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# Development of Mathematics Module Based on Problem Based Learning to Improve Students' Mathematical Problem Solving Ability and Learning Independence

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Abstrak

Penelitian ini bertujuan untuk: mengetahui keabsahan dan kepraktisan modul matematika berbasis model pembelajaran berbasis masalah dalam meningkatkan kemampuan pemecahan masalah matematis dan kemandirian belajar siswa; mengetahui kepraktisan modul; dan mengetahui model pengembangan ADDIE. Penelitian ini melibatkan siswa salah satu SMP Negeri di Medan. Hasil penelitian menunjukkan bahwa modul matematika berbasis pembelajaran berbasis masalah valid dan praktis. Modul matematika berbasis pembelajaran berbasis masalah dapat meningkatkan kemampuan pemecahan masalah matematis dan kemandirian belajar siswa SMP kelas VIII. Hasil N-Gain menunjukkan bahwa modul matematika berbasis masalah berbasis PBL dapat meningkatkan kemampuan pemecahan masalah matematis dan kemandirian belajar siswa kelas VIII dari uji coba I sampai uji coba II.

**Kata Kunci**: Modul Matematika, Problem Based, Learning, Kemampuan Pemecahan Masalah, Kemandirian Belajar Siswa.

*Abstract*

*This study aims to: determine the validity and practicality of the mathematics module based on the problem-based learning model in improving students' mathematical problem-solving abilities and learning independence; determine the practicality of the module; and determine the ADDIE development model. This study involved students of one of the State Junior High Schools in Medan. The results of the study indicate that the mathematics module based on problem-based learning is valid and practical. The mathematics module based on problem-based learning can improve the mathematical problem-solving abilities and learning independence of junior high school students in grade VIII. The N-Gain results show that the problem-based mathematics module based on PBL can improve the mathematical problem-solving abilities and learning independence of grade VIII students from trial I to trial II.*

***Keywords**: Mathematics Module, Problem Based, Learning, Problem Solving Skills, Student Learning Independence.*

## A. Introduction

Problem-solving skills help solve daily issues. (Andayani, F., & Lathifah, 2019) define problem-solving skill as the capacity to solve narrative issues, non-routine problems, and apply mathematics in daily life. (Lestari, I., Andinny, Y., & Mailizar, 2019) defined mathematical problem solving ability as the ability to understand a math problem by solving something difficult, especially when working on questions. The ability to solve mathematical problems from provided questions is crucial for pupils.

Solving mathematical issues involves four processes, according to (Polya, 1973) (1) comprehending the problem, where pupils grasp the context and identify information. (2) planning, where students use mathematical principles to solve problems. (3) applying the plan, where students use a methodical solution technique to reach a conclusion. Re-checking allows students to correct their answer outcomes.

The education center study found that the average computer-based national examination Medan Junior High School score for Medan city has fallen every year in mathematics, indicating that students' problem-solving skills are still inadequate. The average 2017 score was 66.00. The average score dropped to 47.81 in 2018. In 2019, the average score dropped to 42.38. Average scores from 2017 to 2019 show that pupils' math learning achievements are poor. Low student learning results are caused by pupils not understanding the teacher's queries, making it hard to solve the issues.

On Monday-Tuesday, January 30-31, 2023, researchers observed class VIII-8 Medan and found that instructors still practice traditional (teacher-centered) learning. Students tend to be passive and unwilling to ask questions about the subject provided by the instructor, making traditional learning useless. Students don't comprehend the teacher's principles since they only listen. Due to a lack of mathematical comprehension, pupils cannot employ mathematical resources to solve issues.

This is reinforced by the researcher's interview with a mathematics instructor at Medan Junior High School, who said that most students were less involved throughout the mathematics learning process, seldom asking questions or expressing their thoughts. When students were given narrative issues to solve in ordinary life, their results tended to be lower than when they were asked objective questions. According to the responses provided by students, the majority of pupils struggle to comprehend the problems presented in mathematical form. In addition, pupils struggle to identify the mathematical principles that may be applied to solve the issues presented.

They often draw inferences to do mathematical operations on the numbers in the narrative problem without fully comprehending and considering the situation. The findings of diagnostic examinations in the form of problem-solving questions connected to two-variable linear

equation systems show that pupils have a poor ability to solve mathematical issues. The questions provided are as follows:

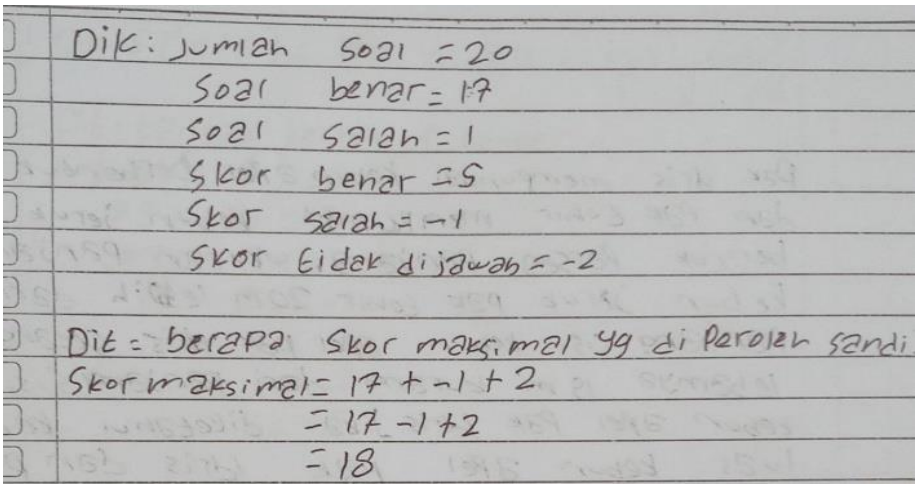


Figure 1. Students' Errors in Answering Questions

Most pupils in the class failed the diagnostic test's problem-solving questions on the system of linear equations of two variables. 17 students (53.12%) were unable to represent the issue mathematically and misunderstood it. Eight students (25%) were able to articulate the scenario into a mathematical model and grasp the challenge, however they made incorrect calculations while formulating a strategy. In executing the strategy, 5 students (15.62%) were able to translate the issue into a mathematical model, grasp the problem, and present the calculation findings. In the recheck, just 2 students (6.25%) were able to translate the scenario into a mathematical model, grasp the problem, describe the calculations, and apply the findings. According to Latifah & Sutirna (2021:541), 46.60% of students solve problems using trial and error strategies, 6.65% using diagram or drawing strategies, 23.30% using pattern search strategies, and 23.30% using logical thinking strategies.

These results suggest that students' mathematical problem-solving abilities are generally good. (Agustini, D., & Pujiastuti, 2020) found that students have trouble understanding material, formulas, and problems, which makes it harder for them to translate problems into mathematical forms, plan problem-solving procedures, apply problems to concepts and strategies, and check their solutions. (Fatmala, R. R., Sariningsih, R., & Zanthy, 2020) found that many students fail to grasp the issue, create a solution, apply it, and review the solutions. This is because kids are still not habituated to problem-solving tasks, so they have trouble comprehending them, make errors while calculating, and don't verify their solutions. Poor problem-solving instruction and resources lead kids to struggle in math. Lack of information of problem-solving procedures, grasp of the issue, capacity to transform problems into mathematical models, and ability to apply mathematics are students' challenges. Mathematics education should emphasize problem-solving. Medan Junior High Schoolpupils have limited

learning independence and mathematics problem-solving skills. This is consistent with an interview with one of the school's mathematics teachers, who said that many students cannot learn independently, such as (1) students often do not do their homework even though the questions are relatively easy and in accordance with the examples studied at school, (2) students do not prepare before learning at school and only study the material during tests or exams.

This suggests that pupil mathematics learning independence is poor. (Sulistiowati, 2023) observed that student learning independence remains poor. The features of pupils studying mathematics demonstrate limited learning independence. (Sari, N. W., & Nur, 2023) found that pupils lack appropriate learning freedom. This is because kids don't want to study arithmetic and continually want others to do it. Most pupils lack self-motivation to study. Students wait to be prompted to complete practice questions, even though they should learn for themselves. This poor learning independence substantially impacts pupils' arithmetic problem-solving. Self-regulated learning (SRL) is an important attitude in any classroom, particularly math courses. According to (Ansori, 2020) learning independence is self-directed, choice-driven, and responsible learning without outside support. Students who can complete learning activities without help are considered independent learners. According to (Al-Khwarizmi, 2018) learning independence indicates a student's willingness to choose a learning technique.

During the learning process, students should be able to set their own study hours, choose activities that support academic achievement, develop learning strategies, and other behaviors that show they are responsible for themselves to achieve learning goals. This learning freedom may help children learn independently, motivate them, and solve difficulties without depending on others. Similarly, learning activities with an autonomous learning attitude would make pupils accountable for their learning, have strong aspirations, and discipline, resulting in better results. To address these issues, select and implement learning modules that improve mathematical problem-solving and student learning independence.

Modules are systematic educational resources that may be used with or without a facilitator/teacher. (Prastowo, 2018) defines a module as educational material that is methodically organized in an easy-to-understand language according to students' age and knowledge level so they may study freely with little instructor support. (Chuseri, A., Anjani, T., & Purwoko, 2021) defines a learning module as a training material including resources, procedures, and assessments geared to accomplish anticipated skills. Based on their past knowledge and habits, students might answer issues in different ways in the module. Modules may improve student learning, according to (Santri, 2018). This is because the lesson starts with ordinary situations to help pupils relate to the topic. The module also helps instructors convey content during learning activities. Besides providing rich learning material, the module may explain itself. Thus, students may utilize the module to assist them comprehend and solve

arithmetic issues. After learning, students may study the module individually to clarify any confusion and expand their understanding.

According to (Prastowo, 2018) the module is designed to help students learn skills like: (1) students can learn independently or with minimal teacher assistance, (2) the teacher is not dominant and authoritarian in learning, (3) train students' honesty, (4) accommodate various learning levels and speeds, and (5) students can measure their own mastery of the material. (Fiteriani, I., & Solekha, 2016) found that the product trial questionnaire answers from instructors and students were extremely excellent and the module was appropriate for usage, with an average value of 4.48. (Islahiyah et al., 2021) found that ten students scored 46.2 on the module interest questionnaire. The contextual approach module was shown to be appropriate for algebra instruction and boost student.

The study of the learning modules utilized and observations at Medan Junior High School showed that 1) the ideas in the learning modules were presented directly without exploration activities. 2) Teachers and students still see learning modules as a secondary source of knowledge after the instructor explains. 3) Students just listen, take notes, and ask questions they don't understand since the instructor doesn't engage them in learning. 4) The learning modules don't engage pupils sufficiently in arithmetic, exploration, and knowledge development.

Teachers' current learning modules mainly discuss ideas and assign pupils to practice answering questions. The learning module and LKPD questions are objective and closed, making it harder for instructors to apply learning to real-world issues. Thus, pupils are unfamiliar with ordinary issues and find them difficult to tackle.

Each instructor must build modules and choose relevant learning models for each learning activity. Learning models must allow students to actively engage with one other or with learning objects to autonomously discover material ideas. Along with modules, learning models are essential for increasing student learning outcomes, particularly mathematical problem-solving and independence. One learning approach is Problem-Based Learning. The problem-based learning methodology pushes students to address real-world issues in groups. According to Hendriana (2018: 2), contextual problem-based learning needs exploratory problem-solving. Fauzia (2018: 42) states that the problem-based learning methodology helps students apply content to actual life. According to Aulia, (Aulia, N., Nurmawati, N., & Andhany, 2020) the problem-based learning model develops problem-solving skills by having students seek information and draw conclusions from it.

Authentic adults, autonomous learners, and thinking and problem-solving abilities are the goals of problem-based learning, according to (Trianto, 2016). The problem-based learning methodology helps students solve challenges by applying their knowledge or acquiring new

information. Students' learning will be more meaningful. According to (Maryati, 2018) the problem-based learning model has five phases: student orientation to the problem, organizing students in learning, individual and group investigation guidance, development and presentation of work results, and analysis and evaluation of the problem-solving process. Learning should match the module. No problem-based mathematics module has been created by instructors, notably at Medan Junior High School. Students frequently struggle to solve difficulties if the question is different because the instructor does not allow them to build on/construct student knowledge using real-world challenges. Thus, a problem-based mathematics module may improve student learning independence and mathematical problem-solving abilities.

Problem-based learning approaches improve student learning results, according to many research. According to (Ramadhana, R. S. A., Andriani, R., Ritonga, M. W., & Marpaung, 2023), problem-based mathematics modules improve mathematical problem-solving. Junior high school students using the problem-based learning methodology should also experience this. The researcher will develop a learning module titled "Development of a Mathematics Module Based on Problem Based Learning in Improving Mathematical Problem Solving Skills and Student Learning Independence at Medan Junior High School" to solve problems.

## B. Research Method

This study uses developmental research (Developmental and Research) with the ADDIE development model consisting of 5 stages of development, namely Analysis, Design, Develop, Implementation and Evaluation. This model was chosen because it aims to produce a product that is developed and then tested for its feasibility with validity and product trials to determine the extent to which students' mathematical problem-solving abilities have increased with problem-based learning-based mathematics modules. This research was conducted at Medan Junior High School in the odd semester of the 2024/2025 school year. The reason the researcher chose this school was because the school had never used a problem-based learning-based mathematics module on the Two-Variable Linear Equation System material. The subjects of this study were class VIII students of Medan Junior High School in the 2024/2025 school year. In this study, class VIII-1 was chosen with 32 students. While the object of this study is a problem-based learning-based mathematics module to improve students' problem-solving abilities and learning independence

## C. Result and Discussion

Data analysis and research results obtained at each stage of development are presented as follows:

### *Analysis*

According to observations of Medan Junior High School mathematics module, instructors' teaching materials had various shortcomings that indirectly improved students' mathematical problem-solving and learning independence. According to the teaching modules, the learning steps have not referred to the learning model listed, teachers still use Teacher Centered Learning (teacher-centered learning), there are no clear time allocations for each process, and the assessment questions do not promote problem-solving.

This makes it hard for children to articulate innovative ideas and relies on instructors to solve arithmetic difficulties. Students don't feel pushed to think further. The teaching materials are old student books with several weaknesses, including: some of the material is not in accordance with the learning objectives, such as solving contextual problems that are adjusted to learning objective indicators. So instructors' resources don't meet expectations, making pupils less competent to tackle contextual difficulties. Thus, the educational materials make contextual issues harder to solve, affecting students' mathematical problem-solving and learning independence. The mathematics learning method at Medan Junior High School has numerous key issues, as discussed above. To solve these issues, Medan Junior High School students' problem-solving and learning independence must be improved by creating mathematics modules that are valid, practical, and effective. After implementing the designed mathematics module, Medan Junior High School pupils' problem-solving and learning independence should improve.

***Design***

Draft 1 is ready to develop open modules, research instruments, and questionnaires. The processes to create an open module, mathematics module, and problem-solving ability test are as follows: Test preparation Based on learning goals and ability indicators, tests and non-tests are created. The exam requires mathematical problem-solving. Based on mathematical problem-solving indications, a grid is created to build the exam. The exam is tailored to pupils' cognitive capacities. Test scores are scored using an assessment guide with answer keys and scoring standards for each question. Format Selection involves learning content, models, instructional materials, and resources to be generated. The selected format is entertaining, fits requirements, and aids system of linear equations in two variables learning. The format includes open, mathematics, and Student Activity Sheets modules. Draft I is the first device design after format determination.

At this stage, an initial design was produced in the form of a teaching module, a mathematics module and Student Activity Sheets for four meetings, a problem-solving ability test, a learning independence questionnaire, scoring guidelines, and answer keys. All the results of this design stage are then referred to as draft I which is described as follows. Then, in each sub-chapter, examples of questions are given along with alternative solutions to increase students'

understanding in solving problems and practice questions are given based on problem-solving skills at the end of the sub-chapter to train students' problem-solving skills.The mathematics module resulting from this stage is called draft I. The following is a display of the mathematics module based on problem-based learning that will be developed on the material on two-variable linear equation systems.


Figure 2. Module Cover View

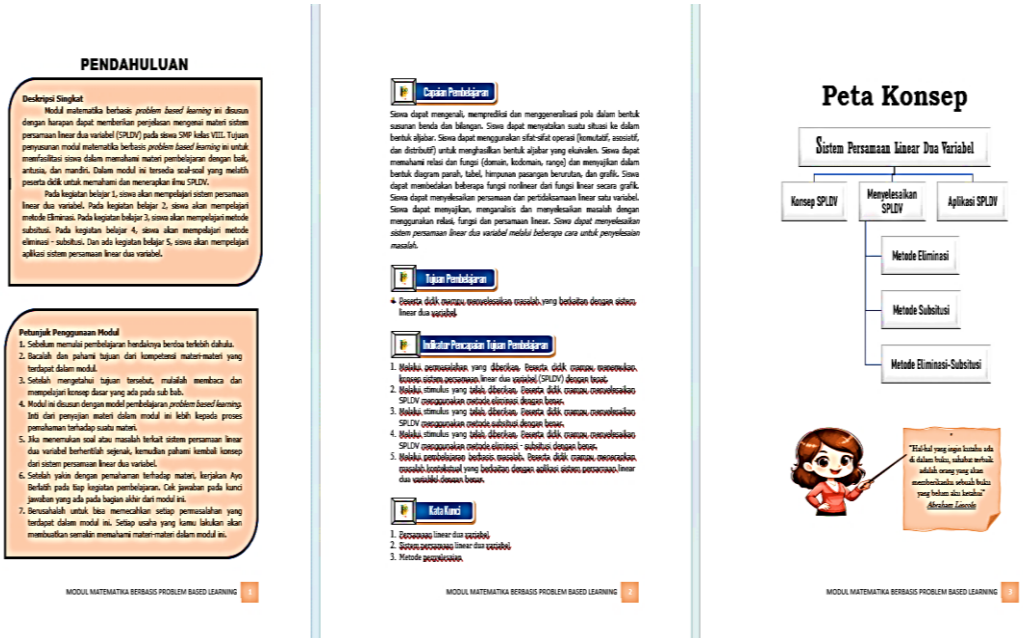


Figure 3. Introduction View and Concept Map of the Mathematics Module

***Development***

The results of expert validation in the form of validation values, corrections, criticisms, and suggestions are used as the basis for revision and improvement of the developed product. The revised product is a mathematics module that has met the valid criteria and is hereinafter referred to as draft II. The following is a display of the student worksheet that was developed:

Table 1. Validation Results

| No | Aspect | Average | Category |
|---|---|---|---|
| 1 | Teaching Module | 4,4 | Valid |
| 2 | Mathematics Module | 4,4 | Valid |
| 3 | Student Worksheet | 4,4 | Valid |

Table 1 shows that the Student Worksheets have a total "valid" average of 4.4. The data in this study were analyzed using descriptive statistical analysis. According to Sheskin (2004), descriptive statistics as an analysis tool for the purpose of describing data without drawing conclusions and making predictions. Common procedures used in descriptive statistics are in the form of tables, graphs, diagrams and calculations on the size of the central and dispersion of data.

***Implementation***

Analysis of Classical Learning Completion Results of Students' Mathematical Problem Solving Ability

In this study, students' learning completeness is reviewed from students' mathematical problem-solving abilities which are tested using a test that has been developed in the form of an essay. The results of the problem-solving ability test (pretest) and the results of the problem-solving ability test (protest). The description of the results of students' mathematical problem solving in the trial is shown in the following table.

Table 2. Description of the Results of Students' Mathematical Problem Solving Ability in Trial II

| Skor Maks | *Pretest* | | | *Posttest* | | |
|---|---|---|---|---|---|---|
| | $X_{terendah}$ | $X_{tertinggi}$ | $\bar{x}$ | $X_{terendah}$ | $X_{tertinggi}$ | $\bar{x}$ |
| 100 | 38,3 | 78,33 | 57,0 | 68,33 | 95,00 | 81,09 |

Based on Table 2, it shows that the average mathematical problem solving ability of students in the pretest results is 57.40. and the average problem solving ability of students in the posttest results is 81.09. If categorized based on the level of problem solving ability in table 3.15, the level of problem solving ability of students in the pretest trial results can be seen in Table 3 below.

Table 3. Level of Students' Mathematical Problem Solving Ability Results of Pretest Trial

| No | Interval Nilai | Problem Solving Skills | | Infomation |
|---|---|---|---|---|
| | | Number of Students | Percentage (%) | |
| 1 | $90 < x \leq 100$ | 0 | 0,00 | Very High |
| 2 | $80 < x \leq 90$ | 0 | 0,00 | High |
| 3 | $70 < x \leq 80$ | 5 | 15,63 | Medium |
| 4 | $60 < x \leq 70$ | 8 | 25,00 | Low |
| 5 | $x \leq 60$ | 19 | 59,38 | Very Low |

Based on Table 3, the results of the pretest of students' problem-solving abilities are that there are no students whose problem-solving abilities are in the "very high" and "high" categories (0%), those who get the medium category are 5 students (15.63%), those who get the low category are 8 students (25%) and as many as 19 students (59.38%) get the very low category.

Furthermore, if the posttest results are categorized based on the level of mathematical problem solving ability in table 3.15 Chapter III, the level of students' problem solving ability can be seen in table 4.

Table 4. Level of Students' Mathematical Problem Solving Ability Result of Posttest Trial

| No | Interval Nilai | Problem Solving Skills | | Infomation |
|---|---|---|---|---|
| | | Number of Students | Percentage (%) | |
| 1 | $90 < x \leq 100$ | 4 | 12,50 | Very High |
| 2 | $80 < x \leq 90$ | 11 | 34,38 | High |
| 3 | $70 < x \leq 80$ | 15 | 46,88 | Medium |
| 4 | $60 < x \leq 70$ | 2 | 6,25 | Low |
| 5 | $x \leq 60$ | 0 | 0,00 | Very Low |

Based on Table 4, no students received a very low category (0%), 2 students (6.25%) received a low category, 15 students (46.88%) received a medium category, 11 students (34.48%) received a high category and 4 students (12.50%) received a very high category.

Analysis of Student Learning Independence Questionnaire Results

The results of the initial questionnaire and the results of the final questionnaire on student learning independence in the trial. If categorized based on the level of student learning independence, the level of student learning independence can be seen in the following table describing the results of student learning independence in the trial.

Table 5. Description of Initial and Final Questionnaire Data on Student Learning Independence in Trial

| No | Category | Initial questionnaire | | Final questionnaire | | Category |
|---|---|---|---|---|---|---|
| | | Number of Students | Percentage | Number of Students | Percentage | |
| 1 | $73,33 < x \leq 100,00$ | 5 | 15,63% | 28 | 87,50% | High |
| 2 | $46,67 < x \leq 73,33$ | 19 | 59,38% | 4 | 12,50% | Medium |
| 3 | $20,00 < x \leq 46,67$ | 8 | 25,00% | 0 | 0,00% | Low |
| Amount | | 32 | 100% | 32 | 100% | |
| Averange | | 58,56 | | 81,75 | | |

From the table above, it can be seen that the average student learning independence in the initial questionnaire of trial II was 58.56 while the average student learning independence in the final questionnaire of trial II was 81.75. To see the percentage of student learning

independence, the following is a bar chart of the percentage of student learning independence results in trial II.

Improvement of Problem Solving Ability

Improvement of mathematical problem solving ability in trial II will be seen through N-Gain from the results of the pretest and posttest of mathematical problem solving ability in trial II. The results of the N-Gain calculation are presented in appendix 27. The results of the N-Gain Summary of mathematical problem solving ability in trial II can be seen in table 6 below.

Table. 6 Summary of N-Gain Results of Students' Mathematical Problem Solving Ability Trial II

| Skor *N-Gain* | Criteria *N-Gain* | Amount |
|---|---|---|
| $0{,}00 < N - Gain \leq 0{,}30$ | Low | 0 |
| $0{,}30 < N - Gain \leq 0{,}70$ | Medium | 29 |
| $N - Gain > 0{,}70$ | High | 3 |

The average N-Gain value of 0.57 if interpreted into the classification that has been described in Chapter III, then the total increase in mathematical problem solving ability in the II trial obtained is in the "moderate" category or with an N-Gain percentage of 57%. Based on table 4.30, students who get an N-Gain score> 0.70 or experience an increase in mathematical problem solving ability with the "High" category are 1 person. For students who experience an increase in mathematical problem solving ability with the "Moderate" category or get a score of 0.3 <N-Gain ≤ 0.70, there are 32 people and no students get a score of 0.00 <N-Gain ≤ 0.30 or experience an increase in problem solving ability with the "Low" category. In this study, the aspects of problem solving ability studied consist of understanding the problem, planning problem solving, solving the problem and re-checking

Improving Student Learning Independence

The increase in student learning independence in trial II will be seen through the N-Gain from the results of the initial questionnaire and the final questionnaire of the student learning independence questionnaire in trial II. The results of the N-Gain calculation are presented in appendix 29. The results of the N-gain summary of student learning independence in trial II can be seen in the following table 7.

Table 7. Summary of N-Gain Results for Learning Independence

| Skor *N-Gain* | Criteria *N-Gain* | Amount |
|---|---|---|
| $0{,}00 < N - Gain \leq 0{,}30$ | Low | 0 |
| $0{,}30 < N - Gain \leq 0{,}70$ | Medium | 29 |
| $N - Gain > 0{,}70$ | High | 3 |

The average N-Gain value of 0.57 if interpreted into the classification that has been described in Chapter III, then the total increase in learning independence in trial II obtained is in the "moderate" category or with an N-Gain percentage of 57%. Based on table 7, the number of students who got an N-Gain score > 0.70 or experienced an increase in learning independence with the "High" category was 3 people or 9.38%. For students who experienced an increase in learning independence with the "Moderate" category or got a score of 0.30 < N-Gain ≤ 0.70, there were 29 people or 90.63% of the total number of students and no students got an N-Gain score ≤ 0.3 or experienced an increase in learning independence with the "Low" category.

***Evaluation***

The problem-based learning mathematics module has an average teaching module validity of 4.40, a mathematics module validity of 4.48, and a student worksheet validity of 4.47. After the second trial, the problem-based learning mathematics module was "Well implemented" with a 3.40 score. Success was achieved with this score. The trial had 90.63% classical problem-solving completeness. The problem-based learning mathematics module received favorable feedback in the second trial, averaging 97.44. Mathematical problem-solving ability and student learning independence increased somewhat with N-gain values of 0.57. Thus, the problem-based learning mathematics module is legitimate, effective, and practical.

**Discussion**

Five specialists (validators) developed this gadget. The five validators gave it an average of 4.40 for the teaching module, 4.48 for mathematics, and 4.47 for LKPD. Math problem-solving ability test and student learning independence questionnaire were valid. The validity test of the mathematical problem-solving ability test instrument on pretest questions 1, 2, 3, 4, and 5 was 0.652; 0.658; 0.791; 0.818, and 0.658. Furthermore, the trial of the mathematical problem solving ability test instrument on posttest questions consecutively numbered 1, 2, 3, 4 and 5 showed 0.655; 0.731; 0.744; 0.785 and 0.825, proving its validity and applicability. This was also discovered in the instrument reliability test. Mathematical problem solving ability test reliability in the pretest was 0.749, posttest reliability was 0.790, and student learning independence questionnaire reliability was 0.931. Factors making the mathematics module legitimate include: First, the module and devices are content-valid. The mathematics module was developed to meet curricular requirements. These curricular expectations connect to students' learning successes and goals in lesson-related learning activities. (Sinaga, 2007) agrees that content validity is a test's accuracy based on its contents. Content validity of a measurement instrument means its content accurately represents the learning material. This indicates that the measuring instrument's contents are approximated to match the curriculum. (Arikunto, 2017) also mentioned that excellent content validity is when a learning device can assess certain goals that match the lesson's content. Many call this content validity curricular validity.

The mathematics module is construct-valid. This signifies that this maths module was developed using mathematical problem-solving principles and indications. To ensure the measuring instrument reliably measures the construct, construct validation is equally crucial. The teaching module, mathematics module, and Student Worksheet are designed to complement each other and assess mathematical problem-solving and learning independence. study supports the aforesaid findings. A, (Zulkarnain, 2015)define a learning module as valid if expert assessment shows that Mustarni's device is based on a strong theory and has internal consistency, meaning its components are interrelated. (Rahayu, 2019) study also showed that the learning gadget built meets the minimal requirements of excellent.

Therefore, the learning apparatus designed meets the requirements. Trial I's posttest problem-solving findings showed 65.63% classical student learning. From trial II's posttest problem-solving outcomes, 90.63% of students learned classically. At least 85% of students who completed the problem-solving ability exam achieved a minimum score of ≥75, meeting the requirements defined in Chapter II for comprehensive learning outcomes. The posttest of trial II revealed students' problem-solving skills improved and met classical completeness. According to (Aufa, M., Saragih, S., Minarni, 2015), PMR-based learning devices had 30% student learning result completeness. Trial I's posttest had 62% classical completeness and trial II 92%. (Wanahari, M., Amry, Z., Simamora, 2022) study indicated that learning device development improved student learning outcomes from trial I to trial II. The learning instruments produced meet traditional student learning completion standards.

## D. Consclusion

The problem-based learning mathematics module is approved for class VIII students at Medan Junior High School to increase mathematical problem-solving and learning independence. The teaching module has 4.40 validity, the mathematics module 4.48, and the student worksheet 4.47. The problem-based learning mathematics module is useful for improving class VIII students' mathematical problem-solving abilities and learning independence at Medan Junior High School. Practicality is assessed by learning implementation (Ok), which is well executed with a score of 3.40. Class VIII students at Medan Junior High School may strengthen their mathematical problem-solving abilities and learning independence with the problem-based learning mathematics module. From an efficacy perspective 1) Classical completeness satisfied criterion at 90.63%. 2) 97.44% of students felt happy about learning. (3) The improvement in mathematical problem-solving skill and student learning independence are modest with N-gain values of 0.57. From trial I to trial II, the N-Gain showed that class VIII students of Medan Junior High Schoolimproved their mathematical problem-solving and learning independence using the PBL-based mathematics module. In trials I and II, mathematical problem-solving skill increased 0.45 and student learning independence 0.41.

Trial II showed a 0.57 "moderate" improvement in mathematical problem-solving ability and student learning independence.

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