum pretest and posttest values; 2) Normality test (Kolmogorov Smirnov); 3) Homogeneity test (Levene statistics); and 4) Comparison test (t-test). The data collected in this study include pretest and posttest scores. The data of this study were collected through written tests. Data processing techniques consist of normality tests, homogeneity tests of pretest and posttest scores, and t-tests. The t-test determines the influence of learning models on student learning outcomes.

Results and Discussion

STEM learning process

STEM learning is carried out with 26 students in 1 meeting. The summary of the learning process is the main material in the form of geometric transformations in Mathematics subjects, which are then integrated with eco-print learning. Learning activities with eco-print are carried out to train students' skills during learning so that they have direct implications for improving student learning outcomes (Damayanti 2022). The learning steps are Opening (saying greetings, praying, asking for news, checking the number of students' attendance, forming groups), Core Activities (delivering geometric transformation material, explaining the stages of making eco prints, students practising making eco prints, students displaying their work in front of the class) and Closing Activities (Teachers ask students for reflections on the material, student feedback, praying, saying greetings).

Figure 1. Delivery of Material

Picture 2. Ecoprint Manufacturing Process

Data analysis

The results of this study are quantitative data analyzed through the initial and final stages. The initial stage consists of a normality test and a homogeneity test, while in the final stage there is a t-test with a paired sample t-test. The following are the results of the pretest and posttest carried out by students.

Table 1. Descriptive Analysis of Student Pretest and Posttest Data

	N	Min.	Max.	Average
Pretest	26	30	90	60
Posttest	26	50	100	75.76

Table 1 shows that the average score of students before treatment was 60, with a minimum score of 30 and a maximum score of 90. The average score of students after treatment was 75.76, with a minimum score and a maximum score of 50 and 100, respectively.

Furthermore, a data normality test was carried out on the pretest and posttest scores to determine whether the data was normally distributed. The data normality test was carried out using the Kolmogorov-Smirnov test, with the basis for decision-making, namely, if the significance value is less than alpha (0.05), then the data is not normally distributed. The data is normally distributed if the significance value exceeds alpha (0.05). The data normality test was carried out using IBM SPSS Statistics 22 so the normality test results were obtained in Table 2.

Table 2. Data Normality Test with Kolmogorov-Smirnov Test

	p-value	Decision
Pretest	0.200	Normal
Posttest	0.110	Normal

Based on the information in Table 2, the normality test results show that the significance values of the pretest and posttest are 0.200 and 0.100, respectively. Since the significance values of the pretest and posttest are greater than 0.05, it can be concluded that the pretest and posttest value data are normally distributed.

The next initial stage is the homogeneity test; the results are in Table 3 below.

Table 3. Data Homogeneity Test with Levene Statistic

	p-value	Decision
Levene Statistic	0.869	Homogen

The homogeneity test results in the table above show that the significance value is 0.869, which is greater than 0.05. Thus, the pretest and posttest value data are homogeneous or the same data.

The next data analysis is the t-test, which analyzes student learning outcome data. The hypotheses tested in the t-test are as follows.

Ho = There is no difference in learning outcomes before and after providing the STEM learning model with local wisdom.

Ha = There is a difference in learning outcomes before and after providing the STEM learning model with local wisdom.

Hypothesis testing was conducted to examine the differences in student learning outcomes before and after being treated with the STEM learning model. The data used in the t-test were paired sample t-tests, which were conducted using IBM SPSS 22. The results of the t-test calculation are shown in Table 4.

Table 4. SPSS Paired Samples Test output

	p-value	Decision
Paired t-test	0.00	significant

The paired samples t-test difference test proves that there is a difference in student learning outcomes before and after providing a STEM learning model based on local wisdom. This can be seen from the significance of learning outcomes, 0.000 <0.05. It can be concluded through the paired samples t-test that Ha is accepted. Namely, there is a difference in student learning outcomes before and after providing a STEM learning model based on local wisdom.

Conclusion

Based on the results of the research and discussion described in the previous chapter, it can be concluded that the average student learning outcomes before the action are relatively low, as can be seen from the table with an average of 60. The minimum value is 30, and the maximum value is 90. Then, after being given treatment, the average student learning outcomes are 75.76. The minimum value is 50, and the maximum value is 100. Where the average learning outcomes have increased. So there is a difference in the average before and after the provision of the STEM learning model based on local wisdom, it can be seen from the significance value of the learning outcomes, namely 0.000 <0.05. The learning outcomes of students after the provision of the STEM learning model based on local wisdom are higher than the learning outcomes of students before the provision of the STEM learning model based on local wisdom. From this study, it can provide an overview of the application of the STEM learning model can affect student learning outcomes. To develop and optimize learning outcomes, it is recommended that schools, especially teachers, include elements of culture and local wisdom in mathematics learning.

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