

Implementation of the STEAM model in mathematics subjects to improve learning outcomes

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Abstract: *The purpose of this research is to implement the STEAM learning model to improve the mathematics learning outcomes of fourth grade elementary school students. The method used is classroom action research with research procedures including implementation, among others, preparing action plans, implementing actions, observing, and reflecting. The results obtained in cycle 1 of the student's average score were only 58.5 with an incomplete scale and the need for improvement/reflection. After the action in cycle 1, cycle 2 found a significant increase in learning completeness, namely reaching 85.75. So it can be concluded that the STEAM learning model can be implemented in class IV in mathematics.*

Keywords: *STEAM; Mathematics; Learning Outcomes*

Introduction

The world of education is inseparable from the role of the teacher in increasing student intelligence. Various teacher efforts were made in achieving learning competencies. Recently the independent curriculum has been implemented in schools. Obstacles began to emerge from grade 1 and 4 teachers. Especially in translating teaching modules into learning related to the 21st century. From the results of interviews on Wednesday 15 March 2023, it was found that teachers had difficulties implementing activities related to learning models. Rarely does the teacher use the learning model in fact it has a lot of influence on the quality of learning. One of the efforts that will be made to improve is learning mathematics using the STEAM learning model. STEAM learning is a novelty from the previous model, namely STEM. The lack of motivation to learn using STEM is used as a reference for developing the STEAM learning model with the addition of Art which is linked to learning. The addition of Art is based on the importance of creativity and innovation capabilities to face future challenges (Kusenberg et al. 2022; Quigley, Herro, and Jamil 2017; Turnbull and Zhou 2004).

STEAM itself has a meaning, namely (Science, Technology, Engineering, Art, and Mathematics) (Khiné and Areepattamannil 2019; Perignat and Katz-Buonincontro 2019; Quigley et al. 2017) The use of this learning model is an effort to develop students' abilities by analyzing various symptoms -Symptoms that occur with a scientific approach so that they have the impact of increasing cognitive, affective and psychomotor abilities. The STEAM learning model is suitable for learning mathematics. The STEAM learning model can be used as a reference in improving students' cognitive through meaningful activities in a learning process. Besides that, it can also be used as a place for creativity and stimulate soft skills so as to build a collaborative learning atmosphere. STEAM can encourage students in 21st

century learning, namely the use of technology (Sahin 2009; Silber-Varod, Eshet-Alkalai, and Geri 2019; Silva 2009).

21st century learning includes aspects of forming learning skills and being able to apply innovations from patterns of thinking and ways of working, besides being able to provide information to other students in their groups, use media and technology, and have the ability/skills/life skills and careers globally. Jacobson-Lundeberg 2016) (Bellanca 2010). In line with STEAM, 21st century learning has a positive impact, namely being able to improve communication skills, collaborate, be able to think critically in problem solving, as well as be creative and innovative (Baroya 2018) (Syahputra 2018). So far, there are still many old models used by teachers in teaching and learning activities, and teachers' difficulties in utilizing technology have become an obstacle in implementing STEAM learning in technology activities. One thing that can be done with the use of technology is to provide interactive learning videos or PowerPoint. The millennial generation is currently competing in implementing technology in the learning process.

The learning process must support the increase and occurrence of cognitive, affective, and psychomotor activities in the learning process and outcomes. Cognitive activities in STEAM learning can be integrated into students' mindsets in the learning process, examples of activities are students' criticality in asking questions with peers and with teachers, students' ability to analyze a lesson, students' ability to reason, and at the end of learning can use tests evaluation as evidence of achievement of learning indicators. Whereas in affective activities in the STEAM learning model in the form of collaborating activities with other students such as mutual cooperation activities, communicating, exchanging opinions. Psychomotor abilities in STEAM learning activities include being able to design art, speak, write. The existence of this learning model has a very positive impact on the world of education, especially in learning mathematics.

This study emphasizes STEAM learning in mathematics in the material Measurement (Area of Rectangle and Square) by utilizing interactive media. In another study, this learning model emphasized science learning. The researcher tries to describe STEAM learning as a mathematics subject so that students no longer think that mathematics is a difficult subject, with this research it is hoped that learning mathematics will be more enjoyable. STEAM provides student experiences in broader thinking skills by linking knowledge and science and humanities. The benefits of the STEAM learning model are greatly felt by teachers, including (1) the use of science (Science) in learning which includes the linkage of physics, chemistry and biology which applies facts, concepts and principles that are interrelated, (2) the use of technology (Technology) involves the use of software in the learning process such as learning videos or interactive media, (3) the use of engineering, namely solving problems in mathematics, science, and technology in making a product, (4) the use of Art is a forum for exploring abilities in art, and (5) Mathematics deals with numbers, numbers, and shapes with theoretical and applied mathematics in scope.

Method

This research uses Classroom Action Research (CAR) with the aim of solving learning problems faced by teachers to improve learning outcomes so that the ultimate goal can be used to improve teacher performance to become professional and develop teacher skills in the learning process. This classroom action research has several stages of implementation, including planning, acting, observing, and reflecting. This research process took place in March 2023, taking place at SDN Merjosari 4 Malang City. The subjects of this study were 30 students in class IV in the Mathematics subject on Measurement (Area of Rectangle and Square). The following is an overview of the steps or procedures for classroom action research (CAR) in learning research using the STEAM model.

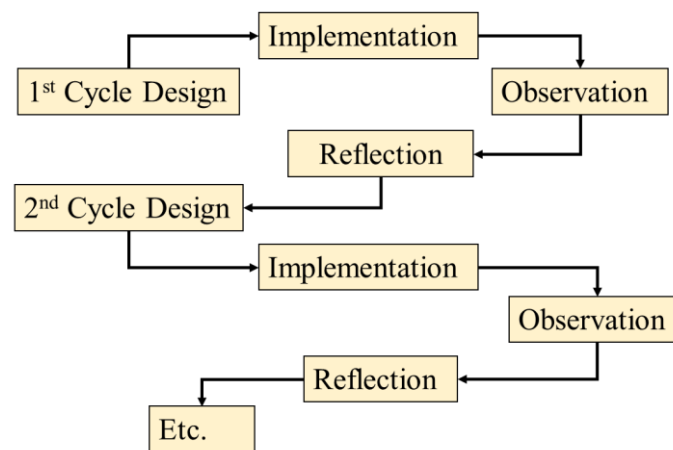


Figure 1. Classroom Action Research Procedures (CAR)

This research data collection techniques include tests, observation techniques, interviews, documentation techniques. According to (Pujaastawa 2016) techniques in data collection are carried out in order to meet needs that can be used as a source of data obtained through observations, interviews, and documentation. Tests are carried out to find out, measure, identify, and determine students' abilities to the learning outcomes that have been learned by students in the teaching and learning process in class (Arikunto 2021). Observation techniques are carried out by displaying data by making observations during ongoing activities (Sanjaya 2016) (Nasution 2017). Interviews were conducted to get answers to problems that occurred as one of the references used in the data collection process (Farhana and Awiria 2019). While documentation was obtained based on the results of the analysis in the form of printed and non-printed documents which were used as concrete evidence during the research.

The data analysis technique uses a qualitative descriptive technique by collecting the necessary data and then classifying it according to the specified formulation. Data in the form of qualitative described with sentences in the form of descriptive then analyzed by making conclusions based on the data obtained. The data obtained was obtained from the assessment of lesson plans, assessment of the learning process, and observation sheets.

Results and Discussion

The results of class action research conducted at SDN Merjosari 4 Malang City. The implementation was carried out in 2 stages, namely cycle 1 and cycle 2. However, before entering cycles 1 and 2, pre-cycles were carried out to determine the conditions and characteristics of fourth grade students in mathematics subject matter measurement. Some students still have not mastered learning mathematics measurement. So there is a need for learning innovation. The following is the description of cycle 1 for 2 meetings.

The cycle design is carried out by developing teaching modules using an independent curriculum. This activity is structured based on the characteristics and needs of students in utilizing the STEAM learning model. Likewise the teaching module in the learning steps section contains STEAM learning steps (Lestari, Mulyana, and Muiz 2020). As well as compiling evaluations to see the final abilities of students. While at the implementation stage, namely the implementation of the STEAM learning model. As in learning in general, each lesson begins with prayer, attendance, an apperception with a wide-awake song made using Doraemon's song lyrics, as well as the delivery of learning objectives. Entering the core learning activities begins to link STEAM, namely (1) Science activities (Science) students are invited by the teacher to observe square and rectangular ice cubes, then students are invited by the teacher to measure the area and height of each ice cube brought by Teacher. From this activity the activities of science and mathematics can already be seen. Then the students are invited by the teacher to watch the learning video in the process of melting from ice to water at room temperature. Then students are invited to solve the problem from the presentation of the video shown by the teacher. Students are asked to analyze and calculate various shapes of squares and rectangles, then in the final stage student's work on assignments to make squares and rectangles using clay.

The results of observations of the completeness of student learning outcomes in cycle I at the first meeting obtained student data with an acquisition score of 65, while at the second meeting students' learning activeness obtained a score of 70 with the "incomplete" category. The success indicator of the completeness of student learning outcomes in the cycle is marked if the number of students completing is greater than or equal to 85% of the number of students who get grades in mathematics get a score of ≥ 75 out of 100. Meanwhile the data is through the observation results of the STEAM learning model cycle 1 at the meeting The first meeting based on the observation score obtained a score of 43 while the second meeting obtained a score of 56. The criteria for student effectiveness were declared effective if students obtained an average score on learning outcomes with a percentage of ≥ 70 with a minimum of "good" criteria.

Table 1. Results of Cycle 1 Data Acquisition

Cycle I	Mastery Learning Outcomes	STEAM implementation	Total
1 st meeting	65	43	108
2 nd meeting	70	56	126
	Total score		234
	Average		58,5
	Completeness Criteria		Not Completed

Based on Table 1, the results of cycle 1 obtained an overall score of 234 out of a maximum score of 400 with an average of 58.8 out of a maximum score of 100 with an "incomplete" qualification. From these data it can be concluded that at the stage of cycle 1 the required criteria had not been reached and continued to stage 2 of the cycle. Based on the average value of cycle 1, reflection was held for further activities, namely emphasizing the STEAM learning model by providing more guidance for students who had not reach KKM. This situation occurs because students are the type who do not like learning mathematics. With guidance and approaches with students in cycle 2 getting good results, students have started to be brave in conveying and providing solutions to problems given by the teacher.

The results of observations of the completeness of student learning outcomes in cycle 2 at the first meeting obtained student data with an acquisition score of 85, while at the second meeting students' learning activeness obtained a score of 92 with the "complete" category. The success indicator of the completeness of student learning outcomes in the cycle is marked if the number of students completing is greater than or equal to 85% of the number of students who get grades in mathematics get a score reaching ≥ 75 out of 100. Meanwhile the data is through the observation results of the STEAM learning model cycle 2 at the meeting the first meeting based on the observation value gets an acquisition score of 80 while at the second meeting gets a score of 86 in the "very good" category.

Table 2. Results of Cycle 2 Data Acquisition

Cycle II	Mastery Learning Outcomes	STEAM implementation	Total
1 st meeting	85	80	165
2 nd meeting	92	86	178
Total score			343
average			85,75
Completeness Criteria			Complete

Based on Table 2, the results of cycle 2 obtained an overall score of 343 out of a maximum score of 400 with an average of 85.75 out of a maximum score of 100 with the qualification "complete". Thus, the results of the analysis of the implementation of the STEAM model in classical mathematics have been achieved and can improve student learning outcomes.

The existence of the STEAM model can hone students' skills and activeness in critical thinking because this model focuses on practical learning rather than theory. STEAM implementation can encourage students to develop, utilize, design, hone, manipulate, and apply subjects in the form of Science, Technology, Engineering, Art, Mathematics which are packaged in a learning activity (Amelia and Marini 2022) (Mu'minah 2021) (Parniati et al., 2021). Based on the results of the implementation of STEAM learning, there are advantages that can be used as teaching references, namely students who are reliable in solving problems, broad-minded, making it easier to solve problems, according to 21st century learning (Buckner and Boyd 2015), the existence of collaborative classes (Qomaria and Wulandari 2022). This STEAM learning model is suitable for use in learning that links between subjects or is integrated.

Conclusion

The STEAM Science, Technology, Engineering, Art, Mathematics learning model is a breakthrough that can be used as an effort to encourage students to think critically in the 21st century learning process according to the demands of an independent curriculum. Based on the results of the study it was found that through the STEAM learning model it can improve student abilities/student learning outcomes increase. This is proven by the increase from cycles 1 and 2. In cycle 1, the average student score was only 58.5 with an incomplete scale and needed improvement/reflection. Reflection was carried out with the finding that students did not like learning mathematics, they were still afraid to give opinions (possibly because of the role of researchers in class) so the researchers invited students to hold fun activities such as art. Apart from being asked to make square creations, they were also invited to sing together. After the action in cycle 1, cycle 2 found a significant increase in learning completeness, namely reaching 85.75. So it can be concluded that the STEAM learning model can be implemented in class IV in mathematics.

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