ALGEBRA : JURNAL PENDIDIKAN, SOSIAL DAN SAINS

ISSN : 2807-663X e-ISSN : 2807-629X
Journal Homepage : https://algebra.yana.or.id/index.php/ejournal/index
Volume 6 Number 2 (2026)

DEVELOPMENT OF STUDENT WORKSHEET BASED ON A REALISTIC APPROACH TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITIES AT SMP NEGERI 30 MEDAN

Nazri Maulana[1], Endah Dwi Atika[2], Putri Elmaretha Purba[3]
[1]Program Studi Akuntansi, Fakultas Ekonomi, Universitas Al-Azhar, Medan, Indonesia
[2]Program Studi Pendidikan Matematika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Medan, Medan, Indonesia
[3]Jurusan Program Studi Pascasarjana Pendidikan Matematika, Universitas Negeri Medan, Indonesia
Email Correspondence: maulananazri21@gmail.com

ABSTRACT

This study aims to determine the improvement of students' mathematical problem-solving abilities through Student Worksheets developed with a realistic approach. This research was conducted at SMP Negeri 30 Medan. This type of research is development research. The development carried out is the development of learning tools that refer to the 4-D development model (four-D Model) proposed by Thiagarajan, Semmel and Semmel. This model includes four stages: Define, Design, Develop, and Disseminate. Due to the limitations of the researchers, the research was conducted up to the development stage. The subjects of this study were students in grades VII-6 and VII-8 of SMP Negeri 30 Medan. The instruments used to measure the quality of the developed STUDENT WORKSHEET were the RPP and STUDENT WORKSHEET assessment sheets to measure validity, and a test of students' mathematical problem-solving abilities. The results of the study showed that the classical learning completeness had exceeded the minimum limit of 94% in trial 2. The achievement of indicators/completeness of learning objectives had been achieved for each indicator in trial 2. Students' mathematical problem-solving abilities had increased with the number of students who completed trial 1 only 59% increasing by 35% to 94% in trial 2. The average class value also increased from trial 1 of 67.08 to 83.66 in trial 2. So it can be concluded that the development of STUDENT WORKSHEET based on a realistic approach can improve students' mathematical problem-solving abilities.

Keywords: Student Worksheet; Realistic Approach; Problem Solving.

INTRODUCTION

Education is a crucial aspect in improving the quality of human resources, enabling them to cope with advances in science and technology. According to Trianto (2009), education is a manifestation of human culture that continues to evolve according to societal needs. Therefore, the learning process must develop students' potential, enabling them to think critically and creatively, and to solve various problems they face.

Educational developments in the 21st century demand a shift in the learning paradigm from teacher-centered to student-centered learning. Rusman (2014) states that teachers no longer merely act as transmitters of information (transfer of knowledge), but also as facilitators capable of creating active learning, utilizing technology, utilizing various learning resources, and encouraging student creativity and participation. Therefore, learning must be designed in such a way as to increase student involvement in constructing their own knowledge.

Mathematics is a vital subject in life, supporting the development of various disciplines and technologies. Cornelius (in Abdurrahman, 2010) states that mathematics is important to learn because it is a means of logical thinking, problem solving, pattern recognition, creativity development, and cultural awareness. Similarly, Cockcroft (in Abdurrahman, 2010) explains that mathematics is essential in various aspects of life, serving as an effective communication tool, enhancing logical thinking skills and precision, and providing satisfaction in solving challenging problems.

One of the primary goals of mathematics learning is to develop problem-solving skills. These skills are not only necessary for solving math problems but also for dealing with various everyday life challenges. Pimta, Tayruakham, and Nuangchalerm (2009) state that problem-solving is the core of mathematics learning because it develops thinking skills and encourages students to apply their knowledge in real-world situations. Therefore, problem-solving skills are an important indicator of successful mathematics learning.

However, various studies have shown that Indonesian students' mathematical problem-solving abilities are still relatively low. OECD data from the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) indicate that Indonesian students' achievement in problem-solving is still below the international average. Hadijah and Surya (2016) also suggest that this low ability is influenced by the conventional learning process, which results in students receiving information rather than constructing their own understanding. This condition causes students to experience difficulties in understanding concepts and applying mathematical concepts to problem-solving.

One factor influencing low problem-solving skills is the teaching materials used in the learning process. Based on observations, Student Worksheets used in schools are still dominated by the presentation of definitions, example questions, and routine exercises. these student worksheet do not provide opportunities for students to construct knowledge independently, do not present contextual problems close to students' lives, and do not encourage the development of higher-order thinking skills. As a result, the learning process still tends to be teacher-centered, with students simply following the problem-solving procedures that have been demonstrated.

Developing student worksheets tailored to student characteristics is one alternative for improving the quality of mathematics learning. Putranto and Dhoruri (2016) explain that developed student worksheet must meet curriculum requirements, take into account student characteristics, the social and cultural environment, and meet construction and technical requirements for teaching materials. Furthermore, Astra, Nasbey, and Muharramah (2015) demonstrated that the use of systematically developed student worksheet can improve student learning outcomes compared to learning without student worksheet.

One approach deemed appropriate for developing student worksheets is the Realistic Mathematics Education Approach. According to Susanto (in Zulyadaini, 2017), this approach links mathematical concepts to students' real-life experiences, making learning more meaningful. It also provides students with the opportunity to discover mathematical concepts themselves through contextual problem-solving activities. Marsigit (in Lestari, Afri, and Richardo, 2016) emphasized that students need to be given the opportunity to construct knowledge in their own ways and languages through the process of mathematization.

Research by Harahap and Surya (2017) shows that the application of the Realistic Mathematics Approach significantly improves students' mathematical problem-solving abilities. Therefore, the development of student worksheets based on the Realistic Mathematics Approach is expected to be a solution to improve the quality of mathematics learning while enhancing students' mathematical

problem-solving abilities, particularly in the area of integer arithmetic operations in junior high schools.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach using a modified Four-D (4-D) model proposed by Thiagarajan, Semmel, and Semmel. The development process consisted of the Define, Design, and Develop stages, while the Disseminate stage was not implemented. The study aimed to develop a Student Worksheet based on the Realistic Mathematics Education (RME) approach to improve students' mathematical problem-solving abilities.

The research was conducted at SMP Negeri 30 Medan during the first semester of the 2025/2026 academic year. The participants were seventh-grade students selected randomly from two classes. The research object was an RME-based student worksheet for algebraic operations.During the Define stage, preliminary analysis, learner analysis, material analysis, task analysis, and learning objective formulation were carried out. The Design stage focuses on developing lesson plans, worksheets, and research instruments, resulting in the first prototype. In the Develop stage, the prototype was validated by experts, revised, and tested in classrooms to evaluate its validity and effectiveness.

The research instruments consisted of worksheet validation sheets, lesson plan validation sheets, mathematical problem-solving tests, and student response questionnaires. Data were collected through expert validation, classroom observations, questionnaires, documentation, and achievement tests.

The independent variable was the implementation of the RME-based student worksheet, while the dependent variable was students' mathematical problem-solving ability. Problem-solving skills were assessed through four indicators: understanding the problem, planning the solution, implementing the solution, and reviewing the results.

The data were analyzed using descriptive statistics. Product validity was determined from expert validation scores, whereas effectiveness was evaluated based on individual and classical learning mastery, achievement of learning indicators, and improvement in students' mathematical problem-solving ability. The developed worksheet was considered effective when at least 85% of students achieved the minimum mastery criterion of 65%.

RESULTS AND DISCUSSION

Results

The development of the Student Worksheet based on the Realistic Mathematics Education (RME) approach was carried out through the Define, Design, and Develop stages. The quality of the developed product was evaluated in terms of validity and effectiveness through expert validation and classroom trials. Expert validation indicated that the developed learning materials met the required standards for classroom implementation. The average validation score for the student worksheet was 3.82, while the lesson plan obtained an average score of 3.96, both categorized as good. In addition, all mathematical problem-solving test items were declared suitable for implementation after minor revisions.

Table 1. Expert Validation Results

Instrument	Average Score	Category
Student Worksheet	3.82	Good
Lesson Plan	3.96	Good
Problem-Solving Test	Valid	Usable

After the validation stage, the developed worksheet was implemented through two classroom trials involving seventh-grade students. The first trial showed that the average mathematical problem-solving score reached 67.08, with 19 out of 32 students (59%) achieving the minimum mastery criterion. Since the percentage of classical mastery did not reach the required 85%, several revisions were made to improve the worksheet and learning activities before conducting the second trial.

Following the revisions, the second trial demonstrated a considerable improvement. The average score increased to 83.66, and 29 out of 31 students (94%) achieved mastery learning. These findings indicate that the revised worksheet successfully improved students' mathematical problem-solving performance and met the predetermined effectiveness criteria.

Table 2. Comparison of Trial I and Trial II

Indicator	Trial I	Trial II
Mean Score	67.08	83.66
Students Achieving Mastery	19	29
Classical Mastery	59%	94%
Learning Objective Achievement (TPK)	67%	100%

The improvement was also observed in the achievement of each learning indicator. During the first trial, the achievement percentages for the three indicators were 66%, 81%, and 22%, respectively. After revising the worksheet and improving classroom implementation, these percentages increased to 84%, 97%, and 71%, indicating substantial progress in all aspects of mathematical problem-solving.

Table 3. Achievement of Learning Indicators

Learning Indicator	Trial I	Trial II
Addition of Algebraic Expressions	66%	84%
Subtraction of Algebraic Expressions	81%	97%
Multiplication of Algebraic Expressions	22%	71%

A significant improvement in students' mathematical problem-solving performance. The mean score increased from 67.08 in Experiment I to 83.66 in Experiment II as shown in Figure 1, indicating that the revised RME-based worksheet effectively improved students' understanding of algebraic operations and their ability to solve mathematical problems.

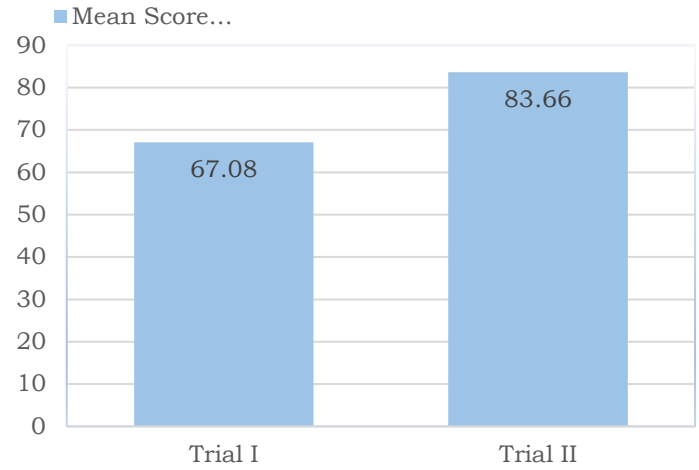


Figure 1. Mean Score Comparison

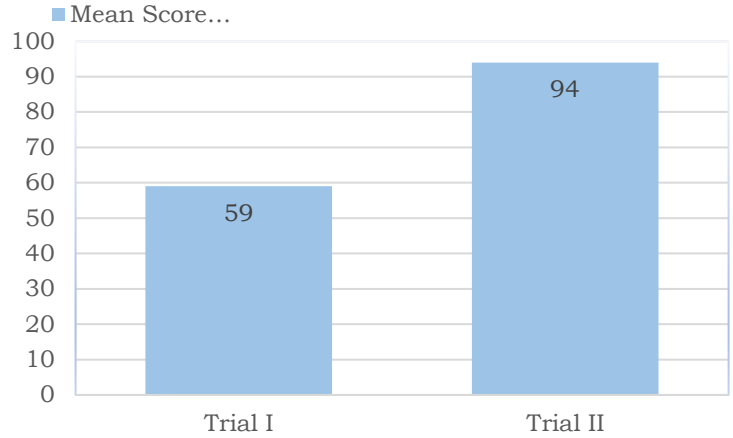


Figure 2. Classical Mastery Comparison

Discussion

The findings demonstrate that the developed RME-based Student Worksheet is both valid and effective for improving students' mathematical problem-solving abilities. The positive validation results indicate that the worksheet satisfies the requirements regarding content, presentation, language, and conformity with the principles of Realistic Mathematics Education. The improvements suggested by experts contributed to the refinement of the learning materials before classroom implementation.

The increase in students' average score from 67.08 to 83.66, accompanied by the improvement in classical mastery from 59% to 94%, suggests that contextual learning activities successfully facilitated students in understanding algebraic concepts. The RME approach encourages learners to construct mathematical knowledge from real-life situations, making abstract concepts more meaningful and easier to understand. As a result, students become more active in identifying problems, discussing solution strategies, and evaluating their answers during collaborative learning activities.

Furthermore, the improvement in the achievement of all learning indicators indicates that students not only mastered computational skills but also developed higher-order thinking skills required for mathematical problem solving. The greatest improvement occurred in the multiplication of algebraic expressions, which increased from 22% to 71%, showing that repeated revisions and contextual learning experiences effectively addressed students' previous misconceptions.

These findings are consistent with previous studies reporting that the Realistic Mathematics Education approach enhances mathematical problem-solving abilities by encouraging students to construct knowledge through contextual situations and collaborative learning. The results also support the principle that meaningful learning occurs when mathematical concepts are connected to students' everyday experiences. Therefore, the developed worksheet can serve as an effective learning resource for improving students' mathematical problem-solving skills, particularly in learning algebraic operations.

CONCLUSIONS

The results of this study indicate that the Realistic Mathematics Education (RME)-based worksheet is valid, practical, and effective in improving students' mathematical problem-solving abilities in algebraic operations. The implementation of the worksheet increased the average problem-solving score from 67.08 to 83.66, improved classical mastery from 59% to 94%, and enhanced the achievement of learning objectives from 67% to 100%. These findings confirm that contextual learning activities embedded in the developed worksheet successfully support students' understanding of mathematical concepts and problem-solving processes. Therefore, the developed worksheet is recommended as an alternative learning resource for improving mathematics learning outcomes in junior secondary schools.

BIBLIOGRAPHY

Afifah, I. N., Sudargo, S., & Prasetyowati, D. (2019). Efektivitas Model Problem Based Learning dan Think Talk Write terhadap Kemampuan Pemecahan Masalah Matematika Siswa SMP. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *1*(5). https://doi.org/10.26877/imajiner.v1i5.4462

Abdurrahman, M. (2010). *Pendidikan bagi anak berkesulitan belajar*. Rineka Cipta.

Astra, I. M., Nasbey, H., & Muharramah, F. (2015). Development of student worksheet using guided inquiry learning model. *Journal of Education and Practice, 6*(8), 195–203.

Gravemeijer, K. (1994). *Developing realistic mathematics education*. Utrecht University.

Hadijah, S., & Surya, E. (2016). Analysis of students' difficulties in solving mathematical problems. *International Journal of Sciences: Basic and Applied Research, 27*(1), 191–200.

Harahap, M. S., & Surya, E. (2017). The effect of realistic mathematics education approach on students' problem-solving ability. *International Journal of Sciences: Basic and Applied Research, 33*(2), 34–44.

Hudojo, H. (2005). *Pengembangan kurikulum dan pembelajaran matematika*. UM Press.

Kilpatrick, J., Swafford, J., & Findell, B. (2001). *Adding it up: Helping children learn mathematics*. National Academy Press. https://doi.org/10.17226/9822

Lestari, K. E., Afri, L. E., & Richardo, R. (2016). The effect of realistic mathematics education approach. *Journal on Mathematics Education, 7*(2), 123–134. https://doi.org/10.22342/jme.7.2.3531.123-134

Marsigit. (2016). *Pembelajaran matematika berbasis realistik*. Universitas Negeri Yogyakarta.

NCTM. (2000). *Principles and standards for school mathematics*. National Council of Teachers of Mathematics.

OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Pimta, S., Tayruakham, S., & Nuangchalerm, P. (2009). Factors influencing mathematical problem-solving ability. *Journal of Social Sciences, 5*(4), 381–385. https://doi.org/10.3844/jssp.2009.381.385

Polya, G. (1973). *How to solve it* (2nd ed.). Princeton University Press.

Putranto, H., & Dhoruri, A. (2016). Development of student worksheets in mathematics learning. *International Journal of Evaluation and Research in Education, 5*(3), 205–212.

Rusman. (2014). *Model-model pembelajaran: Mengembangkan profesionalisme guru*. Raja Grafindo Persada.

Skemp, R. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching, 77*, 20–26.

Stacey, K., & MacGregor, M. (2001). Curriculum reform and approaches to algebra. *Mathematics Education Research Journal, 13*(1), 3–18. https://doi.org/10.1007/BF03217101

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children*. Indiana University.

Trianto. (2009). *Mendesain model pembelajaran inovatif-progresif*. Kencana.

Zulyadaini. (2017). Development of student worksheets based on realistic mathematics education. *Journal of Mathematics Education, 8*(1), 45–56.