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The Development of Problem Based Learning Materials to Improve Students' Logical Mathematical Intelligence on SPLTV

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ABSTRACT: The research was conducted with the aim of developing valid, practical, and effective PBL learning materials for SPLTV subjects. The development of learning materials aims to improve students' logical mathematical intelligence. This research is a type of development research with the 4D Thiagarajan model with the stages of define, design, develop, and disseminate. The learning materials produced include teaching modules, students worksheet, learning videos, test packages, and instruction manuals for using learning materials. Data collection was carried out using observation, questionnaire, and test methods. The results of the study showed that the learning materials developed were valid, practical, and effective. The level of validity can be seen from the validity value of each tool as follows, teaching modules of 3,79, students worksheet of 3,82, test packages 3,86, and instruction manuals 3,75. The level of practicality can be seen from the results of observations of the implementation of learning materials with an average of 3,43. The level of effectiveness of the materials can be seen from the results of student learning completion with a classical completion percentage of 84,6%, the N-Gain category is high with a student percentage of 97,29%, students' logical mathematical intelligence activities are in the good category with a percentage of 84,33%, and the percentage value of student responses is 92,05% with a positive response.

KEYWORDS: Logical Mathematical Intelligence, Problem Based Learning, System of Linear Equations with Three Variables

INTRODUCTION

Mathematics as a basic science that plays a very important role in the development of science and technology, because mathematics is a means of thinking to develop reasoning power, logical, systematic, and critical thinking (Yunizar et al., 2025). Logical mathematical intelligence is a person's ability to think logically, mathematical calculations, problem solving, deductive and inductive considerations, find cause and effect, and the sharpness of patterns and relationships. Each student has a different logical mathematical intelligence (Milsan & Wewe, 2019). Students who can solve mathematical problems correctly indicate that the student has high logical mathematical intelligence (Husna dkk., 2020; Lestariningrum & Handini, 2017). Leonard & Linda, 2018; Hidayatulloh dkk., 2024; Santoso & Utomo, (2020) stated that the logical mathematical intelligence of students in Indonesia is still relatively low. This shows that students' ability to solve problems that require analytical, reasoning, and logical skills is very lacking (Kurniati et al., 2016).

This intelligence can be measured by giving mathematical problems that involve the ability to calculate systematically and think logically at a high level. One of the materials that can be used to measure students' logical mathematical intelligence is the Three Variable Linear Equation System (SPLTV). Solving a SPLTV problem requires skills in understanding problems, performing mathematical calculations, thinking logically, and the ability to perform inductive and deductive reasoning (Wulandari et al., 2016). However, students' mastery of the SPLTV topic is still low. This is supported by research by Bey & Asriani (2013) that most students still have difficulty understanding SPLTV, one of the causes is the learning process that still emphasizes the teacher as the center of learning.

In general, learning in class is mostly taken over by the teacher, so that students become passive as listeners and only listen to the teacher's explanation (Islamiah dkk., 2024 ; Indah dkk., 2023). This is in line with preliminary studies that instructional activities that occur in the classroom still apply the lecture method. Law Number 12 of 2012 Chapter I Article 1 (1) states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential. To overcome this problem, it is necessary to apply a learning model that focuses on students and applies real-world problems to learning, one of which is the Problem Based Learning (PBL). The PBL is learning that focuses on students in constructing their own understanding concepts through the process of observing, finding themselves, reasoning, experimenting and drawing conclusions of

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understanding with their own thought processes by providing problems from the real world at the beginning of learning (Jayahartwan & Sudirman, 2022).

In addition to learning methods, learning materials also influence the process of increasing students' logical mathematical intelligence. Learning materials are a number of materials, materials, media, instructions and guidelines prepared by the teacher for use in learning activities so that the implementation and evaluation of learning can provide results according to expectations (Mangelep, 2017). The use of the lecture method in the learning process in schools is due to the lack of learning materials available to improve logical mathematical intelligence. The learning materials currently available are only arranged according to Learning Outcomes (CP) without paying attention to the indicators of logical mathematical intelligence properly. In general, in schools, many teachers still have difficulty in compiling learning materials that can be used properly (Amelia, Chotimah, & Putri, 2021). Thus, it is necessary to develop learning materials using the Problem Based Learning (PBL) to improve students' logical mathematical intelligence in the SPLTV subject matter.

METHOD

This study aims to develop learning materials that include a materials usage guidebook, teaching modules, learning media in the form of learning videos, Student Worksheets, and test questions with valid, practical, and effective criteria so that this research is categorized as research and development with a 4D development model consisting of the define, design, develop, and disseminate stages. The 4D development model was chosen because the development stages in this model can be carried out in detail and systematically so that it is hoped that the learning materials to be developed can be in accordance with the research objectives. The research area in this study was SMK Nurut Taqwa.

The area determination technique used for this study was purposive sampling. Purposive sampling is a technique for determining the research area with certain considerations (Sumargo, 2020). The population in this study were 10th grade students, while the samples were three classes taken randomly, namely class X Accounting 2 as a trial class, X Accounting 1 as an experimental class, and X Hospitality as a control class. The research in the control class used learning materials and learning models available in the school, while the experimental class used PBL materials. The reasons for choosing the research area were: (1) the school had just implemented the independent curriculum; (2) there were prospective subjects to be used in the research; (3) the school needed PBL materials; and (4) the school received something new, especially related to increasing logical mathematical intelligence.

The research instruments used were validation sheets, observation sheets, student response questionnaire sheets, readability test sheets, and logical mathematical intelligence test packages. Data collection methods used observation methods, questionnaire methods, and test methods. Data analysis was used to determine the level of validity, practicality and effectiveness of the learning materials. The level of validity of the materials was seen from the validation results carried out by 3 validators. The level of practicality can be seen from the results of observations of the implementation of the learning materials. The level of effectiveness of the materials can be seen from the results of student learning completion, N-Gain categories, students' logical mathematical intelligence activities, and student responses.

RESULT

The learning materials developed in this study consist of teaching modules, students worksheet, logical mathematical intelligence test packages, instructional materials usage manuals, and learning videos. The learning materials development process uses the Thiagarajan 4D model which consists of four stages, namely the define stage, the design stage, the develop stage, and the disseminate stage. The explanation related to the four stages of development is described as follows.

a. Define Stage

This stage aims to determine and define learning needs by analyzing the objectives and limitations of the material to be used in developing learning materials. There are five activities carried out in this stage described as follows.

1) Front-End Analysis

This analysis is used to determine the basic problems needed in the development of learning materials. Activities carried out at this stage include observation and interviews with one of the mathematics teachers of SMK Nurut Taqwa. The following is an explanation of some information based on observation and interview activities.

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1. Learning activities at SMK Nurut Taqwa use the independent curriculum in class X using lecture and assignment methods. Learning activities in the classroom also still adhere to teacher-centered learning so that only a few students are active during learning.
2. The learning media used at SMK Nurut Taqwa is a mathematics textbook for high school/vocational school students in class X. Most teachers give assignments in the form of routine questions found in the textbook.
3. The teaching modules used are obtained from downloads via the website which are then modified by the teacher, where the downloaded teaching modules are still general in nature and the learning methods used are lectures and assignments.

2) Learner Analysis

This analysis is intended to determine the character of students who are the subjects of the trial. The characteristic analysis is focused on grade X students of SMK Nurut Taqwa which includes analysis of the characteristics of academic ability, cognitive development of students, and logical mathematical intelligence of students.

3) Concept Analysis

Concept analysis is conducted to identify and systematically organize the materials used in Learning Outcomes. This is because the success of the teaching and learning process depends on the success of the teacher in designing the materials. Based on the initial-final analysis activities and student analysis, Learning Outcomes, Learning Objectives, and Learning Objective Flow used in developing learning materials are adjusted to the Independent Curriculum with SPLTV materials.

4) Task Analysis

This stage contains details of activities that must be carried out by students during the learning process. Based on the concept analysis of the SPLTV material, learning tasks are outlined in the students worksheet at each meeting as follows.

1. students worksheet meeting 1, studying mathematical modeling of contextual problems.
2. students worksheet meeting 2, studying solving SPLTV contextual problems using the elimination method and substitution method.
3. students worksheet meeting 3, studying solving SPLTV contextual problems using the elimination-substitution method (mixed) and the determinant method.

5) Specification Instructional Objectives

At this stage, the formulation of learning objectives is carried out based on the initial-final analysis, student analysis, concept analysis, and analysis of tasks that have been carried out. Learning objectives are adjusted to the elements and CP that will be used in the SPLTV material and become the basis for compiling learning materials. The formulation of learning objectives is described in the following
Table ***1***.

Table 1. Formulation of Element, Learning Outcomes, and Learning Objectives

Element	Learning Outcomes	Learning Objectives
Algebra and Functions	Students can solve problems related to three-variable linear equation systems.	1. Creating mathematical modeling of SPLTV contextual problems 2. Solving problems related to a system of linear equations of three variables using the elimination method and substitution method 3. Solving problems related to a system of linear equations of three variables using the elimination-substitution method (mixed) and the determinant method.

b. Design Stage

At this stage, the design of learning materials is carried out according to the needs at the definition stage, so that an initial design (draft 1) is produced which is then validated by experts and tested. Activities at each stage are described as follows.

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1) Criterion Test Construction
At this stage, the preparation of logical mathematical intelligence test questions is carried out in the form of essay questions consisting of 3 questions. This activity begins with making a test question grid, 3 test questions, alternative answers along with scoring guidelines oriented to logical mathematical intelligence indicators so that the scores obtained reflect students' logical mathematical intelligence abilities.
2) Media Selection
The selection of media is done to help students understand the learning material. The media used are students worksheet and learning videos that are arranged based on the Problem Based Learning (PBL). students worksheet and learning videos are arranged so that they can direct and guide students to solve problems systematically so that they can improve students' logical mathematical intelligence.
3) Format Selection
Format selection is carried out to compile the contents of learning materials which include teaching modules, students worksheet, learning videos, test packages, and instruction manuals for using learning materials. The selection of the format in question is the selection of approaches, strategies, models, methods, and learning resources.
4) Initial Design
This initial design activity is a design of all learning materials activities that must be carried out before the trial is carried out. At this stage, the design of research instruments is also carried out in the form of validation sheets, observation sheets for the implementation of learning materials, observation sheets for logical mathematical intelligence, readability test sheets, and student response questionnaires. The design of the learning materials produced at this stage is in the form of draft 1.

c. Development Stage
The first activity carried out at this stage is the validation/assessment of the experts on draft 1. Draft 1 has been validated and revised based on the suggestions and input of the experts to produce draft 2 which is valid and ready to be tested. The results of the activities at this stage are described as follows.
1) Validator Assessment
This activity was carried out to test the validity of draft 1, the purpose of which was to obtain input and suggestions on the learning materials and research instruments to be used. This validation was carried out by three validators consisting of two lecturers of Mathematics Education, University of Jember and 1 mathematics teacher. The results of the validation and input from the experts became a reference in refining draft 1 and revisions were made which then met the valid category.
2) Materials Trial
This trial activity began by providing a readability test sheet of the materials, namely students worksheet and test questions to 5 students of class X SMK Nurut Taqwa. This stage aims to test whether the students worksheet and test questions developed are ready to be tested in the next stage. The field trial was continued in class X Accounting 2 consisting of 37 students as a trial class to determine the practicality and effectiveness of the learning materials that had been declared valid and worthy of being tested after the readability test was carried out. The trial activity was carried out in 3 meetings with details of the first meeting as many as 3 JP, the second meeting 2 JP, and the third meeting 3 JP.

d. Dissemination Stage
This stage is the final stage which aims to disseminate the use of PBL mathematics learning materials that have been developed by researchers on a wider scale. This stage carries out packaging which aims for the product to be utilized by other parties. Mathematics learning materials are disseminated offline, namely at SMK Nurut Taqwa, and online, namely on the Whatsapp group MGMP MAT SMK Banyuwangi and social media including Instagram and Facebook by providing Google Drive links for all learning materials.

The results of the data analysis of the development of PBL materials to improve students' logical mathematical intelligence in the SPLTV topic are as follows.

a. Validity Criteria for Learning Materials and Instruments

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The validity criteria of the developed learning materials and research instruments used can be seen from the following validation results in Table 2.

Table 2. Validation Result

No.	Learning Materials	Coefficient of Validity	Category
1	Teaching Module	3,79	Valid
2	Students Worksheets	3,82	Valid
3	Learning Videos	3,79	Valid
4	Test Package	3,86	Valid
5	Guidebook	3,75	Valid
6	Readability Test Sheet	3,83	Valid
7	Logical Mathematical Intelligence Activity Observation Sheet	3,90	Valid
8	Learning Materials Implementation Observation Sheet	3,82	Valid
9	Student Response Questionnaire	3,72	Valid

The validation results of the research materials and instruments are in the score interval $3 \leq V_a \leq 4$ which is categorized as valid. This indicates that the research materials and instruments have carried out the measuring function appropriately. Therefore, it can be concluded that the learning materials and research instruments meet the valid category.

b. Practicality Criteria for Learning Materials

This practicality criterion is based on the results of observations of the implementation of learning materials. Observations were carried out in three meetings. Data from observations of the implementation of learning materials are presented in the following Figure 1.

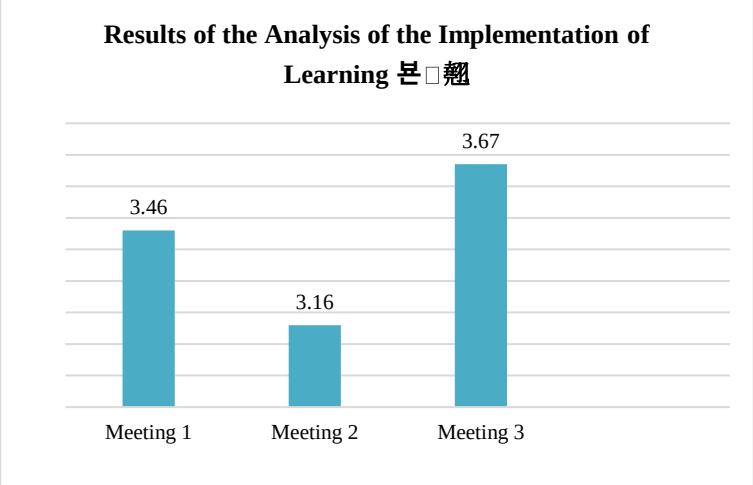

Figure 1. Results of Observations

Based on Figure 1, it is known that the average value of the implementation of learning materials at the first to third meetings was 3,46; 3,16 and 3,67 respectively. Based on the results of the analysis obtained from the implementation data of learning materials, an average of 3,43 was obtained and was at $3 \leq IO \leq 4$, which concluded that it was high. From this conclusion, it indicates that the learning materials is said to be practical.

c. Criteria for Effectiveness of Learning Materials

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The effectiveness criteria in this study were measured using five indicators, including the completeness of learning outcome data, N-Gain category, students' logical mathematical intelligence activities, student response questionnaires, and statistical tests. Details regarding the analysis of the learning materials effectiveness criteria data are as follows.

1) Learning Completion

Learning completion is obtained from the results of a test containing 3 essay questions given at the end of learning 3. The test questions are arranged based on indicators of logical mathematical intelligence that meet valid criteria based on validation results by experts. General learning outcomes can be seen in the Table ***3***.

Table 3. Learning Completion

Highest score	94
Lowest score	52
Average	80
Many students achieved scores ≥ 70	31
Many students achieved scores < 70	4
Percentage of classical completion	84,6%

Based on the Table ***3***, it is known that the percentage of classical completion is 84,6%. This percentage explains that students in the trial class are categorized as having completed classically. Thus, it can be concluded that the learning outcomes of students in the trial class are categorized as having completed classically meeting the effectiveness category in terms of student learning outcomes.

2) N-Gain Category

The values of the pre-test and post-test of the logical mathematical intelligence test questions conducted at the first and last meetings were then analyzed using the N-Gain test. The results of the N-Gain category can be seen in Table ***4***.

Table 4. N-Gain Result

Low Category		**Medium Category**		**High Category**		**Category Medium and High**	
Students	**Percentage**	**Students**	**Percentage**	**Students**	**Percentage**	**Students**	**Percentage**
1	2,70%	13	35,13%	23	62,16%	36	97,29%

Based on Table ***4***, it is known that the average N-Gain category is high, with the percentage of students ≥70 entering the minimum moderate category, which is 97,29%, this percentage concludes that students in the trial class meet the effectiveness category in terms of the N-Gain category. The highest N-Gain score is 0,92 and the lowest score is 0,26.

3) Students' Logical Mathematical Intelligence Activities

This data was obtained from the observation sheet of students' logical mathematical intelligence activities conducted by the observer. The following is a brief recapitulation of the results of observations of students' logical mathematical intelligence activities which can be seen in Table ***5***.

Table 5. Result of Students' Logical Mathematical Intelligence Activities

Meeting	**Group (%)**							**Average**
	1	**2**	**3**	**4**	**5**	**6**	**7**	
1	75	79,17	79,17	75	79,17	83,33	75	77,98

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2	79,17	87,5	83,33	87,5	79,17	91,67	83,33	84,52
3	87,5	91,67	91,67	87,5	91,67	95,83	87,5	90,48
Average	80,56	86,11	84,72	83,33	83,33	90,28	81,94	**84,33**
Category	Good	Good	Good	Good	Good	Very Good	Good	**Good**

Based on
Table ***5***, it is known that the average category of students' logical mathematical intelligence activities is 84,33% with a good category. From this average, it can be concluded that the category of students' logical mathematical intelligence activities is good and meets the effectiveness category in terms of students' logical mathematical intelligence activities.

4) Students Response

This questionnaire was given at the last meeting after the post-test was conducted. The following is a brief recapitulation of the results of the student questionnaire contained in
Table ***6***.

Table 6. Result of Students Response

No	Percentage Students Response (%)	
	Agree (Positive)	**Don't Agree (Negative)**
1	100	0
2	95,45	4,55
3	90,91	9,09
4	88,64	11,36
5	95,45	4,55
6	90,91	9,09
7	86,36	13,64
8	95,45	4,55
9	97,73	2,27
10	79,55	20,45
Average (%)	92,05	7,95

Based on
Table ***6***, it is known that the percentage value of student responses is 92,05% with positive responses, thus the learning materials meets the effectiveness category in terms of student responses.

5) Statistical Test

Data analysis of pre-test and post-test results from the experimental class and control class was conducted to determine whether there was an influence of the Problem Based Learning materials that had met the criteria of valid, practical, and effective on improving students' logical mathematical intelligence. Quantitative data analysis using IBM SPSS Statistic 25 which began with conducting prerequisite tests, namely normality tests and homogeneity tests. After the data was declared normally distributed and homogeneous, the hypothesis test was continued with the independent sample t-test with the following results.

The results of the t-test for the post-test experimental class and control class can be seen in
Table ***7***.

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Table 7. Result of the t-test for the Post Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Posttest	Equal variances assumed	,021	,886	9,900	68	,000	22,54	2,277	17,999	27,087
	Equal variances not assumed			9,900	67,978	,000	22,54	2,277	17,999	27,087

Based on

Table *7* shows that the Sig. (2-tailed) value = 0.000 (sig. <0.05), referring to the hypothesis that has been proposed. So the decision that can be taken is H0 is accepted, this interprets that there is a significant influence of the implementation of the Problem Based Learning of mathematics learning materials on students' logical mathematical intelligence.

The results of the t-test on the N-Gain value of the experimental class and the control class are presented in Table 8.

Table 8. Result of the t-test for the N-Gain

Independent Samples Test

		Levene's Test for Equality of ...		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
N_Gain	Equal variances assumed	1,022	,316	10,054	68	,000	,29771	,02961	,23862	,35681
	Equal variances not assumed			10,054	64,186	,000	,29771	,02961	,23856	,35687

Based on Table 8, it shows that the Sig. (2-tailed) value = 0.000 (sig. < 0.05), refers to the hypothesis that has been proposed. So the decision that can be taken is H0 is accepted, this interprets that there is a significant influence of the implementation of the Problem Based Learning of mathematics learning materials on increasing students' logical mathematical intelligence.

DISCUSSION

The results of the development research conducted in class X of SMK Nurut Taqwa stated that the learning materials met the criteria of valid, practical, and effective. The interesting thing in the development research stage conducted in class X Accounting 2 was seen from the learning process using the PBL models. It can be seen from the data obtained by the observer, the teacher was not yet accustomed to using the PBL materials, then the children who were initially passive, had not seen their logical mathematical intelligence activity, and there was no initiative to ask questions, slowly showed logical mathematical intelligence activity, such as classifying the main information in the problem. Based on observation data, this success was also supported by teachers who intensively read the user manual which functioned to guide teachers in implementing the PBL process. Based on the description above, the findings of this study are that the habituation of logical mathematical intelligence activity is something that is very important to support the improvement of students' logical mathematical intelligence.

The existence of two learning media used, namely students worksheet and learning videos, helps students improve logical mathematical intelligence. This learning media can be an alternative for students who have visual and auditory learning styles.

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students worksheet and learning videos that are developed in such a way using the PBL model and indicators of logical mathematical intelligence can improve students' logical mathematical intelligence. This can be seen from the results of observations that initially only 1-2 groups were active and showed logical mathematical intelligence, to almost all groups showing good logical mathematical intelligence during the problem solving process. This is in line with research conducted by (Safira & Nasrudin, 2025) that problem-solving-based learning media can significantly improve students' logical mathematical intelligence.

The materials that has been declared practical and effective from class X Accounting 2 as a trial class, was then tested in the experimental class, namely class X Accounting 1 SMK Nurut Taqwa and the control class, namely class X Hospitality. Before the learning activities were carried out, a pre-test was given first to the experimental class and the control class. At the beginning of the meeting, the indicators of students' logical mathematical intelligence had not yet appeared. This can be seen in some students who were still passive during the learning process. To bring out student activity, in the next meeting the teacher provides reinforcement and motivation in between learning so that students dare to express ideas and can work together with their groups in the problem-solving process. Slowly students begin to show logical mathematical intelligence, dare and are confident to express opinions and are active during discussion activities and participate in groups in the problem-solving process using students worksheet. Based on the description above, the findings in this study are that PBL-based students worksheet can help students to improve logical mathematical intelligence, bring out an active attitude, and work together with groups in the problem-solving process. Yulaikhah et al. (2025)stated that the integration of the PBL model with visual media can increase the effectiveness of mathematics learning and can provide reciprocal interaction for students and create cooperation in the success of their group. Thus, students can more easily master the material, solve problems, and can improve logical mathematical intelligence.

Learning in the control class uses materials that are usually used daily in schools and uses the direct instruction method. The teacher plays a dominant role, only giving routine questions from the textbooks used without any special treatment, lack of interaction between students and teachers, students always wait for directions from the teacher, and the classroom situation is not conducive, thus students in the control class do not show indicators of logical mathematical intelligence. Based on the description above, the findings in this study are that the learning model and learning materials used by teachers can influence the increase in logical mathematical intelligence. These findings are in line with the findings (Arafah et al., 2023) that the learning outcomes of students using the PBL are more improved than the learning outcomes of students using the direct instruction.

Post-test questions were given at the third meeting after learning 3 in the experimental class and control class was completed. Furthermore, a hypothesis test was carried out on the post-test results of students in the experimental and control classes. Based on the N-Gain results of the experimental class and control class, it shows that there is a significant influence of the implementation of the Problem Based Learning materials on increasing students' logical mathematical intelligence. The difference in the increase in mathematical logical intelligence in the experimental class is higher compared to the mathematical logical intelligence ability of students in the control class after the application of the Problem Based Learning materials, this is obtained from the average N-Gain value of the experimental class of 0,73 which enters the high category and the control class of 0,43 which enters the medium category.

The percentage of the number of students in the experimental class who are in the N-Gain category of at least moderate mathematical logical intelligence is 93%, while the percentage of the number of students in the control class who are in the N-Gain category of at least moderate mathematical logical intelligence is 88,5%. Based on this percentage, it can be concluded that many students are in the N-Gain category of at least moderate mathematical logical intelligence in the experimental class more than in the control class. This is the cause of the average N-Gain value obtained from the experimental class and the control class being quite far apart. Based on the discussion above, the findings in this study are that the PBL materials is effective in improving students' mathematical logical intelligence. The significant difference in the influence of the implementation of the PBL of mathematics learning materials is in line with research (Maryani et al., 2025) that the effectiveness of the Problem Based Learning is better than the Direct Instruction. Overall, based on the results of the analysis of validity, practicality, and effectiveness, it can be concluded that the Problem Based Learning (PBL) materials meets the criteria of being valid, practical, and effective.

The last stage in this study is dissemination. Learning materials are disseminated offline and online. Offline, dissemination is carried out by distributing learning materials in the form of hard files at SMK Nurut Taqwa. As for online distribution via social media, namely Instagram and Facebook by providing a Google Drive link so that learning materials can be accessed by SMK teachers.

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Based on the research activities that have been carried out, there are several advantages and disadvantages, both in the research process and the application of learning materials. The advantages of this PBL materials are that the teaching module is arranged according to the latest curriculum which presents systematic learning steps for each meeting along with a user manual, students worksheet and learning videos developed based on PBL syntax and containing indicators of logical mathematical intelligence that can help students in the process of solving problems systematically so that they can improve students' logical mathematical intelligence, test questions are arranged based on indicators of logical mathematical intelligence, and this learning materials is designed to be very interesting and easy for students to understand. The disadvantages of this study include the dissemination process which is carried out in a limited manner, namely only distributed in schools and several online sites. At the dissemination stage, they do not wait for the results of using learning materials from other teachers. In addition, the study was conducted in only one school and for a limited time.

CONCLUSSION

The results of the development research conducted in class X of SMK Nurut Taqwa stated that the learning materials met the criteria of valid, practical, and effective. The valid criteria were obtained based on the validity test conducted by three validators to determine whether the learning materials carried out the measuring function correctly. The practicality criteria were obtained based on the results of observations of the implementation of the learning materials in the trial class with high results. The effective criteria were learning completeness obtained with a percentage of 84,6%, the N-Gain category with a percentage of 97,29% of students meeting the minimum moderate category, students' logical mathematical intelligence activities with a percentage of 84.33% which were in the good category, and positive student responses.

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