Jurnal Teknologi Pendidikan:
Jurnal Penelitian dan Pengembangan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jtp/index

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

Development of Problem-Based Mathematical Learning Tools to Improve Critical Thinking Skills of Grade V Elementary School Students

Riska Wahyu Hidayati*, Tatag Yuli Eko Siswono, Sendi
Magister Pendidikan Dasar, Pascasarjana, Universitas Terbuka
*Email Corresponding: riskawahyu.h@gmail.com

Abstract: The aims of this study is to describe the feasibility of learning tools that include valid, practical, and effective, and describe the increase in students' critical thinking skills after using problem-based mathematics learning tools. This research is a development research developed with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The learning tools developed in this study are the Learning Implementation Plan, teaching materials, Student Activity Sheets and evaluation. While the learning model used in this study is the Problem Based Learning (PBL) model. The results of the study show that the developed learning device is feasible, in terms of validity it meets very valid criteria with a score of 89%. The learning device developed in terms of practicality meets the very practical criteria with an average student response score of 88%. The learning tools developed in terms of effectiveness meet the criteria of being effective with an average grade completeness score of 87. Students' critical thinking skills increased after using the PBL model learning tool, indicated by a significance value of 0.000 (less than $\alpha = 0.05$). It can be concluded that problem-based mathematics learning tools can improve the critical thinking skills of fifth grade elementary school students.

Article History
Received: 15-07-2023
Reviewed: 22-07-2023
Published:25-07-2023

Key Words
Development of learning tools, Problem Based Learning , Critical thinking skill

How to Cite: Wahyu, R., Siswono, T., & Sendi, S. (2023). Development of Problem-Based Mathematical Learning Tools to Improve Critical Thinking Skills of Grade V Elementary School Students. Jurnal Teknologi Pendidikan : Jurnal Penelitian dan Pengembangan Pembelajaran, 8(3), 707-713. doi:https://doi.org/10.33394/jtp.v8i3.8625
https://doi.org/10.33394/jtp.v8i2.8625

Introduction

Critical thinking ability is one of the abilities that students must have in solving various problems. Critical thinking is one of the abilities that must be built to face the demands of the 21st century (Tanjung & Nababan, 2018). Targeted learning in the 21st century is learning that can design students to be active, creative, critical and fun so that meaningful learning will be created (Azizah et al., 2018). Critical thinking is included in one of the higher order thinking skills (High Order Thinking Skill). With higher-order thinking skills, students can assess evidence, use logic, and look for ideas to solve something. Critical thinking skills are also considered very important because they can support students in decision making, assessment, and problem solving. By having this ability, students can study problems systematically, formulate questions, then design solutions (Tanjung & Nababan, 2018).

Learning mathematics can train students to think critically. Mathematics aims not only to make students able to use mathematics theoretically, but also to be able to apply it and have the ability to reason logically and critically in solving problems (Effendi et al., 2021). This is supported by the statement that mathematics education does not only act as an educational provision that educates students, but can also shape students' character, especially

Jurnal Teknologi Pendidikan:
Jurnal Penelitian dan Pengembangan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jtp/index

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

the character of critical and creative thinking. These characters do not just appear naturally, but need to be taught and designed from the elementary school level (Siswono, 2016).

Critical thinking has stages according to experts. In assessing critical thinking skills, indicators are needed to observe and analyze student learning outcomes. Glaser in Siswono (2018) describes indicators of critical thinking, namely: 1) recognize problems, 2) find ways that can be used to deal with these problems, 3) collect and compile the necessary information, 4) recognize assumptions and values that are not stated, 5) understand and use precise, clear, and distinctive language, 6) analyze data, 7) recognize that there is a logical relationship between problems, 8) draw conclusions and the necessary similarities. Meanwhile, indicators of critical thinking according to Facione in Filsaime (2008) are: 1) interpretation, 2) analysis, 3) evaluation 4) inference, 5) explanation 6) self-regulation. In this study researchers used 4 indicators of critical thinking. Refers to the indicators of critical thinking ability used from Facione, but only uses four indicators with consideration of adjusting the abilities and characteristics of fifth grade elementary school students. The indicators of critical thinking ability used are: 1) interpretation, 2) analysis, 3) evaluation, 4) inference. Interpretation means being able to write down what is known and asked questions clearly and precisely. Analysis (analysis) means being able to write down the relationships between concepts used in solving problems, being able to write down what must be done in solving problems. Evaluation (evaluation) can write down problem solving using the right and correct strategy in doing calculations. Inference (inference) means being able to draw conclusions from what is asked logically, can surmise other alternatives.

At the time of observing mathematics learning material on the volume of space in class V SDN Bendungan, it was found that students' critical thinking skills were still low. This can be seen in the students' answers to the problem solving description questions, students should write down the stages in solving the problem, but there are students who immediately answer with short answers without any stages of the method and the answers are not correct. The following is an example of student work that has not shown critical thinking.

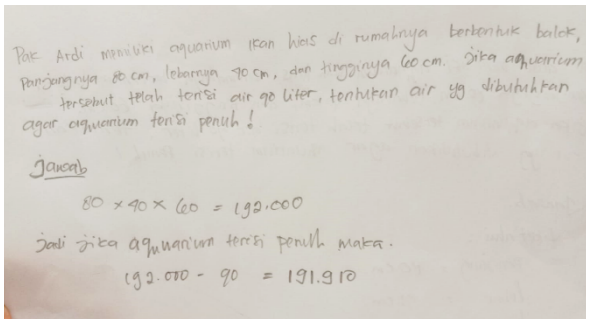

Figure 1. Student Work Results

In Figure 1 it can be analyzed that the student did not carry out the interpretation stage, the student should have written down what was known and asked the questions to describe the problem given. In addition, these students also did not carry out the analysis, because they had not connected the concepts used in solving the problem. It can be seen that students immediately subtracted, they should have changed from cm3 units to liters first. The stages of the evaluation become inaccurate because the analysis is inaccurate, even though the calculation method is correct. The inference stage is not quite right, it should make a final conclusion in the form of the sentence "so the water needed to fill the aquarium is 102 liters".

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

Based on the problems that occur, it can be analyzed that students have not been able to understand the problems in the questions, so they do not know how to solve them and are also not right in analyzing solving problems. It can be said that students' critical thinking skills have not developed well, because they have not met the indicators of critical thinking skills, especially interpretation, where students should be able to describe the problems given in order to do problem solving. Glaser in Siswono (2016), that one indicator of critical thinking is that students can recognize problems and then find ways that can be used to deal with these problems.

Based on the results of interviews with students, it was found that students had difficulty working on questions that were mostly problem-solving analysis questions. The lack of students' ability to think critically in solving problems can be analyzed that this is a possible factor causing these difficulties. When viewed from the results of student work, it can be analyzed that not all students carry out the stages of interpretation, analysis, evaluation, and inference. In addition, teachers have not been accustomed to inviting students to study at the higher-level thinking stage, relying on routine practice questions in textbooks, and are more dominant in giving low-level questions. In addition, the learning patterns that still tend to be teacher centered learning, namely the teacher being the center of learning makes students not actively involved in arguing. Learning mathematics like this is known as conventional learning. Teachers also have never developed learning tools that can trigger students to practice critical thinking in learning mathematics.

Critical thinking skills are needed by students to better understand learning mathematics. Students assume that mathematics is more difficult than other subjects. Most students experience difficulties in applying mathematics contextually. When learning mathematics should be associated with everyday experiences so that students understand it more easily (Gazali, 2016). As with the goals of developing the 2013 curriculum in Indonesia, there is a change in the paradigm of learning mathematics, where students are initially told, then students find out. The assessment process is from output-based to process-based and output-based. Besides that, it also balances soft skills and hard skills, where one of the hard skills demanded in the 2013 curriculum is the ability to think critically (Siagian, 2019).

Learning mathematics will be effective if students are actively involved in meaningful tasks. If students are actively involved in learning, it can increase the opportunity to learn within themselves so as to improve the students' thinking skills. One way to facilitate students to actively participate in learning mathematics is to use the Problem Based Learning (PBM) model. Problem Based Learning Model (PBM) can train students to think critically. Problem-Based Learning (PBM) can encourage students not only to think simply or concretely, but also to train them to think about ideas that are abstract and more complex (Maryati, 2018). Critical level thinking skills can be trained to students with a problem solving approach.

To be able to apply Problem Based Learning (PBM) properly, teachers need to develop good learning tools. Developing learning tools is one of the professional competencies that must be possessed by teachers. In Law No. 14 of 2004 concerning Teachers and Lecturers article 10 paragraph 1, it is stated that teacher competence includes pedagogical competence, personal competence, social competence, and professional competence. With this professional competence, a teacher has an obligation to compile and develop learning tools in a complete and systematic manner so that they can motivate students to learn actively. Teachers as educators have the task of facilitating students in improving critical thinking skills, one way is by designing problem-based learning tools. This

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

learning tool consists of a Learning Implementation Plan (RPP), teaching materials, Student Activity Sheets (LKPD), and evaluation instruments. By compiling appropriate learning tools, it can help students understand concepts, train critical thinking skills such as preparing, experimenting, observing, and analyzing data.

Based on the problems described above, the researcher offers a solution by conducting a study entitled "Development of Problem-Based Mathematics Learning Tools to Improve Critical Thinking Skills of Class V Elementary School Students". The purpose of this study is to describe the feasibility of learning tools that include valid, practical, and effective, and to describe the increase in students' critical thinking skills after using problem-based mathematics learning tools.

Research Methods

This research method uses Research and Development (RnD) with the research and development model used in the form of the ADDIE model. ADDIE stands for Analysis, Design, Development, Implementation, Evaluation. This model was developed by Dick and Carry in 1996. Mulyatiningsih (2016) explains that the ADDIE development model is a model used to develop media, teaching materials, learning models and learning strategies.

The development research object used is a problem-based learning tool to improve critical thinking skills. While the research subjects were material experts, media experts, practitioner experts, 26 fifth grade students at Bakalanrayung Elementary School as a trial class, and 34 fifth grade students at Bendungan Elementary School as a research class. The research instruments were validation sheets, observation sheets, and interview guidelines, practicality questionnaires, documentation, test instruments.

The learning device validation sheet instruments include lesson plan validation, teaching material validation, LKPD validation, and evaluation item validation containing indicators that correspond to the validation grid that will be assessed by expert validators. This instrument is equipped with a score column for each indicator. The score criteria given are: very bad (score 1), not good (score 2), not good (score 3), good (score 4), very good (score 5). The observation sheet is an instrument used to observe students' critical thinking skills during the learning process. This observation sheet is compiled based on critical thinking indicators which include interpretation, analysis, evaluation, inference.

There are 2 data analysis methods used in development research, namely techniques, namely qualitative and quantitative (Statistical Test). Qualitative analysis was carried out through interview descriptions, validation descriptions, student response descriptions, and descriptions of students' critical thinking abilities based on critical thinking indicators. While quantitative analysis techniques were carried out to analyze the results of material expert validation, media expert validation, student response questionnaires and also used statistical tests T-test and N-Gain test to determine student learning outcomes.

Research Results and Discussion

The feasibility of problem-based mathematics learning tools to improve critical thinking skills in terms of validity, effectiveness, and practicality. RPP was declared valid 84%, teaching materials and worksheets were declared by material experts to be very valid 92%, media experts were very valid 94%, linguists were very valid 87%, and evaluation questions were declared valid 84%. In line with research conducted by (Arifin, 2017) that the instrument has a very important role because with the existence of an instrument the quality of a research can be known. If the instrument made has good criteria, the quality of the

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

research is also good. In testing the validity, the higher the validity value, the more precise the data obtained. So that the quality of the research instrument determines the research results to be achieved (Fitri, 2017).

Practical is a category stated by the results of the questionnaire analysis that the developed problem-based mathematics learning tools are easy to apply in the learning process based on the practical instruments that have been formulated. According to the results of student responses in the trial class by 94% and the research class by 88%. The teacher also gave a positive response after implementing problem-based learning. Teachers feel happy because the device can help students think critically in solving problem solving questions. So that student learning outcomes increase and learning objectives are achieved. The students were also more enthusiastic, because the teaching materials used were more interesting, and they were equipped with LKPD which contained practical activities for calculating water debits through the water bottle experiment. Learning activities are more meaningful for students.

In line with research (Ramadhani, 2016) that learning devices are said to be practical if students give responses that are in the good category. In addition, research conducted by (Rasyid et al., 2016) explains that learning media is said to be practical because students give positive responses.

The learning device is said to be effective if the results of the student's passing test reach the Minimum Completeness Criteria (KKM = 75) after applying the problem-based mathematics learning device. In this study, the problem-based mathematics learning tool for improving the critical thinking skills of fifth grade elementary school students could be declared effective, according to the average grade for achieving completeness during the post test in the trial class of 86 and in the research class of 87. In the test class try there are 7 out of 26 students who do not complete, and there are 19 students out of 26 students who pass. The lowest score was in the trial class of 54 and the highest score was 100. While in the research class there were 5 out of 34 students who did not complete, and there were 29 students who passed. The lowest score in the research class is 58 and the highest score is 100. In line with research conducted by (Lubis, 2020) that Problem Based Learning learning tools are effectively used to improve students' critical thinking skills. Supported by research conducted by (Tanjung & Nababan, 2018) that the learning tools developed oriented to the Problem Based Learning (PBM) model meet the criteria of being effective. This is indicated by the individual and classical learning mastery of the students being fulfilled.

The improvement in critical thinking skills of fifth grade elementary school students after using problem-based learning tools in this study can be seen from the results of the pre-test, post-test, T-test and N-Gain. The average critical thinking ability of the test class students during the pre-test was 59 and included in the sufficient criteria. Then it experienced an increase during the post test of 86 and was very good. While in the research class, the average critical thinking ability during the pre-test was 55 and included in the sufficient criteria. Then it experienced an increase during the post test of 87 and was very good. Based on the statistical analysis of the T-Test and N-Gain, it can be concluded that there is an increase in the critical thinking skills of fifth grade elementary school students after using problem-based learning tools. The N-Gain result in the trial class was 0.6 (moderate) or 61% (quite effective). Whereas in the research class it was 0.7 (moderate) or 75% (quite effective).

Critical thinking is manipulating or managing and transforming information in memory. This is usually done to form concepts, reason and think critically, make decisions, think creatively, and solve problems Wahyudi (2019). So that the ability to think critically

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

can facilitate students in the process of solving mathematical problems. According to Robert Duron in Wahyudi (2019), critical thinking can be defined as the ability to analyze and evaluate information (the ability to make analysis and evaluate data or information).

In this study, the critical thinking ability referred to is the ability of students to analyze problems and provide interpretations of the solutions obtained. In addition, students are also able to evaluate opinions that are appropriate for solving mathematical problems. The way to find out students' critical thinking skills is by analyzing the answers to the evaluation questions being worked on. The answers were analyzed using critical thinking indicators. According to Glaser in Siswono (2018) indicators of critical thinking are described, namely: 1) recognizing problems, 2) finding ways that can be used to deal with these problems, 3) collecting and compiling the necessary information, 4) recognizing assumptions and unstated values, 5) understand and use precise, clear, and distinctive language, 6) analyze data, 7) recognize that there is a logical relationship between problems, 8) draw conclusions and the necessary similarities. In this study using indicators according to Fasione which are then summarized into interpretations, analysis, evaluations, inferences that are adapted to the character of elementary school students.

Conclusion

Based on the results of data analysis and discussion of the results of development research, it can be concluded that problem-based learning tools to improve critical thinking skills of fifth grade elementary school students are declared suitable for use, in terms of: a) their validity, that is, lesson plans are declared valid, teaching materials and LKPD are declared by material experts very valid, media experts are very valid, linguists are very valid, and the evaluation questions are declared valid, b) the practicality of problem-based mathematics learning tools to improve critical thinking skills of fifth grade elementary school students can be stated to be very practical according to the results of student response questionnaires, c) the effectiveness of the tools problem-based mathematics learning to improve critical thinking skills of fifth grade elementary school students can be declared effective, according to the class average score above the KKM at the time of the post test. The improvement in critical thinking skills of fifth grade elementary school students after using problem-based learning tools can be seen from the results of the pre-test, post-test, T-test and N-Gain. The average critical thinking skills at the time of the pre-test included sufficient criteria. Then it experienced an increase during the post test, including very well. Based on the statistical analysis of the T-Test and N-Gain, it can be concluded that there is an increase in the critical thinking skills of fifth grade elementary school students after using problem-based learning tools. The N-Gain results in the experimental class and the research class are in the moderate category.

Suggestion

Future research is expected to develop Problem-Based Learning (PBM) tools in other fields of study, and more extensive experimental research is needed to improve students' critical thinking skills.

References

Arifin, Z. (2017). Kriteria Instrumen Dalam Suatu Penelitian. *Jurnal Theorems (the Original Research of Mathematics)*, *2*(1), 28–36.

Azizah, M., Sulianto, J., & Cintang, N. (2018). Analisis Keterampilan Berpikir Kritis Siswa

July 2023 Vol. 8 No. 3
E-ISSN: 2656-1417
P-ISSN: 2503-0602
pp. 707-713

Sekolah Dasar Pada Pembelajaran Matematika Kurikulum 2013. *Jurnal Penelitian Pendidikan*, *35*, 61–70.

Effendi, R., Herpratiwi, H., & Sutiarso, S. (2021). Pengembangan LKPD Matematika Berbasis Problem Based Learning di Sekolah Dasar. *Jurnal Basicedu*, *5*(2), 920–929. https://doi.org/10.31004/basicedu.v5i2.846

Fitri. (2017). Analisis Validitas dan Reliabilitas Instrumen Kinerja Akuntan Menggunakan Pendekatan Rasch Model. *Jurnal Ilmiah Akuntansi Peradaban*, *3*(1), 34–45.

Gazali, R. Y. (2016). Pembelajaran matematika yang bermakna. *Math Didactic: Jurnal Pendidikan Matematika*, *2*(3), 181–190. https://doi.org/10.33654/math.v2i3.47

Lubis, W. I. Y., & Molliq, Y. (2020). Pengembangan Perangkat Pembelajaran Matematika Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Self Efficacy Siswa Dengan Menggunakan Model Problem Based Learning Di Sma Sultan Iskandar Muda T.a 2017/2018. *Paradikma: Jurnal Pendidikan Matematika*, *13*(2), 54–60. https://doi.org/10.24114/paradikma.v13i3.22917

Maryati, I. (2018). Penerapan Model Pembelajaran Berbasis Masalah Pada Materi Pola Bilangan Di Kelas Vii Sekolah Menengah Pertama. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(1), 63–74. https://doi.org/10.31980/mosharafa.v7i1.342

Mulyatingsih, E. (2016). *Pengembangan Model Pembelajaran*

Ramadhani, R. (2016). Pengembangan Perangkat Pembelajaran Matematika yang Berorientasi pada Model Problem Based Learning. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *7*(2), 116–122. https://doi.org/10.15294/kreano.v7i2.7300

Rasyid, M., Asmawati Azis, A., Rahmat Saleh, A., Jurusan Biologi, M., Mipa, fakultas, Negeri Makassar, U., Jurusan Biologi, D., & Negeri Makassar Prangtambung Jl Daeng Tata Raya No, U. (2016). Pengembangan Media Pembelajaran Berbasis Multimedia Dalam Konsep Sistem Indera Pada Siswa Kelas Xi Sma. *Jurnal Pendidikan Biologi*, *7*(2), 69–80.

Siagian, R. (2019). Pengembangan Matematika Berorientasi Model Pembelajaran Belajar Siswa. *Jurnal Penelitian Bidang Pendidikan*, *25*(2), 68-78,.

Siswono, T. Y. E. (2016). Berpikir Kritis dan Berpikir Kreatif sebagai Fokus Pembelajaran Matematika. *Seminar Nasional Matematika Dan Pendidikan Matematika (Senatik 1)*, 11–26.

Tanjung, & Nababan, S. A. (2018). Pengembangan Perangkat Pembelajaran Matematika Berorientasi Model Pembelajaran Berbasis Masalah (PBM) untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sma Se-Kuala Nagan Raya Aceh. *Genta Mulia*, *9*(2), 56–70.

