

Development of Problem-Based Learning Devices to Improve Mathematics Problem Solving Ability and Learning Independence of Labuhanbatu Private Junior High School Students

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Abstract: This development research generally aims to develop problem-based learning tools that are valid, practical and effective, in particular the objectives are to: 1) Produce product development problem-based learning tools that are valid, practical and effective in improving students' mathematical problem solving skills and independence. 2) Analyzing the increase in students' mathematical problem solving abilities in the application of problem-based learning tools. 3) Analyze the level of student learning independence in the application of learning tools. The researcher gave pretest questions to students to see students' initial abilities before being given the learning tools that had been developed. The data obtained from the results of the pretest and posttest were analyzed to find out how much the increase in students' learning independence abilities occurred. Testing of the assessment instrument was carried out at the beginning (pretest) and at the end (posttest) of the meeting. This learning tool was developed using a development model referring to Plomp's theory, which consists of five phases, namely the initial investigative research phase, the design phase, the design phase, the assessment phase and the implementation phase (trial). LKPD is another tool that was developed using a problem-based learning model for problem-solving abilities and participants' independent learning abilities that can be said to be effective, valid and practical.

Keywords: Development of problem-based learning tools, mathematical problem solving, independent learning.

I. INTRODUCTION

The results of the 2018 Trends International Mathematics and Science Study (TIMSS) survey showed a decrease in mathematics and reading. This was different when the 2015 PISA results increased slightly. Following are the results of a 2018 survey on students' abilities to identify and understand mathematics (PISA) showing that Indonesian students' mathematical ability ranks 64 out of 65 countries (2018 PISA results). The various aspects that cause low mathematical ability are due to the fact that the curriculum used in Indonesia is not in accordance with the assessment given in PISA. In addition, the learning process and students' mathematical solving abilities are still low, so it is necessary to make improvements to improve the quality of student learning. This is very necessary to prepare students' future careers and lives as agents of change.

According to Mahardiningrum (2018) problem solving abilities can encourage students to think logically, consistently, systematically and develop documentation/record systems, and can develop abilities and skills to solve problems. Because solving mathematical problems is very important in learning mathematics, therefore the ability to solve mathematical problems must be owned by a student.

Students who do not understand well the problems given are evident from the way students do not write down what is known and what is asked in the questions. Students are unable to apply mathematical models or do not know how to solve problems. This then causes students to fail in answering problems and are unable to re-examine what is right and what is wrong in their answers. So it can be concluded that students' mathematical problem solving ability in this case is low. One of the causes of the low ability of students' mathematical problem solving is that the learning approach used is less effective. As revealed by Maulana (in Agustiningsih, 2019) that in learning students must be encouraged to do problem solving, in addition, starting class with open problems designed according to student experience or what has been

learned. Through this explanation it is clear that students' mathematical problem solving abilities are trained through effective learning.

From the results of observations in class VIII at the Labuhan Batu Regional Government Private Middle School, that during the learning activities there were still students who did not pay attention and made noise in class. Therefore, learning in the classroom must be designed in an interesting and fun way so that students have high learning motivation. From the results of an interview with a class VIII math teacher at SMP PEMDA Labuhanbatu on January 2 2022, he said that there were still many students who could not become independent learners. For example, (1) students do not prepare before facing learning at school, and study material only when a test is to be carried out, (2) when working on a problem that is applied. In real problems students tend to find it difficult if previously they were not given examples of questions of the same form, (3) and when asked to come to the front of the class to solve problems students are reluctant and just wait for other friends to do it. Based on this fact, it can be concluded that the level of independence in learning mathematics for students at the Labuhan Batu Regional Government Private Middle School is still low. Therefore it needs to be fixed through a good learning process.

Based on the results of observations at Pemda Private Middle Schools, problems were found in developing mathematics learning tools such as lesson plans and worksheets. These four important components have not been fully developed by the teacher. Teachers have not followed the guidelines offered and recommended in the 2013 curriculum. The devices used by teachers at this school are devices purchased by publishers or devices provided by the government where models or methods, as well as media that are not in accordance with the material and conditions of the students being taught. The following is explanation of the Learning Device Plan (RPP) in the Labuhan Batu Regional Government Private Middle School.

The development of learning tools between student worksheets (LKPD / RPP) and tests of problem solving abilities and student learning independence must refer to a learning model so that the tools developed become a single unit that complements each other and focuses on the goals to be achieved. The learning model according to Maulana (2019) is a whole series of presentation of teaching material which includes all aspects before, while and after learning is carried out by the teacher and all related facilities that are used directly or indirectly in the teaching and learning process. There are many learning models that can be used in an effort to develop mathematical abilities, one of the learning models recommended in the 2013 curriculum teacher's book which is in line with the characteristics of mathematics is the Problem Based Learning (PBM) model.

Pemda Private Middle School students during the learning process still experience difficulties in solving math problems. When given questions related to problem solving. Students are not able to analyze the problem. Students still do not understand what is the problem in the problem. In addition, students do not know how to solve these math problems. This happens because students are still lacking in doing exercises on math problems.

These students tend to pass questions that require problem analysis. During learning, it is not uncommon for students to wait for the teacher to explain or wait for their friends to work in front of the class. Students are less independent and tend to take a relatively long time to learn. Study time at school becomes less effective. Thus, student learning independence becomes one of the important things for learning success. With independent learning, students can learn without having to wait or rely on certain learning resources. According to the observations of researchers during PPL, Grade VIII students of the Labuhanbatu Pemda Private Middle School still had difficulty analyzing problems in math word problems. Most of the students asked the teacher what the purpose of the problem to be done was. The following are examples of questions asked by students. The price of 1 liter of rice is $\frac{1}{2}$ the price of 1 kg of sugar, and

the price of 1 kg of sugar is $\frac{3}{4}$ the price of 1 kg of eggs. If the price of 1 kg of eggs is Rp. 16,000, how much is 1 liter of rice in rupiah?

In working on the problem, only a few students were able to do it correctly. Some students who have difficulty asking "This question is divided or multiplied, ma'am?" or "After meeting the price of sugar, then what, ma'am?". In addition, students also ask for examples of problem solving so they can work on similar problems. However, if the questions are only changed in numbers, students are already confused about how to solve them so the teacher needs to explain again about how to do the problem. This makes learning less effective. In addition, student learning independence is still lacking. Students often wait for an explanation from the teacher to explain a concept or in solving problems. Some students asked their friends about problem solving before trying to do it themselves

However, based on observations at the Labuhan Batu Regional Government Private Middle School, researchers observed that the learning process still used less well-structured learning. Therefore by implementing a learning model, namely a problem-based learning model, it is hoped that it can develop students' mathematical problem-solving abilities in local government private junior high schools, as research conducted by Salimah Angreiny (Tanjung, 2019) states that problem-based learning can improve problem-solving abilities and student mathematics communication. For this reason, it is necessary to conduct research on the development of quality learning devices. The quality of the tools developed must meet valid, practical and effective criteria and comply with the applicable 2013 curriculum. The learning tools developed in this study will refer to the problem-based learning model, including: Student Work Sheets (LKPD), lesson plans, problem-solving ability tests and student learning independence questionnaires .

Based on the description of the problems above, the research objectives are: (1) To analyze the validity of problem-based learning tools in improving the mathematical problem-solving abilities of private junior high school students in Labuhan Batu. (2) Analyzing the practicality of problem-based learning tools in improving the mathematical problem-solving skills of private junior high school students in Labuhan Batu. (3) Analyzing the increase in students' mathematical problem-solving skills using problem-based learning tools at the Labuhan Batu Regional Government Private Middle School. (4) Analyzing the increase in student learning independence, after the development of problem-based learning tools at the Labuhan Batu Regional Government Private Middle School.

II. RESEARCH METHODS

This type of research is development research, namely the development of problem-based lesson plans and worksheets on the material system of two-variable linear equations. The development model used refers to the general education development model proposed by Tjeerd Plomp . This research was conducted in class VIII of the Labuhan Batu Regional Government Private Middle School located on Jalan Binaraga Rantau Prapat, Siringo-ringo Village, Rantau Utara District Labuhan Batu Private Middle School is one of the oldest private schools in LabuhaBatu. The subjects of this study were class VIII students of the Labuhan Batu Regional Government Private Middle School. While the objects in this study are lesson plans and worksheets designed on the material of a two-variable linear equation system. Labuhan Batu.

The research design uses the model proposed by Tjeerd Plomp. In this study, the development of problem-based RPP and LKPD was carried out until the 5th phase. After being tested on a limited basis on students in one class with as many as 30 students . The data obtained in this study were analyzed and then used to revise the developed media in order to produce appropriate media according to the specified criteria. Analysis of each data, namely the Analysis of LKS Validation Instruments and Implementation of RPP, Analysis of the Practicality of the Devices, Analysis of the Effectiveness of the Learning Devices.

III. RESULTS AND DISCUSSION

This learning tool was developed using a development model that refers to Plomp Theory, which consists of five phases, namely the initial investigative research phase, the design & design phase, the assessment phase and the implementation phase (trial).

Based on the results of validation that has been carried out by expert validation (lecturers) and practitioner validation (mathematics teacher), it can be concluded that the mathematics learning tool developed is in the form of lesson plans with an average total validity of lesson plans of 4.39 out of four validators, which means that lesson plans developed is categorized as very valid. The average aspect with the lowest score is the time aspect, where in the implementation process it is necessary to manage time as well as possible by considering the internet quota for each student is different. Meanwhile, based on the practicality of the lesson plan data, an average final score of 84.65 was obtained and the score category was B, which means that the lesson plan developed can be used with minor revisions.

Based on the description above, it can be concluded that the Learning Implementation Plan (RPP) which was developed using a problem-based learning model to improve problem solving abilities and students' independent learning abilities can be said to be "valid" and "practical".

LKPD which has been developed by researchers, has been adapted to the problem-based learning model as a syntax in conducting learning to improve problem solving abilities and students' independent learning abilities. This LKPD contains components covering several aspects to see the feasibility of LKPD for use in the learning and teaching process, namely: format, content, suitability of material, and language. Based on LKPD validity data, an average total LKPD validity is obtained of 4.27 of the four validators, which means that the developed LKPD is categorized as very valid. Meanwhile, based on the practicality of LKPD data, an average final score of 84.17 was obtained and it was categorized as B, which meant that the LKPD being developed could be used with minor revisions.

Based on the description above, it can be concluded that the Student Worksheets (LKPD) which were developed using a problem-based learning model for problem solving abilities and participants' independent learning abilities can be said to be "valid" and "practical".

Based on the results of validation that has been carried out by validation experts (lecturers) and practitioner validations (mathematics teachers), it can be concluded that the assessment instruments in the form of pretest, posttest and questionnaires are said to be valid because the pretest has an average total score of 4.29 with very good criteria and a percentage eligibility 85.83% with very feasible criteria. As well as the validation results of the posttest assessment instrument are said to be valid because they have an average total value of 4.35 with very good criteria and an eligibility percentage of 87.07% with very feasible criteria and the validation results of the student learning independence questionnaire assessment instrument are said to be valid because they have an average the total score is 4.58 with very good criteria and a percentage of eligibility is 91.67% with very decent criteria.

As well as the average final score of the practicality of the problem-solving ability test given by four validators, which is equal to 82.75, where if viewed with the practicality assessment category it is included in the value of B, meaning that the problem-solving ability test that has been developed can be used with a little revision . Finally, the average final score of the practicality of the student learning independence ability test given by four validators, which is equal to 88.19, which when viewed with the practicality assessment category is included in the value of A, means that the student learning independence ability test that has been developed can be used without revision. .

problems and the ability of independent learning of students has increased in the medium category on the *N-Gain test* . -the average *N-Gain of* students' independent learning ability is 0.507 (medium).

Based on research conducted in class VIII of the Labuhan Batu Regional Government Private Middle School, which totaled 30 students, it can be concluded that problem-based mathematics learning

tools to improve mathematical problem-solving skills and students' independent learning abilities are appropriate to use.

IV. CONCLUSION

Based on the results of research on the development of problem-based learning tools to improve students' mathematical problem-solving abilities and students' learning independence, it can be concluded that: (1) Problem-based learning tools to improve students' mathematical problem-solving abilities and students' learning independence are considered "valid". This is based on the assessment of four validators which produce an average total validity value of lesson plans of 4.39 which is included in the "very valid" category, the average total validity value of LKPD is 4.27 which is included in the "very valid" category, the average value -the total validity of the pretest of problem solving abilities is 4.29 which is included in the "very valid" category, the average value of the posttest total validity of problem solving abilities is 4.35 which is included in the "very valid" category, and the average value of the total validity questionnaire of students' independent learning ability of 4.58 is included in the "very valid" category. (2) Problem-based learning tools to improve mathematical problem-solving skills and visual-spatial learning independence of participants are considered "practical". This is based on the assessment of three validators which resulted in an average final value of practicality of the lesson plan of 84.65 which is included in the category "B" which means that learning tools in the form of lesson plans can be used with slight revisions, the average final value of practicality of LKPD is 84.17 which included in the "B" category, which means that the learning device in the form of a LKPD can be used with a little revision, the average final score of the practicality of the problem solving ability test is 82.75 which is included in the category "B" which means that the learning device in the form of a problem solving ability test can be used with a few revisions, and finally the average final score of the practicality of the student learning independence ability test was 88.19 which is included in the "A" category, which means that the learning tool in the form of a student learning independence test can be used without revision. (3) Based on the results of the students' pretest and posttest assessments, it can be concluded that the students' mathematical problem solving abilities have increased to the "medium" category on the N-Gain test of 0.507. (4) Based on the results of the students' pretest and posttest assessments, it can be concluded that the ability of students' learning independence has increased to the medium category on the N-Gain test of 0.463.

REFERENCES

- Agustiningih, LM (2019). Mathematical Critical Thinking Ability of Class XI IPA Ma Al-Ikhsan Beji Kedungbanteng Banyumas. *thesis*. Purwokerto State Islamic Institute.
- Ambiyar, Aziz, I., & Delyana, H. (2020). The Relationship between Student Learning Independence and Students' Mathematical Problem Solving Ability. *Journal of Scholars: Journal of Mathematics Education* , 04 (02), pp. 1171-1183.
- Aminah, Siti Nababan and Henra Saputra Tanjung. (2020). "Development of Learning Devices Based on a Realistic Mathematical Approach to Improve the Mathematical Disposition of Students at SMA Negri 4 Wira Bangsa, West Acih District", in *Genta Mulia Journal*, Vol.X July, 2020.
- Arikunto, S. (2020). *Research procedure; A Practical Approach* , Jakarta: Rineka Cipta
- Azwardi, G., Sugiarni, R. (2019). Improving Mathematical Problem Solving Ability through the Laps-Heuristic Learning Model. *Pi: Mathematics Education Journal* . 2(2): page. 62-68.
- Hidayat, R., Roza, Y., & Murni, A. (2019). The role of applying the problem based learning (PBL) model to the ability of mathematical literacy and independent learning. *Juring (Journal for Research in Mathematics Learning)* .1(3): 213- 218.

- Maharani, M., Supriadi, N., and Widyastuti, R. (2018). Cartoon-Based Mathematics Learning Media to Reduce Students' Anxiety. *Decimal: Journal of Mathematics* ,1(1), 2018, 101-106.
- Mahardiningrum, Anita Sri & Novisita Ratu. (2018). Profile of Mathematics Problem Solving of SMP Pangudi Luhur Salatiga Viewed from Critical Thinking. *Mosharafa Journal*. Vol.7, No. 1.
- Mayasari1 & Rosyana, T. (2019). The Influence of Independent Learning on the Ability to Solve Mathematical Problems in Middle School Students in Bandung City. *Scholar's Journal: Journal of Mathematics Education* 3 (1), pp. 82-89.
- Meisura, A. (2019). The Effect of Applying Metacognitive Strategies on Mathematical Problem Solving Ability Based on Student Learning Independence. *Scientific Journal of Mathematics Education* , 2 (1), 14–20.
- Munangir, Erika; et al. (2019). The Influence of Problem Based Learning Learning Model on Independent Attitude and Mathematical Communication Ability of Class V SD Negeri Bakalrejo 1. *SQUARE : Journal of Mathematics and Mathematics Education*. Vol 1.No. 29.
- Harisuddin, MI (2021). Mathematical Problem Solving Ability and Student Learning Independence with Pjj During Covid-19. *Theorem: Mathematical Theory And Research* , 6 (1), 98.
- Hasibuan, AM, Saragih, S., & Amry, Z. (2019). Development of Learning Materials Based on Realistic Mathematics Education to Improve Problem Solving Ability and Student Learning Independence. *International Electronic Journal of Mathematics Education* , 14(1), 243-252.
- Hendriana, H., & Soemarmo, U. (2020). *Mathematics Learning Assessment* (NF Active (ed.); Second (rev). PT Refika Aditama
- Hs, AU (2018). The Effect of the Missouri Mathematics Project (MMP) Learning Model on the Mathematics Learning Outcomes of Class VII Students of SMP Negeri 10 Pekanbaru. *thesis*. Riau Islamic University Pekanbaru.
- Ministry of Education and Culture. (2018). HOTS Content in 2013 Curriculum Learning. Jakarta: Ministry of Education and Culture
- Kidjab, MR, Ismail, S., & Abdullah, AW (2019). Description of Independent Learning in Middle School Mathematics Learning . *EULER: Journal of Mathematics, Science and Technology*, 7.(1), Pg. 25-31.
- Paridjo. (2018). Students' Algebraic Thinking Ability in Trigonometry Material Viewed from School Background Through Problem-Based Learning. *PRISMA, Proceedings of the National Mathematics Seminar* , 814-829.
- Prastowo, A. (2020). *Creative Guide to Creating Innovative Teaching Materials: Creating Interesting and Fun Learning Methods*. Yogyakarta: Diva Press.
- Reski, R., Hutapea, N., & Saragih, S. (2019). The Role of Problem Based Learning (PBL) Models on Mathematical Problem Solving Ability and Student Learning Independence. *JURING (Journal for Research in Mathematics Learning)* . 2(1): pages 49-57.
- Sari, N. (2020). The Influence of Problem-Based Learning on Mathematical Learning Independence for Students of SMK Ar-Rahman Medan. *Journal of Mathematical Paedagogic*. 4(2): 175-180.
- Sugiyono. (2020). *Educational Research Methods Quantitative, Qualitative and R&D Approaches* . Bandung: Alfabeta.
- Sulistiyani, D., & Roza, Y. (2020). The Relationship between Learning Independence and Mathematical Problem Solving Ability. *Journal of Mathematics Education* , 11(1), 1–12.
- Cape, HS (2019). Problem Solving and Mathematical Communication for Students of SMA NEGERI 3 Kuala, Nagan Raya Regency. *Jambura Journal of Educational Management, Genta Mulia Journal* , X (2), 178 -187)
- Yulianti, Ai Solihat and Asep Ikin Sugandi. (2018). Application of Problem Based Learning Approach to Junior High School Students' Mathematical Problem Solving Ability. *Journal of Innovative Mathematics Learning*. Vol. 1, No. 2