

**Implementation of Mathematics Learning With A STEM Approach
(Science, Technology, Engineering, And Mathematics)
at MTs Muhammadiyah Wuring**

**Implementasi Pembelajaran Matematika dengan Pendekatan STEM
(Science, Teknologi, Engineering, And Mathematics)
di Mts Muhammadiyah Wuring**

Tanti Diyah Rahmawati¹, Vinsensius Herianto Ndori², Murniati³

¹IKIP Muhammadiyah Maumere, t4nt1dr@gmail.com

²IKIP Muhammadiyah Maumere, herik.bonavit@gmail.com

³IKIP Muhammadiyah Maumere, murniat@gmail.com

ABSTRAK

Penelitian ini bertujuan untuk mengetahui implementasi pembelajaran matematika dengan pendekatan STEM (*Science, Technology, Engineering, And Mathematics*) kelas VIII A di MTs Muhammadiyah Wuring. Penggunaan pembelajaran dengan pendekatan STEM agar siswa dapat langsung dengan mudah mempraktekkan dalam kehidupan nyata dan mengasah kemampuannya secara langsung khususnya dalam merencanakan serta dapat membuktikan konsep teori yang diberikan. Penelitian ini dilaksanakan di MTs Muhammadiyah Wuring pada semester 2 tahun ajaran 2020/2021. Metode penelitian yang digunakan adalah deskriptif kualitatif. Sumber data diperoleh dari data primer yaitu guru matematika dan siswa. Sedangkan data sekunder diperoleh berupa nilai harian siswa sebelum dilakukan penelitian. Teknik pengumpulan data yang digunakan yakni observasi, tes, dan dokumentasi. Teknik analisis data yang digunakan meliputi tiga tahap yakni reduksi data, triangulasi, dan penarikan kesimpulan. Dari hasil analisis data dapat disimpulkan bahwa dengan menggunakan model pembelajaran STEM ketuntasan siswa 100%, dengan nilai rata-rata kelas 89, sehingga model pembelajaran efektif digunakan. Penerapan pembelajaran STEM melibatkan siswa berperan aktif, berkreasi, terampil dalam memecahkan masalah matematika. Pendekatan STEM dengan model pembelajaran PBL juga melibatkan siswa berdiskusi, berkreasi, dalam memecahkan masalah dan dapat meningkatkan hasil belajar siswa pada materi SPLDV.

Kata kunci: Implementasi, Pembelajaran Matematika, STEM

ABSTRACT

This study aims to determine the implementation of mathematics learning with a STEM (Science, Technology, Engineering, And Mathematics) approach in class VIII A at MTs Muhammadiyah Wuring. The use of learning with a STEM approach so students can easily practice in real life, hone their skills directly, especially in engineering, and prove the theoretical concepts. This research was carried out at MTs Muhammadiyah Wuring in semester 2 of the 2020/2021 academic year. The research method used is descriptive qualitative. Data sources are obtained from primary data, namely mathematics teachers and students. Meanwhile, secondary data was obtained from students' daily scores before the study. The data collection techniques used are observation, tests, and documentation. Data analysis techniques include data reduction, triangulation, and concluding. From the results of data analysis, it can be concluded that by using a STEM learning model, students' completion is 100%, with an average score of grade 89, so an effective learning model is used. Applying STEM learning involves students playing an active role, being creative, and being skilled in solving mathematical problems. The STEM approach with the PBL learning model also involves students discussing, creating, and solving problems and can improve student learning outcomes on SPLDV material.

Keywords: *Implementation, Mathematics Learning, STEM*

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PRELIMINARY

In the current era of revolution 4.0, it has become a demand that the Indonesian nation must face. The National Research Council (2015) revealed that it is currently feared that students are not prepared for the workforce in the future unless the education system can focus more on STEM education from an early age. STEM reveals many successful innovations in the pedagogical field, such as generating learning contexts that allow interaction, student learning tasks to appear more in real life, and can also give rise to learning advantages that are most substantial for the student self (Balawi, Khalaf, Kinda, Hitt, Wesley, 2015). Along with the development and advancement of technology, the demands in STEM learning affect the shift in all activities in life, most notably in the world of education. The change impacts learning activities, namely creativity in teaching and learning between students and educators, which refers to the guidance of the times. These demands are centered on students who play an active role in learning activities in the classroom. The purpose of changing learning activities is to create and develop creative abilities in students. To achieve the goal, teachers are required to design methods that are by current technological developments. A suitable method of learning by using the appropriate approach.

Gustiani, Widodo, & Suwarma (2017) said that the STEM approach is one of the learning approaches following the 2013 curriculum. The STEM approach is applied in Indonesia because this learning involves many aspects of learning material. The STEM approach is an approach that contains four fields of science, namely, science, technology, engineering, and mathematics, in learning to develop ability and creativity in problem-solving. STEM is a meta-discipline at the school level where science, technology, engineering, and mathematics teachers teach an integrated approach, and each discipline is not divided" (Eva and Haris 2020). The STEM approach requires teachers to play a role in designing and creating learning strategies to interact with students. According to Mulyani (2019), applying STEM in learning can encourage students to design, develop and utilize technology, hone cognitive, effective, and apply knowledge. Through a STEM approach,

students are expected to have learning and innovation skills including critical thinking, creative, innovative, and able to communicate and collaborate" (Ibid, Suherman, 2018). The learning objectives with a STEM approach are suitable for applying to junior high school, whose subject learning requires knowledge and context. The 4.0 revolution increasingly supports it, so academics widely use the STEM approach at various levels of schools, one of which is junior high school "(Ejiwale, 2013).

The appropriate learning model is used in mathematics learning with a STEM approach, one of which is problem-based learning (PBL). According to Liska Ariani et al. (2019), the PBL model is one of the learnings used to foster students' creativity by solving everyday problems. The PBL learning model emphasizes students play an active role in four fields of science so that students are free to explore, design/plan learning activities, implement projects together, and produce a product in the form of actual work. The goal is to realize active mathematics learning by the 2013 Curriculum. Buinicotro (2017) stated that STEAM integration would provide new opportunities for students to carry out the design learning process and produce products with good creativity and problem-solving skills. The STEM approach process with a problem-based learning (PBL) model has steps of learning activities that aim to guide students to achieve a specific learning process. Effective STEM-PBL measures include reflection, research, discovery, application, and communication, so this learning model is suitable for mathematics learning in the 2013 curriculum.

The material in this study is SPLDV. According to Arifin et al. (2016), SPLDV is closely related to daily life. Everything related to everyday life needs a settlement. With problem-solving skills, students become skilled in collecting information, analyzing, and re-researching the results obtained (Handayani, 2017).

Based on observations, researchers saw that the method used by class VIII mathematics teachers was the discovery learning method. According to interviews with teachers of mathematics subjects for odd semesters, teachers have not provided material using learning media. Teachers provide material using learning media in even semesters. The teacher said that in the last semester, students understood more about using learning media when using the discovery learning method. Because students play a more active role in finding material to discuss, this can be seen from the activeness and enthusiasm of students' learning when presenting material using learning media. But back to the students, the teacher said that when the students are active and enthusiastic about learning, the

students understand the material that the students present. Then, according to student interviews, teachers have never used learning media in odd semesters.

According to interviews with some students, students generally understand when given assignments by the teacher using learning media. However, students find it difficult to deliver the material because they have not mastered and obtained it before. Therefore, the efforts made by researchers to overcome problems in the mathematics learning process are to make designs using a STEM approach with a problem-based learning (PBL) model. This learning approach and model are suitable for mathematics learning to improve students' thinking and creativity skills.

Researchers hope that the STEM approach with the PBL model in mathematics learning can increase students' ability and creativity in solving problems in spldv class VIII A material at MTs. Muhammadiyah Wuring. So that the focal point carried out by researchers in their research is how mathematics learning is applied using a STEM approach with the PBL model can provide students with an understanding of the SPLDV class VIII A material in MTs. Muhammadiyah Wuring.

METHOD

This research uses a qualitative descriptive approach. The study subjects were class VIII A MTs Muhammadiyah Wuring students, totaling 29 people consisting of 15 male students and 14 female students. All students conducted tests and observations with a total of 29 people, while respondents' interviews were taken randomly with three students. The data source used is primary data obtained from mathematics teachers and students. Meanwhile, the secondary data source is in the form of daily scores of students from teachers of mathematics subjects before research is carried out. Data collection techniques are observation, test, interview, and documentation. Observation is used to learn firsthand student activities during the learning process in the classroom using the PBL learning model with a STEM approach. The steps for STEM learning in this study can be seen in the following table.

Table 1. Systematics of PBL-based STEM learning

<p>Science :</p> <ul style="list-style-type: none"> • Turning contextual problems into mathematical models • Procedural Solve calculation problems using cube props. • PLDV completion steps 	<p>Technology :</p> <ul style="list-style-type: none"> • Use a glue firing tool to glue the joints on the cube props. • Using the Geogebra application in creating cubes and solving mathematical problems as evidenced by derives in SPLDV calculations • Using mobile phones to search for information
<p>Engineering :</p> <ul style="list-style-type: none"> • Designing procedures by creating cube props • Make cube props using skewers glued together by glue by means of glue at the ends of each using glue (glue shoot). 	<p>Mathematics</p> <ul style="list-style-type: none"> • Calculate the distance/length of the point to another point (using cube props). • Determining the completion of SPLDV

Meanwhile, the data analysis techniques are data reduction, triangulation, and concluding. The research procedure can be seen in the following figure.

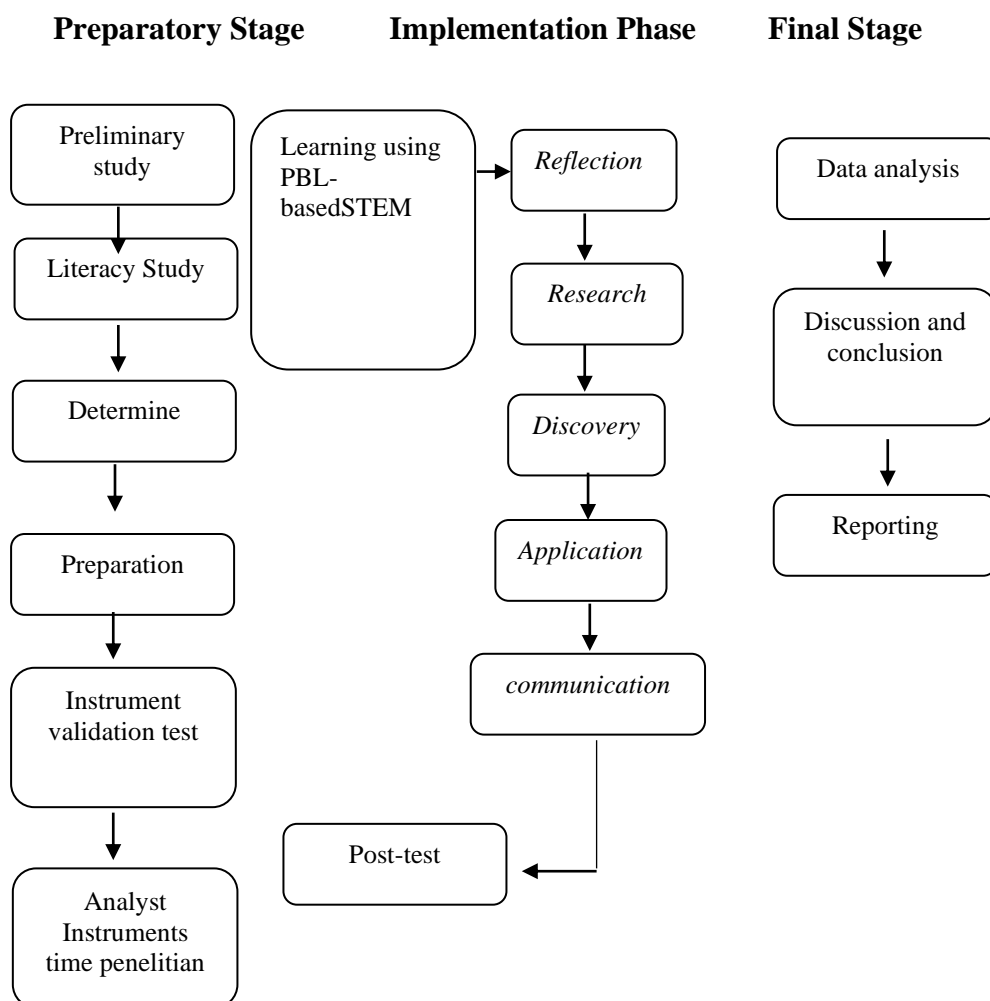


Figure 1. Research Procedure

Before this study was conducted, researchers tested the validity of rpp instruments with a PBL-based STEM learning model. This validity test is carried out to determine whether this RPP is by the expected STEM learning model. Assessment of the validity test with scores of 5, 4, 3, 2, and 1 based on the rating scale measurement scale (advanced scale). A score of 5 for the excellent category, a score of 4 for the good category, a score of 3 for the sufficient category, a score of 2 for the less good category, and a score of 1 for the wrong category. Calculating the average score of each aspect This stage is carried out after the product validity assessment score data is tabulated. At this stage, the validity assessment score data is calculated on average for each aspect. The average score of each aspect of the validity assessment $\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$.

Information:

\bar{x} = the average value of each aspect of the validity of the instrument

$\sum_{i=1}^n x_i$ = number of scores per aspect

n = number of grains of the value of each aspect of the validity of the instrument

Table 2. Interpretation Of Expert Validity

The average interval of scores	Classification
$\bar{x} > 4,2$	Excellent
$3,4 < \bar{x} \leq 4,2$	Good
$2,6 < \bar{x} \leq 3,4$	Enough
$1,8 < \bar{x} \leq 2,6$	Less
$\bar{x} \leq 1,8$	Very Lacking

(EkoputroWidiyoko, 2009)

On instrument test. Students are given a description question of 5 numbers. Description of the answers to the test questions to obtain data on the results of student learning completion with the formula: $KB = \frac{N}{n} \times 100\%$

KB = completeness of learning

N = many students score above KKM

n = many students took the test

RESULT AND DISCUSSION

From the results of expert validation tests related to RPP with an average value of 3.4, including classifications with good categories. So the researcher continued the implementation of the study. In addition, researchers conducted two meetings in classroom

learning using the PBL model with a STEM approach to SPLDV material. The steps of the PBL model STEM approach are as follows.

Science

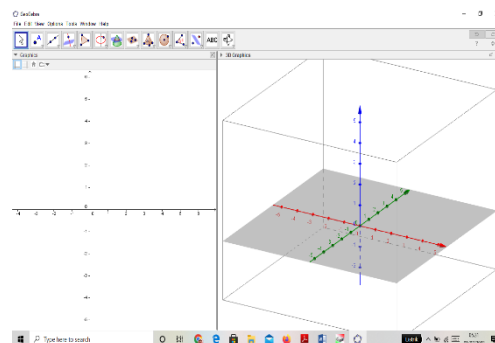
Science is carried out in learning mathematics with a STEM approach, namely by changing contextual problems into mathematical models using two-variable linear equations and their solving steps. In this step, students observe and analyze science-related questions and turn them into a mathematical model using two-variable linear equations. From the observation results, students can solve problems by changing contextual issues into mathematical models using the concept of two-variable linear equations. It can be seen from the steps of completing the students' answers.

Technology

The technology used in learning mathematics with a STEM approach is using cellphones and laptops. From the observation results, students use cell phones to find information or references in solving problems given by teachers, especially in designing a product. The results of the student's design are adjusted using the GeoGebra application. Documentation of the use of technology can be seen in the following figure.



Figure 2. The Result Of The Cube That Created



Figures 3. The Connecting Student Has Work For Geogebra Apps

Engineering

Engineering is carried out by designing cube projects according to procedures. The goal is to make students more active, creative, and skilled with complete accuracy in solving problems. Student activities in engineering are in the following figure.



Figure 4. Student Activities Designing Cube Projects

From the observations, students can perform techniques for designing/designing cube projects by procedures. The procedure starts from measuring skewer sticks to producing cube products. The process of completing student projects is time-consuming and long enough to get done. However, in designing projects, students play an active and creative role in completing cubes.

Mathematics

At this stage, it calculates the distance/length of the point to another point aimed at solving the problem. For example, you can see the following picture.



Figure 3. Student Activities Solve Problems

According to the results of observations during learning, students can determine the solution of two-variable linear equations by calculating the distance of points to other points that have been designed into cubes. The stages of mathematics learning using the PBL (project-based learning) model with a STEM approach are reflection, research, discovery, application, and communication. At this stage, the application is the teacher guiding students to use cube props that students have made in their respective groups to solve the given problems.

At the communication stage, students in groups demonstrate the work results from worksheets shared by the researcher. Students in groups present the discussion results at this stage by calculating the distance/length from point to point (using cube props). During

the discussion activities, researchers conducted a skill assessment using observation of each group. Researchers divide into four assessment criteria stages: mastery of the material, teaching aids, cohesiveness/division of labor, and delivery in presentations. The following can be seen from the table of learning outcomes in mathematics learning using the PBL (problem-based learning) model with a STEM approach.

The conclusion from the results of observations is that students are active and have learning skills, innovation includes critical thinking, creativity, innovation, and able to communicate and collaborate, besides that students can immediately easily practice in real life and hone their skills directly and can prove the theoretical concepts given. While the test results using the PBL model with a STEM approach can be seen in the following table.

Table 3. Learning Outcomes Using the PBL Model with a STEM Approach

Number	Indicators	Knowledge	Skills
1	Highest Score	93,33	84,5
2	Lowest score	80	79,5
	Average	86,66	78,25

Learning outcomes show that STEM approaches significantly affect student learning outcomes. A total of 15 people with completion criteria (100%) from 15 students were declared complete. The grade point average was 86.66. Meanwhile, the KKM set is ≥ 70 . Researchers analyzed the achievement of learning outcomes using STEM and previous approaches. Judging from the previous learning outcomes, 31 students were declared complete (75.61%). Meanwhile, ten students were not total (24.39%). The average score reached 73.41. So the researchers concluded that the percentage of completeness of student learning outcomes in mathematics learning using the PBL model with a STEM approach increased.

The conclusion from the results of interviews conducted with MM, SD, and K, who are respondents to interviews of class VIII-A students, said that using PBL-based STEM learning is very interesting and not boring. This is because students must be active in learning and designing problem-solving associated with concrete objects. In addition, students feel happy when they have found a concept of their own with the collaboration of students accompanied by the teacher. At the end of the interview, one of the students said that this learning was the first time carried out in school with deriving and Geogebra applications which would always be remembered in mathematics learning.

Based on observations, tests, and interviews, mathematics learning using a STEM approach can attract students to be more active in learning. In addition to applying PBL-based STEM methods, students are more active and creative in learning. Students play an active role, are creative, and are skilled in solving mathematical problems. Students also actively discuss, create, and solve problems to find a concept and improve student learning outcomes. This has an impact on the problem-solving ability of students. In addition, students who are initially accustomed to using contextual learning models and lectures have creativity in PBL-based STEM learning models. Researchers hope that STEM learning can be implemented in the following mathematics learning material according to the times and encourage students to be creative by practicing this method according to the independent learning curriculum.

This study's results align with research previously conducted by Betty Heryuriani (2020), which shows that a STEM approach can improve student learning outcomes. In addition, in the nasrah study, rifkah, Yuliana (2021) said that science learning using the STEAM model in grade IV marendeng Marampa students of SD Pertiwi Makassar is effective with the completeness of student learning outcomes of 95.85%. Siti Nurjannah, Dwi, and Diah (2021) showed that 95% of science teachers perceived the STEM approach as increasing students' critical thinking power. Most science teachers also positively respond to applying STEM approaches in science learning in the classroom to provide for their future. Based on research by Siti Nurjannah et al., teachers respond positively to STEM learning to improve critical thinking. This is in line with the research that students are required to think critically and creatively and solve problems by conducting a learning model with STEM. Research Eva susai and haris (2020) the results of the analysis can be concluded that in mathematics learning on the material of number patterns with the PjBL learning model, the STEM approach makes student learning activities more active and enthusiastic, invites students to be creative in creating, active in discussions. Students can communicate presentations on the results of their group work completing project assignments. Following the results of this study, the difference in research is found in the learning model.

CONCLUSION

Based on the results of research that has been carried out on class VIII A students at MTs. Muhammadiyah Wuring, regarding the design of mathematics learning using the PBL model with a STEM approach to SPLDV material, researchers can conclude that the

steps of the STEM approach applied can improve student learning outcomes. Applying the learning model gives students an active role, creative, and skilled in solving problems. In addition, a PBL-based STEM approach can provide students with enthusiasm for discussing, creating, and being responsible for solving problems. This can be from the student's learning completion of 100% with a grade point average of 86.66. Researchers hope that this research does not stop here. Advanced applications with STEM approaches can be continued in the following study by exploring students' potential to be creative in applying their lives to mathematical problems and findings.

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