European Journal of Research Development and Sustainability (EJRDS)
Available Online at: https://www.scholarzest.com
Vol. 5 No 01, January 2024
ISSN: 2660-5570

PROBLEM BASED LEARNING MODEL TO IMPROVE CRITICAL THINKING SKILLS IN LEARNING MATHEMATICS

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Article history:

Received: 20th November 2023
Accepted: 11th December 2023
Published: 20th January 2024

Abstract:

States that one of the main goals of going to school is to form students' critical thinking skills and one of the subjects that is considered to be able to teach critical thinking skills is mathematics. In this study, the researcher acted as a teacher who attempted to carry out learning that focused on problem-based learning models as an effort to improve the mathematical abilities of grade 3 SD GMIM IV Tomohon. The procedures or steps to be carried out in this study are carried out in cycle-shaped activities. Each cycle consists of four main components, namely: 1. Planning (planning), 2. Implementation (action), 3. Observation, and 4. Reflection. Implementation of the Problem Based Learning Model can improve the ability to solve math problems for Grade 3 SD GMIM IV Tomohon, East Tomohon District, Tomohon City. To develop students' thinking skills, students must practice filling in questions with the guidance of the teacher. In addition, teachers can also use something to support learning such as learning media, learning models or approaches in the learning process. The Problem Based Learning (PBL) model in the process of learning mathematics can improve the ability to solve problems critically, and can increase the maximum activity and creativity of students

Keywords: problem based learning, critical thinking, learning mathematics

I. INTRODUCTION

Marzano (Slavin, 2011) states that one of the main goals of going to school is to form students' critical thinking skills and one of the subjects that is considered to be able to teach critical thinking skills is mathematics. Susanto (2015) states that efforts to form students' critical thinking skills optimally require an interactive class, students are seen as thinkers not as teachers, and teachers act as mediators, facilitators and motivators who assist students in learning not teaching. It turned out that Indonesian children were only able to master 30% of the reading material and found it very difficult for them to answer questions in the form of descriptions that required reasoning (Depdiknas, 2007). This is probably because they are very used to memorizing and working on multiple choice questions.

In addition, the results of the study The Third International Mathematic and Science Study Repeat (TIMSS-R, 1999), (IEA, 1999) show that, among the 38 participating countries, grade 2 junior high school student achievement in Indonesia ranks 32nd for Natural Sciences, 3rd 34 for Mathematics. In the world of higher education, according to Asia Week magazine, out of 77 universities in Asia Pacific, it turned out that the 4 best universities in Indonesia were only able to rank 61st, 68th, 73rd and 75th (Sukasmo, 2011).

In the lecture method students listen more often and take notes on what is explained by the teacher so that problem solving skills are low, while learning mathematics requires reasoning and thinking in order to understand the problem. Mastery of mathematical material requires complex thinking skills including critical thinking. The key to learning mathematics in elementary schools is a good understanding of concepts. This is a requirement for students to be able to accept and understand new concepts easily. With a lack of students' understanding of the material presented, it causes learning outcomes to be not optimal and not to achieve learning mastery (Kamarianto, Noviana, Alpusari, 2018).

Seeing this problem, it is necessary to make improvements so that the learning process becomes better so that it can improve the quality of learning, especially mathematics. Learning needs to be designed and implemented according to the characteristics of students. The teacher must create a pleasant learning atmosphere so that it can foster students' interest in participating in learning.

One way that can make students active in the learning process is to apply various learning models (Riswati, Alpusari, Marhadi, 2018). As educators, teachers need to choose the right model to convey a concept to their students. To achieve optimal learning outcomes, the effort that can be made by a teacher is to use an appropriate model in

conveying material to students. A learning model that can help students associate material with real life. The learning model is Problem Based Learning (PBL) or problem-based learning.
Based on the background above, the authors have conducted research with the title "Implementation of the Problem Based Learning (PBL) learning model to improve critical thinking skills in learning mathematics in class III SD GMIM IV Tomohon".

II. RESEARCH METHODS

According to Puri Rawati (Sudikin et al, Nuryani 2004) that Classroom Action Research (CAR) is able to offer new ways and procedures in an effort to improve and enhance teacher professionalism in an effort to improve the quality, process and learning products in the classroom.

Paying attention to the phenomena that arise around existing problems and proposing research objectives and aspects of the methodological approach that need to be used, this research uses a problem-based learning model in accordance with the problem under study. The application of this research method is used to improve critical thinking skills in the process of learning mathematics.

In this study, the researcher acted as a teacher who attempted to carry out learning that focused on problem-based learning models as an effort to improve the mathematical abilities of grade 3 SD GMIM IV Tomohon.

The procedures or steps to be carried out in this study are carried out in cycle-shaped activities. Each cycle consists of four main components, namely:

1. Planning (planning)
2. Implementation (action)
3. Observation
4. Reflection

The first stage, planning (planning) is planning what actions to take to improve, improve or assist children in solving a problem in learning mathematics. The second stage, implementation (action) is what researchers or teachers have to do in an effort to use improving learning through problem-based learning models to improve student learning outcomes. The third stage, observation, namely observing or the results or impacts of implementation during the learning process with the problem based learning model. The fourth and last stage is reflection, namely the stage of assessment, viewing and considering or the results and processes of each research implementation.

A. Research Model

The research carried out is a cyclic model that is repeated and continuous (spiral), which means that the longer the research is carried out, the more change/achievement of the results will increase. The model is in accordance with what was put forward by Kemmis and Mc. Taggart (Suyanto, 1996:21).
This research model consists of four components, namely: planning, implementation, observation and reflection.

Action Planning Stage
1). Preparing research facilities and infrastructure including requesting permission to conduct research at schools that will be used as research objects, namely the school principal, preparing classrooms for research activities.
2). Conducting observations and interviews with students. The students referred to in this study are focused on class III SD GMIM IV Tomohon. Observations and interviews were carried out to obtain an initial picture of class conditions, attitudes and behavior of students when participating in class learning including observing students' abilities when receiving learning.
3). Identify problems in learning mathematics in class III. After identifying the problem, the researcher then formulates the problem to be studied, namely Fractions. Furthermore, researchers develop learning models that will be carried out in research.
4). Develop a lesson plan for each meeting. What needs to be considered in preparing this plan is to adjust learning activities with the steps of the problem-based learning model that will be used in conducting research.
5). Prepare learning material for fractional numbers according to the problem-based learning model during research.
6). The last step before conducting research is to prepare research instruments which include observation sheets for both students and for teachers or researchers.
Implementation Stage

At this implementation stage, researchers carried out research in class 3 SD GMIM IV Tomohon totaling 29 people with an action plan consisting of two cycles, where in each cycle consisted of four actions that were carried out continuously.
Observation Stage

The observation stage is the most important stage in conducting research. Observations are made to observe every activity carried out by researchers and every activity carried out by the object of research (students). Observation activities carried out also aim to determine whether there is a change in researchers, students and learning when compared to previous actions.
Reflection Stage

This reflection activity is carried out by the researcher together with the observer at the end of each action after the researcher and the observer have analyzed the data collected in each action. Reflection is carried out in order to discuss the results of research so that conclusions can be drawn from the learning outcomes.

B. Research Subjects

The subjects in this study were grade 3 (three) students of GMIM IV Tomohon Elementary School with a total of 29 students consisting of 14 male students and 14 female students taking into account the 2013 Curriculum material on Fractions contained in Thematic Learning Theme 2 Subtheme 4 Class 3.

C. Research Procedures

The research steps carried out are as follows:
Initial Orientation and Observation
a. Carrying out field orientation activities, namely the preliminary study stage before the learning action and observation of mathematics learning activities to find out the initial description of mathematics learning so far.
b. Identify the priority problems faced based on the results of the orientation and observations of researchers.
Planning or Preparation for Action
a. Conduct discussions with the principal and teachers at SD GMIM IV Tomohon
b. Making a learning plan that will be carried out, namely making a Learning Implementation Plan (RPP), Student Worksheets (LKS), observation guidelines, making tools, making assessment instruments used in PTK and making evaluation tools (grid questions, scoring guidelines, rubric of questioning).

Action Implementation

Activities carried out in Cycle I, including:
a. The teacher as a researcher carries out learning in cycle I which uses the application of a problem based learning model and makes observations of students.
b. The teacher analyzes and reflects on the implementation and results of cycle I learning actions. This analysis is carried out by examining and assessing student worksheets. Looking at the results of the observation sheets, the results of cycle I analysis and reflection become material for recommendations and improvements to cycle II action plans if the data obtained has not shown results. which is satisfying.
Activities carried out in cycle II, including:
a. The teacher as a researcher carries out learning in cycle II which uses the application of the problem based learning method and makes observations of students.
b. The teacher analyzes and reflects on the implementation and results of cycle II learning actions. This analysis was carried out by examining and assessing Student Worksheets, looking at the results of the observation sheets. Results of analysis and reflection of cycle II.
Evaluation
Evaluation is carried out during the learning process.

There are two forms of evaluation, namely the process and the final results of learning. Assessment during the learning process is carried out by observing student activities, while the final assessment uses a final test.
Analysis and Reflection
After carrying out learning actions, observations, and evaluation processes, an analysis is carried out which aims to find out weaknesses or deficiencies that occur during the learning process. Then after analyzing, reflection is carried out to improve actions in further learning.

Research Instruments
Data collection technique
Observation

All student activities aimed at identifying them and documenting each indicator of the learning process and learning outcomes achieved both planned and side effects. In this study the type of focused observation, namely the purpose and units of observation that have been determined. This observation focused on student activities, student learning tools and facilities, student-student interaction, and teacher-student interaction prior to the learning process.
Writing test

The test is a question that contains questions related to the learning material that has been submitted to measure students' abilities. The test used is a written test to obtain data and regarding student learning outcomes both in groups and individually.
Data Collection Tools
Observation Guidelines
Observation guidelines are the method used to obtain data about the implementation of learning.
Student Worksheets (LKS)

LKS is a quantitative data collection tool filled in by students with the aim of knowing students' understanding of the material that has been presented. Then this LKS is one of the tools that must be used in conducting learning by applying the Problem Based Learning model, which makes it easier for teachers to carry out learning.

Field Notes

Field notes are written data that contains the findings of all research activities or research objects that occur during learning, where the written data is specific and interesting data or events that have not been included in other instruments that have been made.

DATA ANALYSIS AND PROCESSING

Data analysis

The data obtained based on research instruments that have been made are then analyzed as a test of the formulated actions. Data analysis used in this research is qualitative data analysis and quantitative data analysis. Quantitative analysis to analyze data that shows the process of interaction between teachers and students during learning. The qualitative data were obtained from previous observations and field notes. The data analysis process is adjusted to the first problem formulation, namely the implementation of the Problem Based Learning (PBL) model in learning Mathematics in Grade 3 SD GMIM IV Tomohon?

Data processing

To process the results of this test is done by calculating the total score obtained by students.
The abilities assessed in this study were only limited to students' cognitive abilities.
Value = (Score obtained)/(Maximum score) X 100

With an assessment instrument in the form of a critical thinking rubric.

The critical thinking skills developed in this study are students' ability to identify problems,
With the criteria for critical thinking skills as follows:

Acquisition Scale	Category
81.25 - 100	Very Critical
62.50 – 81.25	Critical
43.75 – 62.50	Less Critical
25.00 – 43.75	Very Less Critical

Indicators of success for indicators of critical thinking skills are in the range of 62.50-81.25, namely critical. If the class has not reached these indicators, the action research is continued in the next cycle. The actions chosen in this cycle are planned based on the reflection results of the actions in the previous cycle.

III. RESEARCH RESULTS AND DISCUSSION

A. Research Results

Classroom action research conducted on class III SD GMIM IV Tomohon, East Tomohon District, Tomohon City. Conducted collaboratively means that between researchers, teachers, and school principals, active participation in working together in research. The process of reflecting on activities between teachers and researchers implements a system of filling each other out and providing input for the improvement of subsequent activities.

The research results were taken from the application of the Problem Based Learning (PBL) learning model to improve mathematical critical thinking skills in grade 3 SD GMIM IV Tomohon. The teaching model is carried out in 2 cycles. Cycle I actions were carried out on Monday 30 January 2023 material "Splits" with a total of 25 people. The implementation of the action is carried out in the form of stages, namely the planning stage, the implementation stage, the observation stage, and the reflection stage.

In the implementation of class action research activities in class III SD GMIM IV Tomohon, East Tomohon District, Tomohon City. Researchers previously conducted interviews with school principals and class teachers as colleagues to find constraints that were not in accordance with the Mathematics learning process.

In an effort to obtain various information, researchers also make observations both inside and outside the classroom, so that they can determine the problem and its solution in a mature manner. The steps taken are (1) to identify the problem, (2) to analyze the problem and formulate the problem (3) to carry out a feasible solution.

Cycle Action Implementation Process

The steps in the implementation of the cycle provide an explanation of the subject matter to be discussed using the lecture, discussion, question and answer method.

Initial activity

Conditioning students in participating in learning, praying, attendance, class arrangement, preparation of tools, learning media.
Core activities
a) Explanation of fractions as a reference for solving mathematical problems.
b) Providing problem solving concepts and clarifying unclear concepts.
c) Provision of Student Worksheets (LKS) in solving problems.
d) Students work on the evaluation individually.
End activities
a) Suggestions for material reinforcement messages.

• Results of Cycle I

For the percentage value of the 5 item description questions totaling 32 points with each question having 16 points. Each point according to the scoring rubric is from 0 – 4 points. These points are based on the scoring rubric of students' mathematical critical thinking skills. After the data is processed and the percentage value is calculated, referring to the model discussed earlier, the ability is calculated according to the percentage value obtained, then it is divided into 4 categories namely very critical, critical, less critical, very less critical. The percentage results obtained by students can be seen:

Score= (Correct number X Score)/(Maximum score) X 100

Very Critical
Score = (Correct number X Score)/(Maximum score) X 100
= (5 X 4)/20 X 100
= 20/20 X 100 = 100

Critical
Score = (Correct number X Score)/(Maximum score) X 100
= (4 X 4)/20 X 100
= 16/20 X 100 = 80

Less Critical
Score = (Correct number X Score)/(Maximum score) X 100
= (3 X 4)/20 X 100
= 12/20 X 100 = 60

Very Less Critical
Score = (Correct number X Score)/(Maximum score) X 100
= (2 X 4)/20 X 100
= 8/20 X 100 = 40
= = 40

Table 4.1 Percentage of Student Answers

No	Criteria for Critical Thinking	Ability Number	Percentage (%)
1	Very Critical	5	20
2	Critical	4	16
3	Less Critical	6	24
4	Very Less Critical	10	40
	Total	25	100

In the table it can be seen that the results of the percentage of student answers are seen in the very critical category there are 5 students 20% of the number of students, critical 4 students or 16% of the number of students, less critical there are 6 students or 24% of the number of students, and very less critical there 10 or 40% of the number of students. Therefore, it means that there are still many students in class III with a total of 25 students who have very poor critical thinking abilities.

Table 4.2 Results of Student Answers based on Critical Thinking Ability Indicators

No	Critical Thinking Ability	The number of students	Percentage (%)	Criteria
1	Interpretation	15	75	Very Critical
2	Analysis	10	50	Critical
3	Evaluation	10	50	Critical
4	Inferences	20	100	Less Critical

Based on the table, the results of student answers are grouped based on each indicator according to the percentage of table categories. It is known that 75% of students are able to interpret the questions by rewriting what is asked and known correctly, 50% of students can analyze questions with the relationship between concepts, questions and statements in the questions were identified by making a mathematical model and explaining, then for evaluation indicators there were 50% of students who were able to use strategies in calculations and could do the questions correctly, completely and precisely. And 100% of students were able to conclude from what was asked correctly.
After the data is processed, then the results of student answers from each criterion will be described or shown. Either very critical, critical, or less critical.
1). Students on very critical criteria

It can be seen that students' questions are able to be interpreted, where the problems in the questions can be understood by students, and students are also able to write down what is being asked and know exactly what it should be. What was asked was not written down by students so that it was incomplete where students only listed what they knew. In the picture above students are able to analyze questions, where the relationship between concepts, questions and statements in the questions students can identify by giving explanations and making mathematical models. Questions can be evaluated by students with the right strategy in calculations so that problems can be resolved properly and correctly. Likewise in the last indicator, which is inferring or making conclusions from something that is asked in the question, students are able to make it.
2). Students on critical criteria

Students can interpret the questions, where students understand the problem, and what is being asked and what is known can students write correctly and completely as they should. However, students include what is known but what is asked cannot be written down, so that students are able to interpret but are incomplete. Furthermore, on the analysis indicators, students are able to identify by making a mathematical model a concept to work on the problem correctly. But in the next indicator the student is not able to evaluate what he has analyzed so that the student cannot answer the question. Therefore, students cannot make conclusions from what is asked, so they are not capable of inference indicators.
3). Students on less critical criteria

According to the results of the analysis of student answers, it can be seen that students are only able to fill in questions up to the interpretation stage, where students understand the existing problems, as well as what is being asked and it is known that students can ask correctly. However, students could not be interpreted correctly and completely because what was asked was not written correctly. Students are not able to identify questions, so that mathematical models cannot be made by students, therefore students do not meet the analysis indicators. On the evaluation indicator students are not able to think about what strategy will be used in the calculation so that students cannot solve the questions. So from that the students were not able to make conclusions according to what was asked. In understanding the problem, students should be able to interpret by writing back what is known and asked appropriately. And based on the results of the analysis, 75% of students can understand the problem. Information obtained by students from a problem so that students know what is known and asked, although there may be differences in writing (Syafruddin & Pujiastuti, 2020).
From understanding the problem to be related to analyzing the problem with the relationship between concepts, questions and statements in the problem are identified with appropriate explanations. Students cannot identify properly because of the habits of students in solving problems by solving them directly without identifying or making concepts in solving them. "Some students who have not been able to identify the interrelationships of a concept make students answer immediately without identifying questions (Pebianto et al., 2019).
If analyzing is related to understanding the problem, then evaluating the problem is also related to both. Because not being able to identify questions properly will affect student results in solving problems with formulas, there are still many students who are unable to solve problems according to the right strategy.

Cycle II results

For the percentage value of the 5 item description questions with each question having 16 points. Each point according to the scoring rubric is from 0 – 4 points. These points are based on the scoring rubric of students' mathematical critical thinking skills. After the data is processed and the percentage value is calculated, referring to the model discussed earlier, the ability is calculated according to the percentage value obtained, then it is divided into 4 categories namely very critical, critical, less critical, very less critical. The percentage results obtained by students can be seen in

Score= (Correct number X Score)/(Maximum score) X 100

Very Critical

Score = (Correct number X Score)/(Maximum score) X 100

= (5 X 4)/20 X 10

= 20/20 X 100 = 100

Critical

Score = (Correct number X Score)/(Maximum score) X 100

= (4 X 4)/20 X 100

= 16/20 X 100 = 80

Less Critical

Score = (Correct number X Score)/(Maximum score) X 100

= (3 X 4)/20 X 100

= 12/20 X 100 = 60

Very Less Critical

Score = (Correct number X Score)/(Maximum score) X 100

= (2 X 4)/20 X 10

= 8/20 X 100 = 40

Tabel 4.3 Hasil Presentase Jawaban Siswa

No	Criteria for Critical Thinking Ability	Number of Students	Percentage (%)
1	Very Critical	8	32
2	Critical	8	32
3	Less Critical	5	20
4	Very Less Critical	4	16
	Total	24	100

In the table it can be seen that the results of the percentage of student answers are seen in the very critical category there are 8 students 32% of the number of students, critical 8 students or 32% of the number of students, less critical there are 5 students or 20% of the number of students, and very less critical there 4 or 16% of the number of students. So from that it means that there are 24 students in class III with a total of 24 students who have the ability to think very critically and think critically.

Table 4.5 Student Answer Results based on Critical Thinking Ability Indicators

No	Indicators of Critical Thinking Ability	Ability Number of students	Percentage (%)	**Criteria**
1	Interpretation	20	100	Very Critical
2	Analysis	15	75	Critical
3	Evaluation	15	75	Critical
4	Inference	10	50	Less Critical

percentage of table categories, it is known that 100% of students are able to interpret the questions by rewriting what is asked and know exactly, 75% of students can analyze questions with concept relationships, questions and statements in the questions are identified by making mathematical models and explaining, then for evaluation indicators there are

75% of students who are able to use strategies in calculations and can do the questions correctly, completely and precisely. And 50% of students were able to conclude from what was asked correctly.

After the data is processed, then the results of student answers from each criterion will be described or shown. Either very critical, critical, or less critical.

1). Students on very critical criteria
It can be seen that students' questions are able to be interpreted, where the problems in the questions can be understood by students, and students are also able to write down what is being asked and know exactly what it should be. What was asked was not written down by students so that it was incomplete where students only listed what they knew. In the picture above students are able to analyze questions, where the relationship between concepts, questions and statements in the questions students can identify by giving explanations and making mathematical models. Questions can be evaluated by students with the right strategy in calculations so that problems can be resolved properly and correctly. Likewise in the last indicator, which is inferring or making conclusions from something that is asked in the question, students are able to make it.
2). Students on critical criteria
Students can interpret the questions, where students understand the problem, and what is being asked and what is known can students write correctly and completely as they should. However, students include what is known but what is asked cannot be written down, so that students are able to interpret but are incomplete. Furthermore, on the analysis indicators, students are able to identify by making a mathematical model a concept to work on the problem correctly. But in the next indicator the student is not able to evaluate what he has analyzed so that the student cannot answer the question. Therefore, students cannot make conclusions from what is asked, so they are not capable of inference indicators.
3). Students on less critical criteria
According to the results of the analysis of student answers, it can be seen that students are only able to fill in questions up to the interpretation stage, where students understand the existing problems, as well as what is being asked and it is known that students can ask correctly. However, students could not be interpreted correctly and completely because what was asked was not written correctly. Students are not able to identify questions, so that mathematical models cannot be made by students, therefore students do not meet the analysis indicators. On the evaluation indicator students are not able to think about what strategy will be used in the calculation so that students cannot solve the questions. So from that the students were not able to make conclusions according to what was asked.

B. Discussion

This classroom action research was conducted to improve the critical thinking skills of grade III SD GMIM IV Tomohon on the subject of Fractions using the PBL (Problem Based Learning) model. This classroom action research was completed in two cycles, where each cycle consisted of four stages, namely:
(1) planning,
(2) implementation of actions,
(3) observation and evaluation,
(4) reflection.
In understanding the problem, students should be able to interpret by writing back what is known and asked appropriately. And based on the results of the analysis, 75% of students can understand the problems in cycle I and 100% of students can understand the problems in cycle II. Information obtained by students from a problem so that students know what is known and asked, although there may be differences in writing (Syafruddin & Pujiastuti, 2020). From understanding the problem to be related to analyzing the problem with the relationship between concepts, questions and statements in the problem are identified with appropriate explanations. Students cannot identify properly because of the habits of students in solving problems by solving them directly without identifying or making concepts in solving them. "Some students who have not been able to identify the interrelationships of a concept make students answer immediately without identifying questions (Pebianto et al., 2019).
If analyzing is related to understanding the problem, then evaluating the problem is also related to both. Because not being able to identify questions properly will affect student results in solving problems with formulas, there are still many students who are unable to solve problems according to the right strategy.
To make an interactive class also requires a support that can make a class active. The supporting factors for learning to be effective include learning methods, learning media and learning processes used by teachers (Sari et al., 2021). For example using learning media in the form of learning videos, learning models that support students in critical thinking, and also teachers can use learning processes that engage students in their learning so that students can be trained to think critically. However, we are reminded again that whatever is learned quickly, other people should not do it in the same way. Therefore, even in learning the teacher must pay attention to the level of student ability.
Through the implementation of the PBL (Problem Based Learning) model carried out in this study, it has provided additional alternatives to be used as a choice of learning models that can improve students' critical thinking skills. There are many advantages that can be taken in applying this model, PBL provides challenges to students so that they can gain satisfaction by discovering new knowledge for themselves and developing each student's critical thinking skills. In applying this model, another thing that needs to be done is to motivate students by providing contextual questions to focus their attention.

IV. CONCLUSION

Implementation of the Problem Based Learning Method can improve the ability to solve math problems for Grade 3 SD GMIM IV Tomohon, East Tomohon District, Tomohon City. To develop students' thinking skills, students must practice filling in questions with the guidance of the teacher. In addition, teachers can also use something to support learning such as learning media, learning models or approaches in the learning process. The Problem Based Learning (PBL) model in the process of learning mathematics can improve the ability to solve problems critically, and can increase the maximum activity and creativity of students.

REFERENCES

1. Agnes Maria Goni, 2022. Konsep Bilangan dan Pembelajarannya di Sekolah Dasar. Manado: Major.
2. Ahmadi,dkk. 2011. Strategi Pembelajaran Sekolah Terpadu. Jakarta: PT. Prestasi Pustakarya.
3. Anderson, Lorin W dan David R, Krathwohl. 2010. Kerangka Dasar untuk Pembelajaran, Pengajaran, dan Assesmen. Yogyakarta: Pustaka Pelajar.
4. Arikunto. 2006. Media Pembelajaran. Surakarta: Yuna Pustaka.
5. BSNP. 2006. Panduan Kurikulum Tingkat Satuan Pendidikan. Jakarta: Dharma Bhakti .
6. Corebima, A.D. 2010. Berdayakan Keterampilan Berpikir Selama Pembelajaran Sain dan Masa Depan Kita. Makalah disajikan pada Seminar Nasional Optimalisasi Sains untuk Memberdayakan Manusia, Prodi Pendidikan Sains PPS UNESA. Surabaya, 16 Januari.
7. Darmadi, 2017. Pengembangan Model dan Metode Pembelajaran dalam Dinamika Belajar Siswa. Yogyakarta: Deepublish.
8. Eggen, P dan Kauchak, D. 2012. Strategi dan Model Pembelajaran: mengajarkan Konten dan Keterampilan Berpikir. Jakarta: PT Indeks.
9. Goni, Tumurang, Pelawiten. 2022. Application of Problem Based Learning Model To Improve Mathematics Learning Outcomes of Students In Class IV of GMIM 1 Woloan Elementary School. UNIMA
10. Heruman. 2012. Model Pembelajaran Matematika di Sekolah Dasar. Bandung. PT. Remaja Rosdakarya.
11. Huda, M. 2013. Model-model Pengajaran dan Pembelajaran. Yogyakarta: Pustaka Belajar.
12. Hudaya, Herman (1990) Strategi Mengajar belajar matematika. IKIP Bandung.
13. Mulyasa. (2006). Kurikulum Tingkat Satuan Pendidikan. PT Remaja RosdaKarya. Bandung.
14. Sugiyono. 2010. Metode Penelitian Kuantitatif, Kualitatif, dan Kombinasi (Mixed Methods). Bandung: Alfabeta.
15. Sugiyono. 2010. Metode Penelitian Pendidikan Pendekatam Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.
16. Sugiyono. 2010. Metode penelitian pendidikan. Bandung: Alfabeta.
17. Sugiyono. 2012. Metode Penelitian Pendidikan. Bandung: Alfabeta.
18. Suharsimi Arikunto (1993) Prosedur Penelitian. Yogyakarta. Rineka Cipta.Suharsimi Arikunto.
19. Suharjono, Supardi (2008) Penelitian Tindakan Kelas. Jakarta. Bumi Aksara.
20. Tuerah, R. M. (2017, September) Analysis of Teacher Performance on Learning Management in Primary School. In 9th International Conference for Science and Teachers (ICSET 2017). Atlantis Press.