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Development of STEAM-based Teaching Materials in Problem Based Learning Model to Improve Mathematical Reasoning

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Abstract

Mathematical reasoning is an important ability in using concepts and logic based on existing rules to solve various problems by making logical and accountable conclusions. However, based on a preliminary study by giving test questions to students, it was found that students' mathematical reasoning is still relatively low. This study was a development research that aims to develop and determine the quality of teaching materials based on Science, Technology, Engineering, Arts, and Mathematics (STEAM) in a problem-based learning model seen from the suitability of feasible characteristics consisting of valid, practical, and effective. This research was conducted using the Research and Development (R&D) stage with a modified 4-D model and implemented at SMP Negeri 2 Geyer in 2023. The data collection techniques used were tests and questionnaires. The results of the study indicate that the teaching materials have met the eligibility criteria. The validity results show a percentage of 90.1% with very valid criteria. Meanwhile, the practicality results obtained a teacher response of 95% and a student response of 85.2% which indicates very practical results. The results of the pretest and posttest analysis show that the teaching materials are effective in improving mathematical reasoning, where the teaching materials can help students achieve the minimum completeness criteria both individually and classically, and there is an increase in students' mathematical reasoning with an N-Gain value of 0.24. Therefore, Science, Technology, Engineering, Arts, and Mathematics (STEAM)-based teaching materials can be used as an alternative in facilitating students to develop mathematical reasoning.

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1. Introduction

Technology is important and needs to be developed because technology can be used to simplify and improve various aspects of human life, from communication and access to information to productivity and efficiency in various fields. To develop technology, fundamental basic knowledge is needed, one of which is mathematics (Andini et al. 2023). Studying mathematics requires several methods to be able to understand and solve an existing problem. Studying mathematics can also be interpret process of students in solving problems or in an effort to achieve certain concepts or principles (Sukestiyarno et al., 2023).

A person needs to master various abilities to assist in learning mathematics, including those mentioned in the NCTM as cited in Jami'atun & Wijayanti (2020), namely: (1) mathematical communication; (2) mathematical reasoning; (3) mathematical problem solving; (4) mathematical connections; (5) mathematical representation. Mathematical reasoning is the ability to think using rules, properties, and logic based on concepts or understandings that have been previously obtained, then these concepts or understandings are interconnected with each other and applied to new problems so that new decisions are obtained that are logical and accountable or proven true (Sholihat et al., 2018). Meanwhile, according to

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Ariati & Juandi (2022) states that reasoning ability is mental activities such as remembering, imagining, memorizing, connecting several meanings, creating concepts or guessing several possibilities. The reasoning abilities are needed in training students to solve a problem by going through various stages based on predetermined rules or logical properties and also to support the achievement of student learning outcomes.

Observation activities carried out at SMP Negeri 2 Geyer revealed that students' mathematical reasoning were still low. This fact was obtained from the results of the mid-semester assessment which showed that from the results of students' work completing questions at the cognitive reasoning level, from all 5 descriptive questions it was found that on average students were only able to get a score of 52% of the overall score. Most students completed questions at the cognitive reasoning level from 5 descriptive questions it was found that on average students were only able to get a score 52% of the total score. The errors that occur are when analyzing and understanding questions, doing calculations and when making conclusions.

Several studies also show that Indonesian students' mathematical reasoning abilities are still relatively low. Research by Nashihah et al. (2019) stated that the average logical reasoning aspect of students was very low (25%), the deductive aspect was very low (16.6%), and the overall ability only reached 35.6% (low category). Meanwhile, Taqiya, Hasanah & Yulianti (2023) also found that there were still many students who fell into the low reasoning category, especially in solving series and series problems.

The low mathematical reasoning ability of students is thought to be because the learning tools used have not been able to assist in learning activities, especially in increasing student activity to practice solving problems. One of the learning tools that is in the spotlight is the teaching materials used in schools, where the teaching materials used have not been able to facilitate students to practice mathematical reasoning. In line with that, Fadli et al. (2024) stated that limited teaching materials can cause students to have difficulty in solving problems. Hesti et al. (2022) also argued that inappropriate teaching materials will make it difficult for students to understand the material.

Several studies have been conducted in an effort to develop teaching materials with various approaches and methods. One approach that can be chosen is the STEAM approach. According to Nurhikmayati (2019) STEAM is a meta-discipline that integrates science, technology, engineering, art and mathematics into an integrated approach that can be implemented in learning in schools. The implementation of STEAM in learning mathematics can be done by understanding the relationship between existing mathematical concepts and other disciplines contained in STEAM which in associating these various ideas can bring up new ideas in solving problems, one of which is in developing reasoning abilities (Katz-Buonincontro, 2018). STEAM also provide another way for teachers to educate students about character building, which has become an important part of education (Chen & Huang, 2020).

The application of STEAM in improving students' reasoning abilities must also be supported by a good learning model. One model that can be applied is learning using the Problem Based Learning (PBL) model. The PBL learning model is a learning model which confronts students with a problem at the beginning of the learning activity. The problem faced is a problem that exists in the real world then students will be guided slowly to solve the problem during the learning process (Isrok'atun & Rosmala, 2018). PBL is a process used to identify problems with scenarios to increase knowledge and understanding (Ali, 2019). Research conducted by Handayani & Mandasari (2018) concluded that learning that applies the PBL model can make it easier for students to solve a problem they face, and it is also easier for students to acquire knowledge and the concepts they learn.

The application of the PBL model combined with the STEAM approach can be used to increase student activeness in participating in learning, where problems will be presented by combining various branches of science so that the problem-solving process is more varied and more interesting. This is in line with what Putri (2021) explained states that in using the STEAM-based PBL learning model make students more active in problem solving activities both in gathering information along with interrelated data, defining and organizing problems both individually and in groups, and provide solutions to problems given by the teacher. The combination of the PBL model and the STEAM approach can be applied to the development of teaching materials to help improve student learning outcomes, especially in problem solving. (Widodo et al., 2021). In addition, adjustments are also needed to the problems in the teaching materials, where the problems presented must not only be interesting but also be able to train and develop mathematical reasoning skills.

This study aims to develop STEAM-based mathematics teaching materials to improve mathematical reasoning skills through the PBL model on the topic of linear equations and inequalities with one variable in seventh grade. Innovation is carried out by collaborating various STEAM and PBL disciplines to produce various learning activities, both in the form of problems raised in the teaching materials and the steps taken by students to solve them. In addition, the development of teaching materials is also carried out to ensure that the resulting product meets the eligibility criteria consisting of valid aspects, practical aspects, and effective aspects.

2. Methods

This research used the Research and Development (R&D) method with 4-D model modification from S. Thiagarajan (1974). Research and Development method is a research method used to produce and test the effectiveness of the product (Sugiyono, 2018). In this study, STEAM-based teaching materials were developed to increase students' mathematical reasoning ability.

The Research and Development (R&D) stages used in this study include: (1) define; (2) design; (3) develop. The disseminate stage was not carried out due to time and energy constraints, so the research stage was only carried out up to the development stage. The data collection techniques used in this study were questionnaires and tests. The questionnaires consisted of a validation sheet, a student response questionnaire, and a teacher response questionnaire. The tests consisted of a pre-test and a post-test to measure mathematical reasoning abilities before and after the treatment.

Data analysis techniques for the results of the validity, practicality, and effectiveness level of the teaching material will be analyzed by using the following equation.

$$\text{The score percentage} = \frac{\text{number of scores obtained}}{\text{the maximum number of scores}} \times 100\% \quad (1)$$

The validity criteria based on Gitnita *et al.* (2018) are shown in Table 1.

Table 1. Criteria of Validity

Interval	Criteria
$0\% \leq score \text{ percentage} \leq 20\%$	Totally invalid
$20\% < score \text{ percentage} \leq 40\%$	Invalid
$40\% < score \text{ percentage} \leq 60\%$	Less valid
$60\% < score \text{ percentage} \leq 80\%$	Valid
$80\% < score \text{ percentage} \leq 100\%$	Very Valid

Teaching materials are said to be valid and can be used for learning if the score percentage > 60%. The practicality level criteria based on Gitnita *et al.* (2018) are shown in Table 2.

Table 2. Criteria of Practicality

Interval	Criteria
$0\% \leq score \text{ percentage} \leq 20\%$	Very impractical
$20\% < score \text{ percentage} \leq 40\%$	Not practical
$40\% < score \text{ percentage} \leq 60\%$	Less practical
$60\% < score \text{ percentage} \leq 80\%$	Practical
$80\% < score \text{ percentage} \leq 100\%$	Very practical

Teaching materials are said practical and can be used for learning if the score percentage > 60%. The data analysis technique for testing the effectiveness of teaching materials described as follows.

1. Average completeness test

Average completeness test aims to determine the average student learning outcomes after using the teaching materials reach the minimum submission criteria at SMP Negeri 2 Geyer for mathematics subject (72). This test uses one-sided average test (right).

2. Classical completeness test

Classical completeness test used to determine whether the proportion of completeness mathematical reasoning ability test results reaches 75% of student or more. This test uses the right side proportion test.

3. Wilcoxon test

This test can be used to determine if there's a difference in test scores before and after using program teaching materials.

4. N-Gain test

The improvement of mathematical reasoning ability scores can be analyzed by using the N-Gain score. According to Sundayana (2015), the formula of N-Gain score is:

$$Normalized\ Gain\ (g) = \frac{\text{posttest score} - \text{pretest score}}{\text{max skor} - \text{pretest score}} \times 100\% \quad (2)$$

According to Sundayana (2015), the criteria of the N-Gain score are shown in Table 3.

Table 3. Criteria of N-Gain score

Interval	Criteria
$0.70 < (g) \leq 1.00$	High
$0.30 < (g) \leq 0.70$	Medium
$0.00 < (g) \leq 0.30$	Low
$(g) = 0$	Constant
$-1.00 \leq (g) < 0.00$	Decrease

3. Results & Discussions

The process of developing teaching materials is carried out sequentially based on the 4-D development stages with the aim of producing teaching materials that are suitable for use in learning activities at school.

3.1. Define

The define stage is the stage for determining and analyzing the various needs needed in learning activities related to information about the product being developed. This step is expected to be able to get the right solution and can be applied to learning and be able to improve mathematical reasoning (Danuri et al., 2023). The define stage itself consists of several stages, namely as follows.

3.1.1. Front-end analysis

Based on an interview with a mathematics teacher, that students' mathematical reasoning are still low. One reason is that teachers use textbooks that have not been able to facilitate students to practice mathematical reasoning. The understaffed and time factors also cause teachers to be unable to present learning resources that suit the needs of students and schools.

3.1.2. Learner analysis

The learning material products developed are aimed at seventh grade students aged 11-14 years. Based on information from the mathematics teacher, it was found that students were still in the transitional stage from the concrete operational stage to the formal operational stage so that most students still needed help from the teacher to understand the problem either with the help of concrete objects or events to get them used to thinking abstractly.

3.1.3. Task analysis

Task analysis aims to identify some of the tasks of students when participating in learning activities. This task analysis will also refer to the analysis of the material concept. Details of the task analysis on one-variable linear equations and inequalities also refer to the competencies on Indonesia Curriculum.

3.1.4. Concept analysis

Concept analysis is carried out by analyzing several concepts needed in learning activities. Concept analysis aims to identify several concepts in the matter of one-variable linear equations and inequalities. After several concepts have been arranged systematically, these concepts are then linked to several other relevant concepts.

3.1.5. Specifying instructional objectives

The specifications for learning objectives are based on Indonesia Curriculum regarding the material of one-variable linear equations and inequalities which are then adapted to the PBL learning method with the integration of STEAM elements.

3.2. Design

The design stage is the stage for creating a teaching material framework that will be developed in the form of Draft I. After that, the research instrument design will also be carried out to be used in trials.

3.2.1. Constructing criterion-referenced test

Test instruments are made to measure and determine the achievement of students' mathematical reasoning. The basis for preparing the test is task analysis and concept analysis that has been made in the specification of learning objectives also adapted to indicators of mathematical reasoning.

3.2.2. Media selection

At the media selection stage, it is done by first determining the right media, especially in displaying subject matter which is also adjusted to some of the analyzes that have been done before. In this research activity, they will choose to develop media in the form of teaching materials that combine all STEAM elements on contextual problems so that it is expected to be able to help students understand the material of one-variable linear equations and inaccuracies, then solve various problems to improve students' mathematical reasoning.

3.2.3. Format selection

The content format chosen in designing teaching materials is adjusted to the basic competencies and indicators of achievement of competencies in the 2013 curriculum, including indicators of mathematical reasoning ability. The format of the teaching materials is designed to contain contextual problems that are integrated with all STEAM elements, besides that the design is also made as attractive as possible so that students are more interested in using it.

3.2.4. Initial design

The initial design stage was carried out by making STEAM-based teaching material product designs in the PBL model. In addition to making product designs at this stage, drafts are also prepared to organize various learning materials from various trusted sources into one systematic teaching material product unit. After finishing making a draft, proceed with compiling a layout that is adapted to the teaching material product.

The STEAM-based teaching material was created by using Microsoft Office Word for writing, and Coreldraw for designing. STEAM-based teaching material are conducted 53 pages and the text of the content was written with the dominant font is Times New Roman by size by 12-20. This was intended for the reader to feel comfortable with the material presentation.

The STEAM-based teaching material consists of three parts, the beginning, the main contents, and the conclusion. For the beginning, it consists of a cover page, introduction, table of contents, core competencies, basic competencies, competencies achievement indicators, learning objectives, concept maps, benefits of the material being studied, issues related to STEAM.

The main content consists of prerequisite material, subject matter, examples of several problems related to STEAM, exercises, and summaries. The material outline is prepared in detail, as well as related to STEAM aspects. Every problems related to STEAM are presented in different color icons. For science" it is presented by a red icon color, "Mathematics" it is presented by a blue icon color, and then "Engineering" it is presented by a green icon color, "Art" it is presented by a purple icon color and "Technology" it is presented by a yellow icon color. For the conclusion, it consists of competences test, glossary, and reference. Competences tests on these learning materials are available for essay. The issues related to STEAM that make it more interesting dan related to the daily life. The glossary in this part contains an explanation of the meaning of the terms used in the teaching material. The product design illustration is shown in Figure 1.

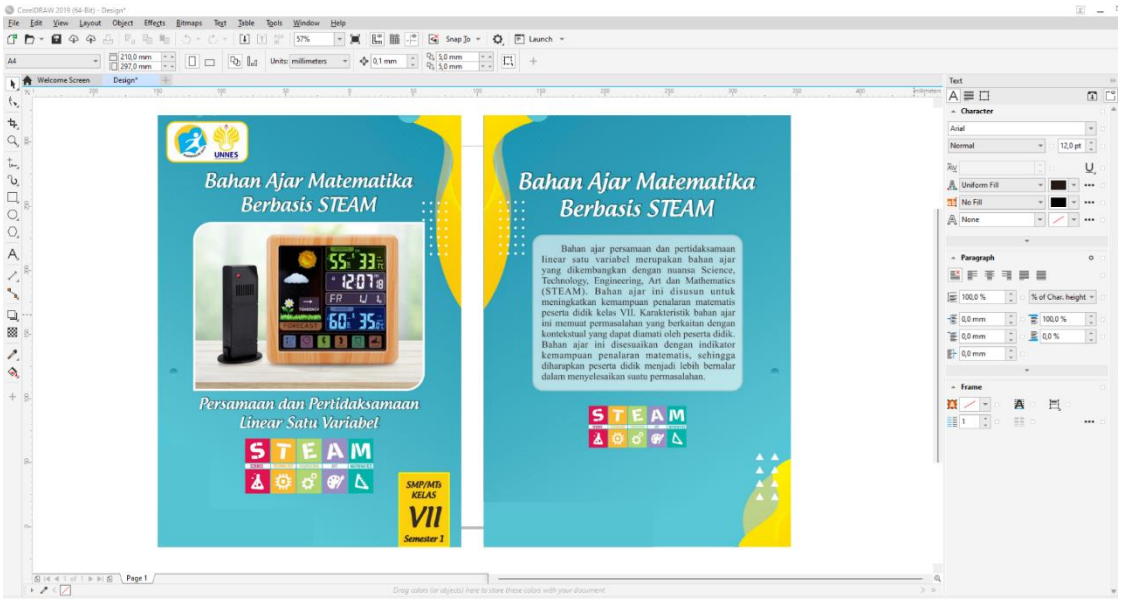

Figure 1. Product Design

3.3. Develop

In the development stage, STEAM-based teaching materials in the PBL model on one-variable linear equations and inequalities that have been designed will be assessed for validity by the validator, tested for practicality and tested for their effectiveness on students in learning activities.

3.3.1. Expert appraisal

Expert appraisal step is a validation of STEAM-based teaching materials in the PBL model, the material on linear equations and inequalities of one variable is evaluated and validated by experts, be they lecturers or teachers. The level of validity are assessed based on aspects in validation' sheet, including (1) content eligibility; (2) eligibility of presentation (3) language eligibility. The teaching materials will be assessed by four validators. Recapitulation of validation results are presented in Table 4.

Table 4. The Validity Score of Teaching Materials

Aspect	Score Percentage	Criteria
Content eligibility	89.3%	Very Valid
Eligibility of presentation	90.8%	Very Valid
Language eligibility	90.6%	Very Valid
Average	89.3%	Very Valid

Based on the results of the validity test, it shows that the STEAM-based teaching material in PBL model which contains aspects of content validity, presentation validity, and linguistic validity are included in the very valid category. Thus, the teaching materials have met the provisions of the validity of teaching materials.

3.3.2. Developmental testing

The development trial consists of two stages, the practicality testing phase of the teaching materials and the testing phase for the effectiveness of the teaching materials. The practicality test is carried out by filling out a questionnaire on the responses of teachers and students regarding learning activities by applying teaching materials. While the effectiveness test is carried out using tests in the form of a pretest and posttest regarding students' mathematical reasoning.

a. Practicality Test Results of Teaching Materials

Practicality test of teaching materials aims to determine the level of practicality of the teaching materials based on STEAM in PBL model to improve mathematical reasoning ability. In this study, this practicality

test is taken from the responses teacher and students at SMP Negeri 2 Geyer to the teaching materials that have been developed. The results of the practicality test of teaching materials are presented in Table 5.

Table 5. Criteria of N-Gain score

Respondent	Final Score Percentage	Criteria
Teacher	95%	Very practical
Students	85.2%	Very practical

Based on practicality test results, the average score is 95% and 85.2% with very practical category. Its shows the teaching materials that have been developed are practical. Therefore, the teaching materials are practical and can be used in mathematics learning.

b. Effectiveness Test Results of Teaching Materials

Test the effectiveness of teaching material used to determine the effectiveness of the use of teaching materials developed. Teaching materials can be said to be effective if the average test results for students' mathematical reasoning exceed the minimum submission criteria, then the proportion of students who complete the class using teaching materials is more than 75%, and there is an increase in students' mathematical reasoning.

1. Test preparation

Before the pretest and posttest questions were given to students, the questions were tested on a test class, that is class of VII-B SMP Negeri 2 Geyer. The results of the trial show that the 6 items compiled are valid, the questions have high reliability, it's have enough and good discriminating power. After that the level of difficulty is moderate as shown in Table 6.

Table 6. Criteria of N-Gain score

Question Number	Validity	Reliability	Difficulty Level	Discriminating Power
1	Valid	Very High	Medium	Enough
2	Valid		Medium	Enough
3	Valid		Medium	Good
4	Valid		Medium	Enough
5	Valid		Medium	Good
6	Valid		Medium	Good

Based on the test results on students' mathematical creative thinking ability, the questions can be used as pretest and posttest questions to improve mathematical reasoning ability. The questions chosen for the pretest are questions numbered 1,2, and 6. Meanwhile, for the posttest questions, the questions chosen are 3,4, and 5.

The pretest and posttest questions were tested to 28 students of class VII-A SMP Negeri 2 Geyer. In the learning process, students are given soft files of teaching materials, and assistance provided by researchers during the implementation of research.

2. Average completeness test

Based on calculations, the value of $t_{count} = 3.12$ and $t_{table} = 1.7$. Because $t_{count} > t_{table}$ it means the average student learning outcomes after using teaching materials is more than 72. Annajmi & Azmi (2017) said that role of students in learning are big, so the teachers is not as the main role. In the other words, students play an important role in learning so they are able to construct their own knowledge. So the student teaching materials are able to help students to beyond the average completeness and purpose of learning can be achieved.

3. Classical completeness test

Based on calculations, the value of $z_{count} = 1.74$ and $z_{table} = 1.65$. Because $z_{count} > z_{table}$ it means the proportion of completeness mathematical reasoning ability test results is more than 75% of student. Annajmi & Azmi (2017) explains that by using teaching materials, students will actively seek, organize

their own knowledge, and create conclusions from their knowledge with the instructions and guidance of the teacher. Therefore, the teaching materials can help students to achieve the classical completeness.

4. Wilcoxon test

Based on the normality test, it is known that the pretest and posttest data are not normally distributed, so to measure whether or not there is a difference in the average pretest and posttest scores, the Wilcoxon test is used. Based on the results of processing with SPSS software, the Asymp. Sig (2-tailed) value was obtained at 0.001, which means it is smaller than the specified test criteria of 0.05. So it can be concluded that there is a difference in the average pretest and posttest scores after using the material.

5. N-Gain test

The improvement of mathematical reasoning ability measured with a written test that refers to indicator of mathematical reasoning ability. The N-gain test results can be seen in Table 7.

Table 7. N-Gain Test Results

Average Score Percentage		N-Gain	Criteria
Pretest	Posttest		
68.36	76.06	0.24	Low

For the average value of the pretest and posttest data obtained an N-Gain test value of 0.24 which indicates that an improvement of students' mathematical reasoning ability on low criteria. Nugroho *et al*. (2022) also stated that mathematical abilities can be improved through utilizing tools and technology developed. One of the tools is the use of teaching materials developed with various approaches. The average score of pretest and posttest is viewed by each indicator of mathematical reasoning ability presented in Figure 2.

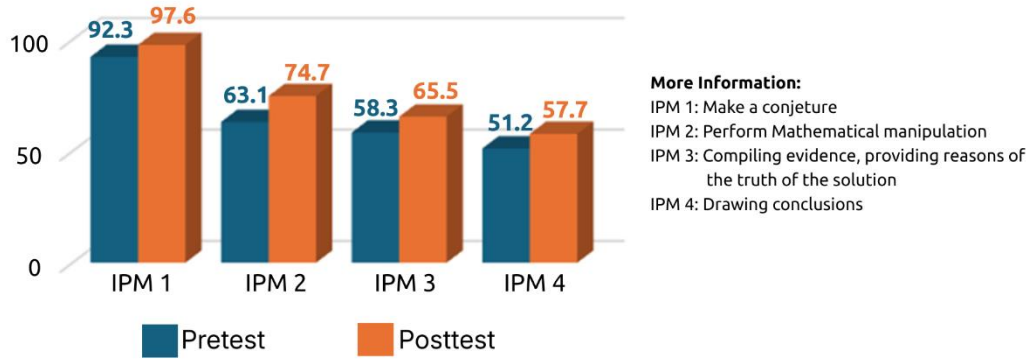

Figure 2. Increased Ability Based Mathematical Reasoning Pretest-Posttest

Based on Figure 2, there was an improvement in the average score of pretest to posttest on mathematical reasoning ability indicators. The improvement was analyzed using the N-Gain test and the results presented in Figure 3.

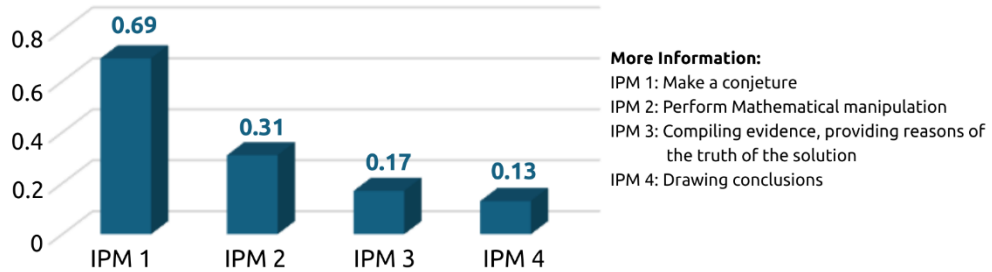

Figure 3. Increased Ability Based Mathematical Reasoning Pretest-Posttest

3.4. Final Product

The final product in this research is in the form of STEAM-based teaching materials in problem based learning model that is valid, practical, and effective. The teaching materials are also equipped a color code for each aspect of STEAM to make it look attractive. The illustration of the final product design is shown in Figure 4.

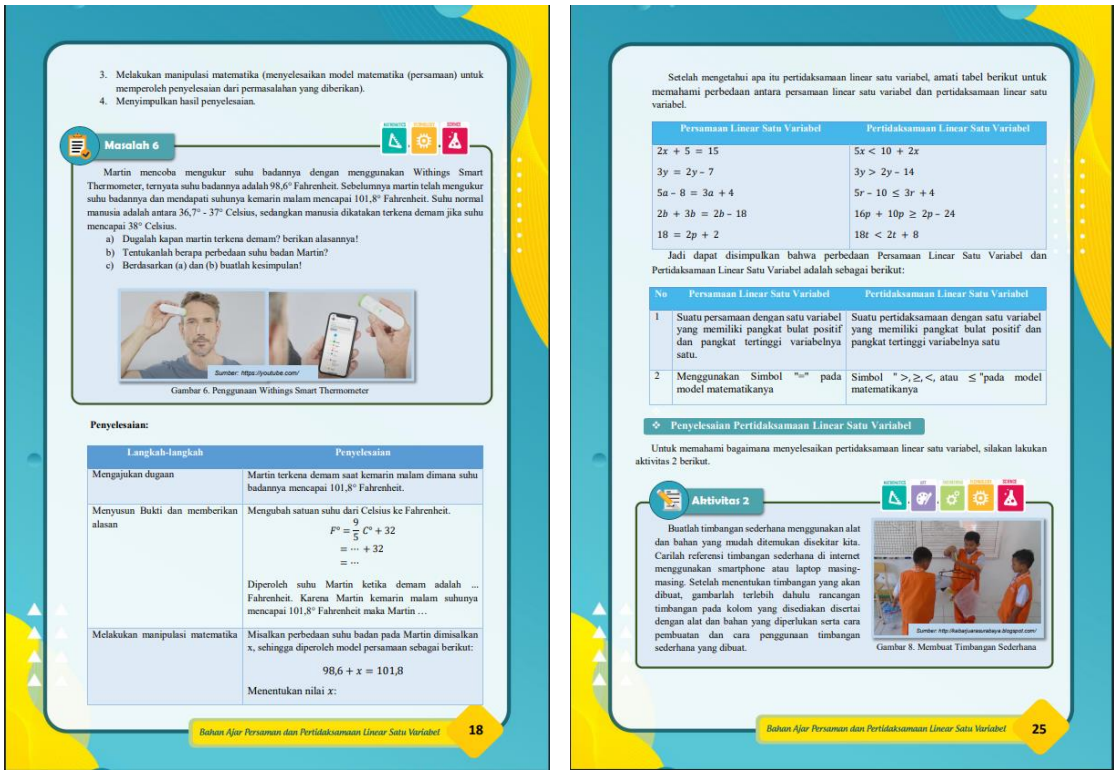

Figure 4. Final Product

STEAM-based teaching materials are created by considering presentation aspects of both writing, images, and content with the aim of providing practicality for teachers and students in using them. The harmonious presentation of images and text can increase the ease of information processing which has a direct positive impact on product assessment (Huang *et al.,* 2022).

The main content consists of teaching materials covering all aspects of STEAM. The science aspect plays a very important role in making various problems more interesting and contextual. Some issues related to the environment are more interesting to a person because they relate to everyday life (Novianti, 2022). Integrating technology into main content in the form of GeoGebra applications where students can conduct experiments to help solve problems. The benefits integrating technology are that the possibility of the provision of a realistic, engaging, and enjoyable learning experience, and boost student-teacher contact (Pujiastuti *et al.,* 2025).

For make a conjecture indicator, the estimated value of the N-Gain test is 0.69 in the medium criteria. This shows that students are more structured in writing down the information obtained in solving problems. The teaching materials are equipped with clear and structured instructions and questions so that students can follow the problem-solving process properly and sequentially. In addition, in the Engineering aspect, students are given clear and consistent instructions in creating a project, starting from preparing tools and materials, conducting experiments to drawing conclusions. Nurhidayati *et al.* (2017) also stated that teaching materials containing questions can make it easier for students to improve their mathematical reasoning. Teaching materials should be very useful for students and must be suitable for current needs in order to improve their students abilities (Sugiman *et al.,* 2020a).

Mathematical manipulation indicator, the N-Gain test value of 0.31 is in the moderate criteria. This shows that students are able to use known information to develop new information that will be used in solving the problems given. The teaching materials contain questions and activities that require sequential

calculations so that students' reasoning abilities can improve, especially in carrying out mathematical manipulations such as making equations or using mathematical formulas. The art aspect also plays a role in helping students understand mathematical concepts by interpreting mathematical problem into images. In line with the research of Wahyuni & Angraini (2021) which states that problem-based teaching materials have been proven to significantly improve the ability to manipulate symbols, numbers, and mathematical models.

The third indicator is compiling evidence, providing reasons of the truth of the solution indicator, the N-Gain test value of 0.17 is in the low criteria. This shows that students are able to provide arguments in the problem solving process but are still not optimal. This is because students rarely conduct investigations to compile evidence in learning activities, so further practice is needed. According to Jannah *et al.* (2020) also stated that the investigation process in learning activities will be able to train mathematical reasoning.

The indicator in drawing conclusions is the N-Gain test value of 0.13 which is in the low criteria. This shows that students are able to write conclusions at the end of the completion process that has been carried out but not optimally. The low increase that occurs is caused by student errors in calculating or compiling evidence, so that if an error occurs in the previous stage it will have an impact on errors in drawing conclusions. Additional media or other approaches are needed that can train students in calculating and compiling appropriate evidence such as a contextual approach that is able to present real problems in everyday life so that students will be accustomed to solving problems (Astriani & Dhana, 2024).

These results indicate that STEAM-based teaching materials on one-variable linear equations and inequalities applied in the PBL model have a positive effect on increasing students' mathematical reasoning. Teaching materials make the learning atmosphere interesting and fun by implementing all aspects of STEAM. If learning is interesting and fun, students' abilities in mathematics will also increase (Sugiman *et al*., 2020b). The design and development of STEAM provides students with diverse problems to improve students' mathematical reasoning as well as teach them how to make scientific investigations by students, requiring them to identify and control variables and practice hypothetico-deductive reasoning as they make hypotheses, interpret data, and draw conclusions from their investigations through the process of engaging in the learning activities. (Jensen *et al*., 2017; Sokolowski, 2019).

4. Conclusion

Based on the research results, it can be concluded that the STEAM-based teaching materials in problem based learning model are qualified, for the following reasons: (1) STEAM-based teaching materials in problem based learning model was valid with average score percentage is 90.1% and can be used in learning; (2) STEAM-based teaching materials in problem based learning model are categorized practical by teachers and students with average score percentage is 95% and 85.2%; (3) The effectiveness test of teaching materials show that the average test results of students' mathematical reasoning ability are more than minimum submission criteria, the proportion of completeness of mathematical reasoning ability test results is more than 75%, and the n-gain test results is 0.24 which means there is an increase in mathematical reasoning ability with a low category. So it can be concluded that the teaching materials based on STEAM in problem based learning to improve mathematical reasoning ability are effective. This teaching material can be used in learning activities, especially to facilitate students in developing mathematical reasoning. Further research is needed to develop teaching materials, especially in improving indicators of compiling argument evidence and drawing conclusions using the latest technology such as artificial intelligence.

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