SENSEI
INTERNATIONAL JOURNAL OF EDUCATION AND LINGUISTICS

Vol. 1, Issue 4, November 2021 *E-ISSN: 2775-3484*

DEVELOPMENT OF PROBLEM BASED LEARNING TOOLS TO IMPROVE MATHEMATICS PROBLEM-SOLVING ABILITY

Beni Ardi[1]
State University of Medan, Indonesia
Email : beniardi88@gmail.com

Mukhtar[2]
State University of Medan, Indonesia

Waminton Rajagukguk[3]
State University of Medan, Indonesia

Abstract

This research is the development of problem-based learning tools to improve the mathematical problem-solving abilities of students of SMP Private Bakti Medan class VIII for the 2021/2022 academic year. Effectiveness; 2) The mathematical problem-solving ability of students using learning tools with Problem Based Learning increased in terms of the average posttest value of the first trial was 76.88 increased to 81.19 in the second trial and experienced an increase in the distribution stage of 84.38 and the N-Gain of trial I was 0.31 in the medium category increased to 0.33 in the medium category in the second trial and at the distribution stage increased to 0, 42 medium categories. The learning tools developed in this research are the Student Book and LKPD. Device development is carried out using the four D model development model.

Keywords: *Problem-based learning, Problem-solving ability*

A. Introduction

Regulation of the Minister of National Education of the Republic of Indonesia Number 22 of 2006 concerning Content Standards for Elementary and Secondary Education Units (2006:345) confirms that mathematics is one of the subjects studied by students starting from Elementary School, Middle School, even up to College. It is intended to equip students with logical, analytical, systematic, critical, and creative thinking and the ability to work together. To achieve the objectives of learning mathematics, it is necessary to improve the quality and quality of education, especially mathematics learning.

The visible reality is that education quality and quality are not as expected (Fatmawati & Yusrizal, 2020; Yusrizal & Fatmawati, 2020). This can be seen from the results of international assessments of students' mathematics learning achievement, which shows that the quality of education in Indonesia tends to be below. The Research and Development Agency (Balitbang) in 2011 reported the results of the Trends in International Mathematics and Science Study (TIMSS) survey in 2003, showing that the mathematics learning achievement of Indonesian junior high school students was ranked 35 out of 46 countries. The average score obtained by students is 411 and is still below the average for the ASEAN region. TIMSS 2007 achievement is ranked 36 out of 49 countries with a score of 397, which is very concerning because student scores have dropped and are much lower than the international average score of 500. Even worse results are shown by TIMSS 2011, which is ranked 39 out of 43 countries. In addition to TIMSS, the Program For International Students Of Assessment (PISA) results also show that the learning achievement of Indonesian children aged around 15 years is still low.

The previous research conducted by PISA was in 2012, involving

510,000 students from 65 countries, including Indonesia. The average value of Indonesian students ranks second lowest out of 65 participating countries. From these results, it can be concluded that the questions taught in Indonesia are different from those standardized at the international level so that students are not familiar with TIMSS and PISA standardized questions (Wardhani and Rumiati, 2011:1). The Program For International Students Of Assessment (PISA) results also show that the learning achievement of Indonesian children aged around 15 years is still low. The previous research conducted by PISA was in 2012, involving 510,000 students from 65 countries, including Indonesia. The average value of Indonesian students ranks second lowest out of 65 participating countries. From these results, it can be concluded that the questions taught in Indonesia are different from those standardized at the international level so that students are not familiar with TIMSS and PISA standardized questions (Wardhani and Rumiati, 2011:1). The Program For International Students Of Assessment (PISA) results also show that the learning achievement of Indonesian children aged around 15 years is still low. The previous research conducted by PISA was in 2012, involving 510,000 students from 65 countries, including Indonesia. The average value of Indonesian students ranks second lowest out of 65 participating countries. From these results, it can be concluded that the questions taught in Indonesia are different from those standardized at the international level so that students are not familiar with TIMSS and PISA standardized questions (Wardhani and Rumiati, 2011:1). The average value of Indonesian students ranks second lowest out of 65 participating countries. From these results, it can be concluded that the questions taught in Indonesia are different from those standardized at the international level so that students are not familiar with TIMSS and PISA

standardized questions (Wardhani and Rumiati, 2011:1). The average value of Indonesian students ranks second lowest out of 65 participating countries. From these results, it can be concluded that the questions taught in Indonesia are different from those standardized at the international level so that students are not familiar with TIMSS and PISA standardized questions (Wardhani and Rumiati, 2011:1).

Realizing this, the problem-solving ability is one of the important abilities that students must have. According to Dahar (1989: 138), problem-solving is a human activity that combines concepts and rules that have been obtained previously and not as a generic skill. This understanding implies that when someone has been able to solve a problem, then that person already has a new ability. This ability can be used to solve relevant problems. The more problems a person can solve, the more abilities he will have to help him navigate his daily life. Therefore,

The importance of problem-solving skills is in line with the opinion of Holmes in Wardhani, et al. (2010:7) which states that the reason someone needs to learn to solve problems is the fact that people who can solve problems will live productively in this twenty-first century, will be able to race against necessities of life and able to understand complex issues related to global society. Cooney in Hudojo (2005:130) also suggests that teaching students to solve problems will enable students to be more analytical in making decisions in life. That is, students who are trained in solving problems will be able to make decisions because they have skills on how to collect relevant information, analyze information,

Naturally, the mathematical problem-solving ability has not been appropriately achieved. From the results of the researcher's observations, obstacles that may occur in the learning process include facilities,

problems that are not following the learning environment, learning activities that are still quite teacher-centered, which can be seen from the excessive use of the lecture method and the activities of students who tend to be passive in the learning process.

According to Ruseffendi in Anisa (2014: 3), an activity carried out with lectures (listening) will be remembered by students by 20%, if conveyed through sight, it can be remembered by students by 50%, and if an activity is carried out by doing it will be remembered. By students by 75%. These data indicate one of the causes of students ' inability to solve problems. So that there is a need for innovation in mathematics learning that can improve problem-solving abilities.

To improve some of these conditions, in the 2013 curriculum, the learning process in educational units is held interactively, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for the initiative, creativity, and independence according to their talents, interests, and abilities. And the physical and psychological development of students. For this reason, each educational unit carries out learning planning, implementation of the learning process, and assessment of the learning process to improve the efficiency and effectiveness of achieving graduate competencies.

B. Method

The type of this research is Research and Development with the model of developing learning tools of Thiagarajan, Semmel, and Semmel, namely the 4-D model (Four D Model). This research was carried out at the Private Bakti Middle School in Medan in the odd semester of the 2021/2022 academic year on the SPLDV material. The subjects of this study were students of SMP Private Bakti Medan class VIII for the

academic year 2021/2022. While the object in this study is a mathematics learning device for SMP Private Bakti Medan class VIII using problem-based learning on SPLDV material. The data collection instruments in this development were a learning device validation sheet and a learning effectiveness observation sheet. The data analysis technique used in this research is descriptive analysis.

C. Finding and Discussion

a. Product Trial Result Data Description

1) Front-End Analysis (Front-End Analysis)

Based on the observations of learning devices at SMP Swasta Bakti Medan, several weaknesses were found in the learning tools used by teachers, which indirectly contributed to the low problem-solving of students. Learning tools used by teachers and students produce teacher-centered learning so that students are not active in learning and have not met the needs of students to acquire problem-solving skills. Some of these problems are the low quality of the learning tools used in SMP Swasta Bakti Medan, which impacts students' low problem-solving abilities. To overcome these problems, it is necessary to develop learning tools that meet the valid criteria,

2) Trial Analysis I

- **Student Learning Outcomes in Trial I**

The following are the learning outcomes of students in the first trial.

Table 1. Student Learning Outcomes In Trial I Problem Solving Ability

No	Value Interval	*Posttest*		Value Category
		The number of students	Percentage	
1	85<SKPMM≤100	6	30%	Tall
2	70<SKPMM≤85	9	45%	Currently
3	55<SKPMM≤70	5	25%	Enough
4	0<SKPMM≤55	0	0%	Low

Based on the table, it can be seen that the learning outcomes of students in the first trial can also be seen that as many as 5 students (25%) did not complete the mathematical problem-solving ability test because they could not achieve a minimum mathematical problem-solving ability score of 71, while the 15 students (75%).

- **Practical Analysis of Learning Devices with Problem-Based Learning Models in Trial I**

The following is the average value of observing the implementation of learning devices for each meeting in the first trial.

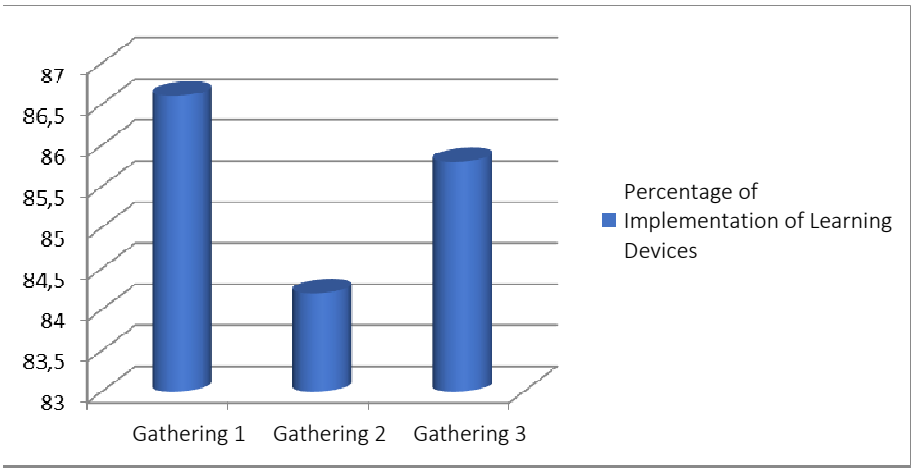

Figure 1. Implementation of Trial Learning Tool I

- **Analysis of Increasing Students' Mathematical Problem Solving Ability in Trial I**

The following are the results of the N-Gain calculation on students' creative thinking abilities.

Table 2. Summary of N-Gain Results of Experimental Mathematical Problem Solving Ability I

N-Gain	**Interpretation**	**Number of Students**
g > 0.7	Tall	0
0.3 < g 0.7	Currently	8
g 0.3	Low	12

Based on the table, it can be seen that there are no students who have scored N-Gain in the range > 0.7 or have increased mathematical problem-solving abilities with the "High" category; students who have increased mathematical problem-solving abilities are in the "Medium" or "Medium" category—got an N-Gain score of 0.3 < g 0.7 as many as 8 students and students who experienced increased mathematical problem-solving abilities in the "Low" category or got an N-Gain score 0.3 as many as 12 students. So, the average N-Gain in the first trial was 0.31 in the medium category.

3) Trial II

- **Results Learner's Learning in Trial II**

The following is a table of student learning outcomes in the second trial.

Table 3. Learning Outcomes of Students In Trial II Ability Solution to the problem

No	Value Interval	*Posttest*		Value Category
		The number of students	Percentage	
1	85<SKPMM≤100	9	45%	Tall
2	70<SKPMM≤85	8	40%	Currently
3	55<SKPMM≤70	3	15%	Enough
4	0<SKPMM≤55	0	0%	Low

Based on the table, it was found that the learning outcomes of students in the second trial can also be seen that as many as 3 students (15%) did not complete the mathematical problem-solving ability test because they could not achieve a minimum mathematical problem-solving ability score of 71. In comparison, 17 students completed the problem-solving ability test (85%).

- **Analysis of Increasing Students' Mathematical Problem Solving Ability in Trial II**

The following are the results of the N-Gain calculation on students' creative thinking abilities.

Table 2. Summary of N-Gain Results of Experimental Mathematical Problem Solving Ability I

N-Gain	Interpretation	Number of Students
g > 0.7	Tall	1
0.3 < g 0.7	Currently	12
g 0.3	Low	7

Based on the table, it can be seen that the learning tools developed have met all the effective established criteria, namely: (1) classical student learning mastery has been fulfilled because mathematical problem solving has obtained a minimum score of 71; (2) the achievement of learning objectives in each item has reached the

specified criteria, namely at least 75%; (3) the achievement of learning time which is at least the same as the usual learning time has been achieved and (4) more than 80% of students gave a positive response to the components of the problem-based learning model learning device developed. More details can be seen in the diagram presented in the following figure.

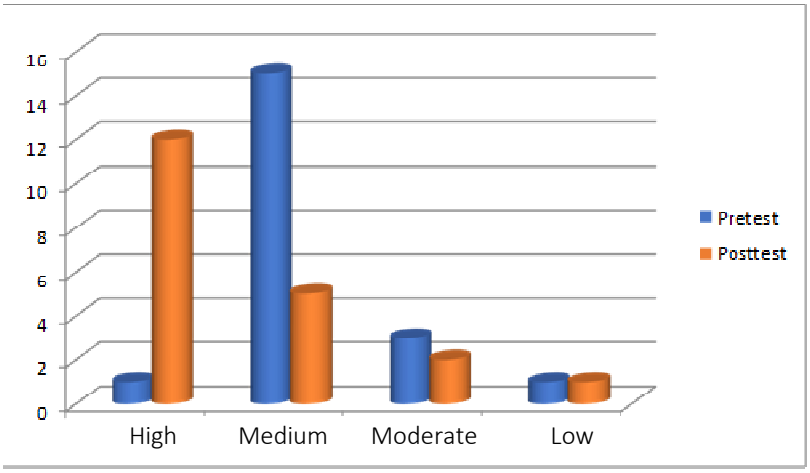

Figure 2. Pretest and Posttest Results of Mathematical Problem Solving Ability in the Spreading Stage

Based on the figure, it was found that the level of mathematical problem-solving ability of the Posttest results at the distribution stage there was 1 student (5%) who obtained a low category, in the excellent category there were 2 students (10%), in the medium category there were 5 participants. Students (25%) and 12 students (60%) obtained the high category.

The increase in students' mathematical problem-solving abilities is due to the learning process using learning tools with a problem-based

learning model starting with contextual problems to use their previous experience in understanding and solving mathematical problems. Contextual problems are designed to make the learning process more meaningful, so it can be understood that the given contextual problems can be used as a starting point in developing students' mathematical problem-solving abilities. Furthermore, the discussion conducted by students is a bridge to help each other between students in understanding contextual problems. This is in line with Ausubel's theory (Trianto, 2011) that meaningful learning relates new information to relevant concepts contained in a person's cognitive structure. In meaningful learning, the learning process starts from contextual problems and constructing information. In other words, knowledge will be meaningful for students if the learning process involves real problems and is carried out in a context(Tjahjana & Arief, 2016)

Based on the research results above, learning with problem-based learning models is significantly better in improving students' mathematical problem-solving abilities. So it can be concluded that learning devices with problem-based learning models positively impact students' mathematical problem-solving abilities.

D. Conclusion

Based on the discussion that has been described previously, several conclusions can be drawn, including the following:

1. The learning tools developed using the Problem-Based Learning model have met the valid, practical, and effective criteria.
2. The improvement of students' mathematical problem-solving abilities by using learning tools developed with the Problem Based Learning model on the material of a two-variable linear equation

system increased in the second trial with the medium category.

Bibliography

Anisa, W.N. 2014. Peningkatan Kemampuan Pemecahan Dan Komunikasi Matematik Melalui Pembelajaran Matematika Realistik Untuk Siswa SMP Negeri di Kabupaten Garut. Jurnal Pendidikan dan Keguruan. 1 (1): 1-10.

Dahar. R.W. 2011. Teori-teori Belajar dan Pembelajaran. Jakarta : Erlangga.

Fatmawati, F., & Yusrizal, Y. (2020). Peran Kurikulum Akhlak dalam Pembentukan Karakter di Sekolah Alam SoU Parung Bogor. Jurnal Tematik, 10(2), 74–80.

Setiawan, A., Jamal, M.A., & Suriasa. 2015. Optimalisasi Hasil Belajar Siswa Melalui Penerapan Model Pembelajaran Kooperatif Tipe VAK (Visual, Auditory, Kinestetik). Berkala Ilmiah Pendidikan Fisika Vol 3 no 2.

Surya, E., Putri, F.A & Mukhtar. 2017. Improving Mathematical Problem-Solving Ability and Self-Confidence Of High School Students Throught Contextual Learning Model. Journal On Mathematical Education. ISSN 2087-8885

Thiagarajan, S, Semmel, D.S & Semmel, M.I. 1974. Instructional Development for Training Teachers of Exceptional Children: A sourcebook. Indiana: Indiana University.

Tjahjana, D., & Arief, Z. A. (2016). Pengaruh Model Pembelajaran Problem Based Learning dan Sikap Peserta Didik Terhadap Hasil Belajar PPKn Kelas X di SMK Negeri 1 Bojonggede Kabupaten Bogor. Jurnal Teknologi Pendidikan, 5(1), 98–127.

Wardhani, S & Rumiati. 2011. Instrumen Penilaian Hasil Belajar Matematika SMP:Beajar dari PISA dan TIMSS. Yogyakarta: PPPPTK.

Yuliani, K dan Saragih, S. (2015). The Development og Learning Devices Based Guided Discovery Model to Improve Understanding Concept and Critical Thinking Mathematically Ability of Student at Islamic Junior High School of Medan. Journal of Education and Preatice IIST. Vol . 6, No.24:116-128.

Yusrizal, Y., & Fatmawati, F. (2020). Analysis of Teacher Abilities in

Implementing Online Learning in Elementary Schools of the North Sumatra PAB Foundation. Jurnal Ilmiah Teunuleh, 1(2), 129–137.