Jurnal Perspektif
Vol. 9 No. 1 Mei 2025
Page 81-92

Development of Mathematics Learning Devices Based on Problem Based Learning Integrated with STEM to Improve Critical Thinking Abilities and Mathematical Communication Abilities

Rizkiyan Hadi[1], Hamidah Nasution[2], Asmin[3]

[1,2,3] *Postgraduate Mathematics Education Study Program, Medan State University*
Jl. William Iskandar Ps. V, Kenangan Baru, Deli Serdang, Sumatera Utara, Indonesia

[*] rizkiyanhadi8897@gmail.com

Received: 10 Januari 2025 ; Accepted: 24 Februari 2025 ; Published: 07 Maret 2025

DOI: http://dx.doi.org/10.15575/jp.v9i1.340

Abstrak

Penelitian ini bertujuan untuk:Mendeskripsikan kevalidan, kepraktisan, keefektifan perangkat pembelajaran matematika berbasis problem based learning terpadu STEM untuk meningkatkan kemampuan berpikir kritis dan kemampuan komunikasi matematis siswa; Mendeskripsikan peningkatan kemampuan berpikir kritis dan kemampuan komunikasi matematis siswa setelah belajar dengan perangkat pembelajaran matematika berbasis problem based learning terpadu STEM. Metode penelitian merupakan penelitian pengembangan dengan menggunakan model ADDIE. Penelitian ini dilaksanakan di kelas VII semester I T.A 2024/2025. Hasil penelitian ini diperoleh bahwa:LKPD model problem based learning berbasis STEM yang dikembangkan dinyatakan sudah valid,praktis dan efektif; Peningkatan kemampuan berpikir kritis dan kemampuan komunikasi matematis siswa kelas VII MTs Riyadhussholihin melalui LKPD berbasis PBL yang dikembangkan dinyatakan meningkat dari uji coba I ke uji coba II dilihat dari N-Gain. Pada uji coba I, Pada uji coba II, peningkatan kemampuan berpikir kritis dan kemampuan komunikasi matematis siswa matematis sebesar 0,46 dan peningkatan kemandirian belajar siswa sebesar 0,42. Pada uji coba II peningkatan kemampuan berpikir kritis dan kemampuan komunikasi matematis siswa matematis memiliki N-gain yaitu sebesar 0,59 sedang.

Kata Kunci : *Pengembangan, Pembelajaran Berbasis Masalah, Kemampuan Berpikir Kritis, Komunikasi*

Abstract

This study aims to: Describe the validity, practicality, effectiveness of STEM-based integrated problem-based learning mathematics learning devices to improve students' critical thinking skills and mathematical communication skills; Describe the improvement in students' critical thinking skills and mathematical communication skills after studying with STEM-based integrated problem-based learning mathematics learning devices. The research method is a development research using the ADDIE model. This research was conducted in class VII semester I of the 2024/2025 academic year. The results of this study obtained that: the STEM-based problem-based learning model LKPD developed was declared valid, practical and effective; The improvement in critical thinking skills and mathematical communication skills of class VII students of MTs Riyadhussholihin through the PBL-based LKPD developed was stated to have increased from trial I to trial II as seen from the N-Gain. In trial I, In trial II, the increase in critical thinking skills and mathematical communication skills of mathematical students was 0.46 and the increase in student learning independence was 0.42. In the second trial, the increase in

critical thinking skills and mathematical communication skills of mathematical students had an N-gain of 0.59, while.

Keywords : Development, Problem Based Learning, Critical Thinking Skills, Communication.

A. Introduction

Thinking critically and reasoning while making judgments are critical thinking abilities. (Branca, 2017) defines critical thinking as testing, questioning, connecting, and evaluating all parts of a situation or issue. Math demands logic, creativity, spatial thinking, problem solving, and good communication, therefore critical thinking abilities are directly tied to math study. Critical thinking abilities are in Bloom's cognitive dimensions C4, C5, and C6. It seems that Bloom's Taxonomy has been amended to incorporate critical thinking abilities in analysis (C5) and evaluation (C6). Critical thinking helps evaluate new ideas, choose the best ones, and change them for creative tasks. Students also require critical thinking abilities to study, particularly in maths, since they enhance cognitive reasoning (Gibby, 2013). Critical thinking abilities are crucial in mathematics because students learn to weigh issues, pick facts from views, and act on analysis. Teachers must provide curriculum that fosters critical thinking in kids.

Thus, instructors must prepare for kids' critical thinking growth to empower them. Critical thinking is linked to the thought process and its indications. Characteristics of critical thinkers indicate their talents. (Fachrurozi, 2021) lists interpretation, analysis, assessment, and inference as critical thinking signs. Students must comprehend and communicate a problem's purpose for the interpretation indication.

Understanding and application are fundamental thinking capabilities, whereas reasoning is high-level. The TIMSS found that Indonesian pupils' critical thinking abilities are inadequate (Helmawati, 2019). (Nurdyansyah & Aini, 2020) found that 43.01% of class X SMA students had poor thinking skills. In addition, (Wahyuni, 2018) found that class IX junior high school pupils in Bekasi Regency had inadequate mathematical critical thinking abilities. MTs Riyadhus Sholihin, a Deli Serdang school, was observed by the researcher. The study observed subject instructors and found that school children are competent at arithmetic understanding but not critical thinking.

Researchers use three indicators of critical thinking ability to assess students' critical thinking: (1) interpretation, where students must understand and express the intent or meaning of a problem; (2) analysis, where students must identify the relationship between various statements, questions, concepts, descriptions, and others; and (3) evaluation, where students must assess the credibility of a source. Researchers' critical thinking ability questions were answered by these kids.

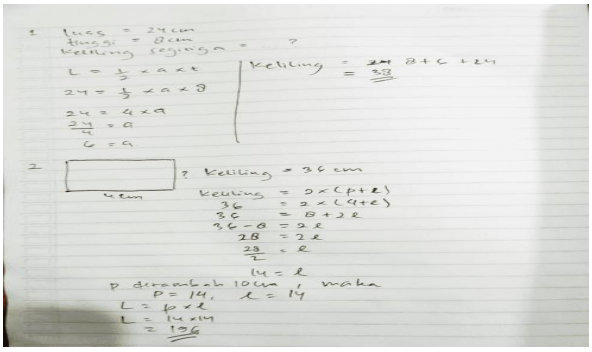

Figure 1. Critical Thinking Ability Test Answers

The teacher's exam results showed that class VII-1's 24 pupils had inadequate critical thinking abilities. Two students (8.33%) scored extremely low in critical thinking abilities, 14 students (58.33%) scored low, 5 students (20.83%) scored medium, and 3 students (12.50%) scored high. The average critical thinking skills scores were: (1) interpretation, where students must understand and express the intent or meaning of a problem; (2) analysis, where students must identify the relationship between statements, questions, concepts, descriptions, and others; and (3) evaluation, where students must assess the credibility of a statement and the truth of a relationship with other statements. The exam results show that pupils' critical thinking abilities are still inadequate. In addition to solving arithmetic problems, students must be able to write and speak about math and make conclusions. One thing students must improve is mathematical communication. Students can communicate mathematical concepts verbally and in writing (Sinaga, R. S. dan Halimah, 2019).

Asikin in (Hendriana, Rohaeti, 2017) states that mathematical communication skills help students sharpen their way of thinking, assess student understanding, organize their mathematical knowledge, build their mathematical knowledge, improve mathematical problem solving skills, advance their reasoning, build self-ability, improve social skills, and establish a mathematical Baroody (Yusdiana, B.I., dan Hidayat, 2018) also emphasized the necessity of mathematical communication abilities, citing two reasons.

Students' mathematical communication skills and talents are used by the researcher to assess critical thinking from the questions: (1) Connecting real objects, images, and diagrams to mathematical ideas; (2) explaining mathematical ideas, situations, and relations orally and in writing with real objects, images, graphs, and algebra; (3) stating everyday events in mathematical language or symbols; (4) listening, discussing, and writing about mathematics; (5) reading written mathematical presentations and formulating Here are some student replies to the researcher's mathematics communication skills questions.

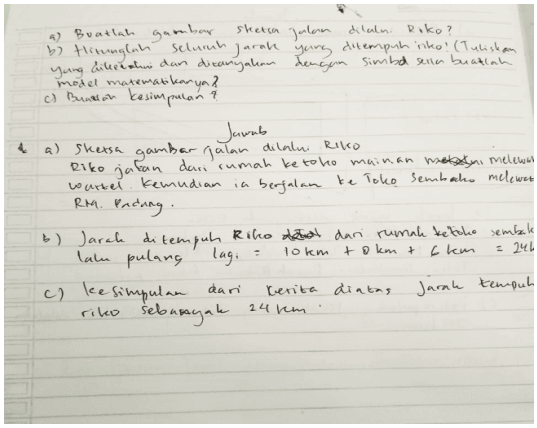

Figure 2. Answers to the Mathematical Communication Ability Test

Students failed to relate the floor plan graphic to arithmetic, as seen by the responses. Students can't represent ordinary occurrences in mathematical language or symbols, hence their mathematical model is incorrect. Students can't link existing facts, thus they make incorrect conclusions. (Daryanto dan Suryatri Darmiatun, 2013) found that low mathematical communication in Junior High Schools (SMP) is caused by teachers still lecturing to students, so students' mathematical communication skills are still poor. Lack of student reaction to mathematical communication questions causes low skills. Too much explanation by the instructor also tenseens the classroom. Thus, instructors must understand students' mathematical communication abilities in math lessons. The researcher also interviewed a grade VII mathematics teacher at MTs Riyadhus Sholihin, who confirmed that students' critical thinking and mathematical communication skills, especially in quadrilaterals and triangles, are poor. He said many kids still can't answer quadrilateral and triangular narrative issues because they don't comprehend tale structures. He also remarked that schools have not established STEM-based PBL math learning gadgets, notably for quadrilaterals and triangles.

The foregoing issues need a remedy to enhance students' critical thinking and mathematical communication. Researchers suggest STEM-based PBL-based math learning gadgets. Learning Devices may improve learning efficiency. Teachers may arrange learning using learning gadgets. The STEM-based PBL paradigm is used to develop mathematical learning gadgets to help students build knowledge from daily events and make learning more relevant. The PBL approach, or problem-based learning model in Indonesia, delivers actual issues to students as stimuli. The PBL methodology teaches critical thinking, problem-solving, and knowledge by using real-world challenges. PBL mastering grammar helps boost pupils' critical thinking.

(Lestari, I., Andinny, Y., & Mailizar, 2019) found that Problem-Based Learning improves mathematical communication skills more than conventional learning, in addition to critical thinking. (Fauzi, K.A., & Mukasyaf, 2018) found that problem-based learners had better mathematics communication abilities than traditional learners. Therefore, the PBL learning paradigm may increase students' critical thinking and mathematical communication. STEM was

used to construct this math learning tool. The STEM learning method stresses problem-solving using science, technology, engineering, and math.

STEM is one of the disciplines that are closely related to each other. In practice, the STEM approach is known as the relationship between sciences or the relationship between several disciplines into one which can be interpreted as multidisciplinary integration. In the relationship between these disciplines, there will be a combination of interrelated materials. Multidisciplinary integration is a term used in the combination of materials where science requires mathematics as a tool in processing data, while technology and engineering are applications of science. According to (Lestari, 2022) STEM learning can help students solve problems and draw conclusions from previous learning by applying them through science, technology, engineering, and mathematics.

According to (Nana Laode Sukmadinata, 2018) learning using STEM can be integrated with flexible learning models, one of which is the PBL Learning model, which can grow students' knowledge and be able to create solutions in solving problems that change rapidly in the future. The development of Mathematics Learning Teaching Aids using the STEM-based PBL model is expected to improve students' critical thinking skills and mathematical communication skills. From the background of the problem, the researcher intends to conduct a study entitled "Development of Mathematics Learning Tools Using STEM-Based Problem Based Learning (PBL) Model to Improve Critical Thinking Skills and Mathematical Communication Skills of MTs Riyhadus Sholihin Students".

B. Research Method

Utilizing the ADDIE approach, this study is included into the research and development research that is being conducted. The ADDIE model is comprised of five distinct stages, which are as follows: (1) Analysis; (2) Design; (3) Development; (4) Implementation; and (5) Evaluation or Assessment (Sugiyono, 2018). The reason for choosing the ADDIE development model is that this development model is simple and systematic in its procedures. This model provides an opportunity to make continuous revisions and evaluations in each stage or phase that is passed, so that the resulting product becomes a valid product. Through the application of the STEM-based PBL approach, this project is concentrating on the development of mathematical learning aids. To increase students' critical thinking abilities and mathematical communication skills in flat form material, the goal of this project is to construct mathematical learning tools utilizing the STEM-based PBL paradigm. These tools will be used to communicate mathematical concepts to students. An investigation of this kind was carried out in the seventh grade at MTs Riyadhus Sholihin. It was during the second semester of the 2024/2025 academic year that the research was carried out, and the material that was collected

for this study consisted of flat forms that were being taught during that semester in the produced curriculum.

Because the researcher had never before performed study at this school on the creation of learning tools using the STEM-based PBL paradigm to increase students' critical thinking abilities and mathematics communication skills, the researcher decided to conduct the research at this particular school. During the academic year 2024/2025, the participants in this research were pupils who were enrolled in the seventh grade at MTs Riyadhus Sholihin. The development of mathematics learning devices that are based on a STEM-based problem-based learning methodology is the purpose of this research project.

C. Result and Discussion

Where at the development stage of the mathematics learning device is validated and revised by validators and assessments from subject teachers and trials to students through small group trials and field trials. This type of research is research and development. The model used is the ADDIE model which consists of several steps, namely Analysis, Design, Development, Implementation and Evaluation. Data analysis and research results obtained at each stage of development are presented as follows.

Analysis

Observations of MTs Riyadhussholihin's mathematics learning devices revealed numerous shortcomings in instructors' teaching materials that indirectly improved students' critical thinking and mathematical communication abilities. The LKPD used did not refer to the learning model listed, teachers still implemented Teacher Centred Learning (teacher-centered learning) and did not adjust clear time allocations for each process, and the problems given in assessing learning outcomes did not support students' critical thinking and mathematical communication skills. This makes it hard for children to articulate innovative ideas and makes them rely on instructors to solve arithmetic issues. Students don't feel pushed to think further. Academically, MTs Riyadhussholihin pupils do poorly. An interview with one of MTs Riyadhussholihin's mathematics teachers said that last year's class VII final exam results were still lacking because not all students reached the KKM (75), then the learning process continued as usual, the teacher explained the material, the students listened, and the teacher gave practice questions in the student's book.

Design

At this stage, an initial design is produced in the form of RPP, Student Activity Sheets (LKPD), critical thinking ability tests and students' mathematical communication skills, scoring guidelines, and answer keys. All the results of this design stage are then referred to as draft I.

Develop

The validators who validated the developed learning devices consisted of 5 people, including 3 UNIMED mathematics education lecturers, 2 teachers from Gajah Mada Middle School, Medan.

Table 1. Recapitulation of Learning Device Validation Results by Experts

No	Objects being assessed	Average total validation value	Validation Level
1.	Lesson Implementation Plan	4,40	Valid
2.	Student Worksheet (LKPD)	4,32	Valid
3.	Critical Thinking Ability Test	4,20	Valid
4.	Student Communication Ability Test	4,40	Valid

Based on the Table 1, the average total validity of the learning device is in the interval: $3 \leq Va < 4$. Based on the validity criteria, it can be said that the learning device developed is "Valid". Based on the learning implementation criteria, it can be concluded that the implementation of the learning device at the first meeting has a learning implementation level at the IO = 4.5, high criteria ($4 \leq IP < 5$). In general, in this Trial, it has a learning implementation level of IO = 4.5, high. Thus, the learning device has met the practical criteria empirically.

Implementation

Description of Trial Results I

In this study, the students' learning completeness is reviewed from the students' Critical Thinking Ability and mathematical communication ability of the students which are tested using a test that has been developed in the form of an essay. The results of the Critical Thinking Ability and Mathematical Communication Ability Test of Students Trial I. posttest results If categorized based on the level of critical thinking ability and mathematical communication ability of mathematical students, the level of critical thinking ability and mathematical communication ability of mathematical students can be seen in table 2.

Table 2. Level of Critical Thinking Ability and Mathematical Communication Ability of Students Mathematical Students Posttest Results of Trial I

No	Value Interval	Students' critical thinking skills and mathematical communication skills		Information
		Number of Students	Persentase (%)	
1	$90 < x \leq 100$	1	3,13	Very high
2	$80 < x \leq 90$	11	34,38	Tall
3	$70 < x \leq 80$	13	40,63	Currently
4	$60 < x \leq 70$	3	9,38	Low
5	$x \leq 60$	4	12,50	Very Low

Based on Table 2 above, in the posttest 4 students (12.50%) obtained the very low category, 3 students (9.38%) obtained the low category, 14 students (40.63%) obtained the medium category, 11 students (34.38%) obtained the high category and 1 student (3.13%) obtained the very high category. The improvement of Critical Thinking Ability and mathematical communication ability of mathematical students in trial I will be seen through N-Gain from the pretest and posttest results of Critical Thinking Ability and mathematical communication ability of mathematical students in trial I. The results of the N-Gain calculation are presented in appendix 26. A summary of the results of N-Gain Critical Thinking Ability and mathematical communication ability of mathematical students in trial I can be seen in table 3 below:

Table 3. Summary of N-Gain Results of Critical Thinking Ability and Mathematical Communication Ability of Mathematical Students in Trial I

Skor *N-Gain*	N-Gain Criterion	Number of Students
$0{,}00 < N - Gain \leq 0{,}30$	Low	5
$0{,}30 < N - Gain \leq 0{,}70$	Medium	27
$N - Gain > 0{,}70$	High	0

The average N-Gain value of 0.46 if interpreted into the classification that has been described in Chapter III, then the total increase in Critical Thinking Ability and mathematical communication ability of mathematical students in trial I obtained is in the "moderate" category or with an N-Gain percentage of 46%.

Description of Trial Results II

The posttest results are categorized based on the level of students' critical thinking skills and mathematical communication skills, the level of students' critical thinking skills and mathematical communication skills can be seen in table 4.

Table 4. Level of Critical Thinking Ability and Mathematical Communication Ability of Students Mathematical Students Results of Posttest Trial II

No	Value Interval	Critical thinking skills and mathematical communication skills of students Mathematics		Description
		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 obtained a very low category (0%), 2 students (6.25%) obtained a low category, 15 students (46.88%) obtained a medium category, 11 students (34.48%) obtained a high category and 4 students (12.50%) obtained a very high category. N-Gain from pretest and posttest findings of trial II mathematics students' Critical Thinking

Ability and mathematical communication ability will show improvement. Appendix 27 shows N-Gain findings. Table 5 shows the Summary Results of N-Gain Critical Thinking skills and mathematical communication skills of trial II math students:

Table 5 Results of N-Gain Critical Thinking Ability and Mathematical Communication Ability of Students in Trial II

Skor *N-Gain*	N-Gain Criterion	Number of Students
$0{,}00 < N - Gain \leq 0{,}30$	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 Critical Thinking Ability and mathematical communication ability of mathematical students 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 Critical Thinking Ability and mathematical communication ability of mathematical students with the "High" category are 1 person. For students who experience an increase in Critical Thinking Ability and mathematical communication ability of mathematical students 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 Critical Thinking Ability and mathematical communication ability of students with the "Low" category. In this study, the aspects of students' Critical Thinking Skills and mathematical communication skills studied consisted of understanding problems, planning problem solving, solving problems and re-checking. In addition to being assessed on average or overall, students' Critical Thinking Skills and mathematical communication skills were also assessed based on their respective indicators. This was done so that it could be analyzed whether there were indicators that were more prominent in students.

Discussion

Learning independence affects students' critical thinking and mathematics communication (Sulistiowati, 2023). Independence allows students to learn on their own, manage their needs, and be responsible for themselves. If this is done consistently, students will not give up on difficult problems and will have a sense of challenge to overcome them (Girsang, R.A.S., Listiani, 2017). This is crucial since students will encounter several challenges during problem-solving. Teachers should investigate student problem-solving behaviour to increase student achievement (Haleva et al., 2021). Related to this, learning independence shows student problem-solving. Further study shows that the built mathematics module helps pupils solve challenges. According to studies, learning freedom might motivate kids to study independently.

Students will be able to control their learning approaches and discover learning materials to solve difficulties more effectively (Zakaria, E & Muzakkir, 2017)

This matches MTs Riyadhussholihin research. LKPD and the problem-based learning approach boost students' critical thinking, mathematics communication, and learning independence in this research. LKPD contains material, example questions, and practice questions, as well as contextual problems described sequentially and clearly at each stage using the problem-based learning model and indicators of students' critical thinking and mathematical communication skills. Khairunnisa, Jamilah & Risalah (2024) found that using LKPD in teaching and learning improves students' critical thinking and mathematics communication abilities. (Ariani, 2017) say this LKPD helps pupils grasp the topic and study independently. STEM-based Problem Based Learning Model LKPD helps students learn independently and improves their Critical Thinking and mathematical communication abilities, making them interested in and motivated to study it (Andayani, F., & Lathifah, 2019). The LKPD has encouraging words and slogans to help MTs Riyadhussholihin kids study independently and overcome arithmetic difficulties.

The increase in students' Critical Thinking Skills, mathematical communication skills, and learning independence in this study is related to the problem-based learning model, which begins with problems. Students must exhibit problem-solving behaviours to succeed in problem-based learning. (Muliza, 2020) listed five characteristics of problem-based learners: (1) Student-centered, meaning students are not passive recipients of information but actively build their own knowledge through investigation and problem solving; (2) Authentic problems presented are relevant to real life so students find it easier to understand and are motivated to find solutions. Students' Critical Thinking and mathematical communication abilities based on Polya's problem solving stage indicators—understanding, planning, implementing, and re-checking can improve with problem-based learning.

D. Conclusion

This research draws numerous findings from its analysis and discussion: MTs Riyadhussholihin class VII pupils may improve their critical thinking and mathematics communication abilities using the STEM-based Problem Based Learning Model LKPD. Teaching module, LKPD, and student worksheet (LKPD) validity average 4.40, 4.48, and 4.47, respectively. MTs Riyadhussholihin class VII pupils may improve their critical thinking and mathematics communication abilities using the STEM-based Problem Based Learning Model LKPD. Practicality is assessed by learning implementation (Ok), which meets the requirements for good implementation with a score of 3.40. 3. The STEM-based Problem Based Learning Model LKPD created improves critical thinking and mathematics communication abilities of MTs Riyadhussholihin class VII pupils. As for efficacy 1) Classical completeness satisfied

criterion at 90.63%. 2) 97.44% of students reported pleasant learning experiences. 4. The N-Gain showed that the PBL-based LKPD created for class VII students of MTs Riyadhussholihin improved their critical thinking and mathematics communication abilities from trial I to trial II. In trials I and II, mathematics students' critical thinking and mathematical communication abilities increased 0.46 and learning independence 0.42. Trial II showed a 0.59 "moderate" boost in mathematics students' Critical Thinking and mathematics Communication abilities.

References

Andayani, F., & Lathifah, A. N. (2019). Analisis kemampuan pemecahan masalah siswa smp dalam menyelesaikan soal pada materi aritmatika sosial. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 3 (1),* 1–10.

Ariani, D. N. (2017). Strategi Peningkatan Kemampuan Komunikasi Matematis Siswa SD/MI. *Muallimuna, 3 No 1*. https://ojs.uniska-bjm.ac.id/index.php/jurnalmuallimuna/article/view/958

Branca, N. . (2017). *Problem Solving as a Goal, Process, and Basic Skill*. NCTM.

Daryanto dan Suryatri Darmiatun. (2013). *Implementasi Pendidikan Karakter di Sekolah*. Gava Media.

Fachrurozi. (2021). Penerapan Pembelajaran Berbasis Masalah Untuk Meningkatkan Kemampuan Berpikir Kritis dan Komunikasi Matematis Siswa Sekolah Dasar. *Forum Penelitian, 1*.

Fauzi, K.A., & Mukasyaf, F. (2018). Lintasan Belajar Kemampuan Pemecahan Masalah dan Berpikir Kritis Matematika Siswa melalui Pendekatan Metakognitif Topik Gsl di SMP Imelda Medan. *Penelitian Bidang Pendidikan, 24 (2)*, 7-14.

Gibby, C. (2013). Critical Thinking Skills in Adult Learners. *Journal ARECLS, 10 (1)*, 147-176.

Girsang, R.A.S., Listiani, T. (2017). Pendekatan Matematika Realistik Indonesia dalam Mengembangkan Kemampuan Disposisi MAtematis Siswa pada Materi Aljabar di Salah Satu SMP di Palembang. *JOHME, 1(2),* 1 – 16.

Helmawati. (2019). *Pembelajaran dan Penilaian Berbasis HOTS*. PT Remaja Rosdakarya.

Hendriana, Rohaeti, S. (2017). *Hard Skills dan Soft Skills Matematik Siswa*. Refika Aditama.

Lestari, I., Andinny, Y., & Mailizar, M. (2019). Pengaruh model pembelajaran situation based learning dan kemandirian belajar terhadap kemampuan pemecahan masalah matematis. *JNPM (Jurnal Nasional Pendidikan Matematika), 3 (1),* 95-108.

Lestari, D. F. (2022). Problematika Implementasi Kurikulum 2013 dalam Pembelajaran Matematika di Tingkat Sekolah. *Jurnal PEKA (Pendidikan Matematika), 6 (1),* 66–76.

Muliza, M. (2020). Analisis Pengaruh Jumlah Penduduk Dan Produk Domestik Regional Bruto

(GRDP) Terhadap Kemiskinan Di Kabupaten Nagan Raya. At-Tasyri'. *Jurnal Ilmiah Prodi Muamalah, 12(1),* 63.

Nana Laode Sukmadinata. (2018). *Metode Penelitian Pendidikan*. PT. Remaja Rosdakarya.

Nurdyansyah, N., & Aini, Q. (2020). Peran Teknologi Pendidikan Pada Mata Pelajaran Matematika Kelas Iii Di Mi Ma'arif Pademonegoro Sukodono. *At-Thullab : Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *1*(1), 124. https://doi.org/10.30736/atl.v1i1.81

Sinaga, R. S. dan Halimah, N. (2019). Pengaruh Model Pembelajaran Koperatif Tipe Stad Terhadap Kemampuan Komunikasi Matematika Siswa Kelas VIII SMP Swasta Palapa Binjai Tahun Pelajaran 2018/2019. *Prosiding Seminar Nasional Multidisiplin Ilmu*, *3*.

Sugiyono. (2018). *Metodologi Penelitian Pendidikan (Pendidikan Kuantitatif, Kualitatif dan R&D)*. Alfabeta.

Sulistiowati, D. L. (2023). Penerapan Model Pembelajaran Math Talk Learning Community Untuk Meningkatkan Kemandirian Belajar Matematika Siswa. FARABI. *Jurnal Matematika Dan Pendidikan Matematika*, *6(2)*, 192-201.

Wahyuni, P. dan F. Y. (2018). Penerapan Pembelajaran Kooperatif Tipe Numbered Heads Together untuk Meningkatkan Kemampuan Komunikasi Matematis dan Self Efficacy Siswa Kelas VIII MTS YKWI Pekan Baru. *Jurnal Ad Math Edu.*, *Vol.8 No.2*, 159:170.

Yusdiana, B.I., dan Hidayat, W. (2018). Analisis Kemampuan Penalaran Matematika Siswa SMA Pada Materi Limit Fungsi. IKIP Siliwangi. *Jurnal Pembelajaran Matematika Inovatif*, *1 No 3*.

Zakaria, E & Muzakkir, S. (2017). The Effect of Realistic Mathematics Education Approach on Students' Achievement And Attitudes Towards Mathematics. *Journal Mathematics Education Trends and Research*, *1*, 32-40.