EMTEKA: Jurnal Pendidikan Matematika
Volume 4, No. 2, 2023. 389-398

e-ISSN 2746-5594
p-ISSN 2746-5608

Solving Word Problems Strategies by Fifth-Grade Students

Millah Mardliyana[1], Mohammad Faizal Amir[2]*

[1,2] Universitas Muhammadiyah Sidoarjo, Sidoarjo, Indonesia
*Corresponding author. Jl. Mojopahit No.666 B Sidowayah Celep, 61215, Sidoarjo, Indonesia.
E-mail: millahm.umsida@gmail.com[1]
faizal.amir@umsida.ac.id[2]

Received 25 June 2023; Received in revised form 27 July 2023; Accepted 15 September 2023

ABSTRAK
Penelitian ini bertujuan untuk mengidentifikasi strategi menyelesaikan masalah oleh siswa kelas V sekolah dasar dalam menyelesaikan *word problems*. Penelitian ini menggunakan pendekatan penelitian kualitatif dengan jenis penelitian studi kasus. Teknik pengambilan data dilakukan dengan cara pemberian tugas, observasi, wawancara, dan dokumentasi. Teknik analisis data yang digunakan adalah reduksi data, penyajian data, dan penarikan kesimpulan atau verifikasi. Subjek dalam penelitian ini sebanyak 32 siswa kelas V SDN Winong II. Penelitian ini menemukan empat strategi yang dilakukan siswa dalam menyelesaikan masalah *word problems* mengenai aritmatika, yaitu menerapkan penalaran, mengalikan sekumpulan benda, menjumlahkan bagian-bagian, dan membagi keseluruhan dengan satuan. Hasil penelitian ini menunjukkan siswa di tingkat sekolah dasar memiliki strateginya masing-masing untuk menyelesaikan *word problems*. Hasil penelitian ini memiliki implikasi dalam pembelajaran, yaitu bagi para guru disarankan untuk memberikan kesempatan bagi siswa dalam mengeksplorasi dan menggunakan strategi siswa masing-masing untuk terlebih dahulu dalam menyelesaikan *word problems*. Hal ini dilakukan sebelum guru menjelaskan penyelesaian yang benar, sehingga terhindar dari pembelajaran dan pengajaran yang menuntut siswa untuk mencontoh strategi penyelesaian *word problems* oleh guru.
Kata kunci: aritmatika; strategi menyelesaikan; *word problems*

ABSTRACT
This study aims to identify fifth-grade elementary school students' problem-solving strategies for solving word problems. This research uses a qualitative research approach with a case study research type. Data collection techniques employed tasks, observation, interviews, and documentation. The data analysis techniques used are data reduction, data presentation, and conclusion drawing or verification. The subjects in this study were 32 fifth-grade students of SDN Winong II. This study found four strategies that students used to solve word problems about arithmetic: applying reasoning, multiplying a set of objects, adding parts, and dividing the whole by the unit. The results of this study show that students at the elementary school level have their own strategies for solving word problems. The results of this study have implications for learning. Teachers should provide opportunities for students to explore and use their respective student strategies first in solving word problems. This is done before the teacher explains the correct solution to avoid learning and teaching that requires students to imitate the teacher's word problem solving strategy.
Keywords*: arithmetic; strategies for solving; word problems*

Introduction

Math word problems are closely related to everyday life. Komalasari & Wihaskoro said that the concepts contained in math word problems result from realistic mathematics, where mathematical concepts are structured based on reality (Dewi, 2022). Based on research conducted by Kasma & Saragih, solving

math word problems can improve reasoning and deductive thinking patterns. This is supported by Soedjadi's opinion that applying problem solving steps in math word problems can improve students' reasoning skills and deductive thinking patterns. Therefore, children in the concrete operational stage aged 7-11 years need to master word problems in every math subject. However, Niak et al. (2018) stated that mastery of concepts and solving word problems owned by students are sometimes inappropriate, so students dealing with mathematical material presented in questions or application problems in the form of story problems experience difficulties. In understanding the concept of word problems, prerequisites are needed, namely students understand the structure of using the appropriate arithmetic operations of addition, subtraction, multiplication, division, or a combination of these operations. Calculation operation solves problems through mathematical processes, namely adding, subtracting, multiplying, and dividing. Word problems play an important role because they provide problems in everyday situations, so they can help students to analyze mathematical problem solving related to everyday life (Kashefi et al. 2015). Students can get the opportunity to practice problem solving, especially those related to their learning experience. In addition, word problems can improve the quality of problem solving skills in elementary school students (Kribbs & Rogowsky 2016).

Mathematical word problems are one of the problems often experienced by elementary school students caused by several factors such as errors in counting, immature mathematical concepts, or obstacles in reasoning or understanding a story problem that is converted into a mathematical model (Komalasari & Wihaskoro, 2017). Maarif & Wahyudi (2015) revealed that most students consider the procedures for solving math story problems to be very complicated. If students continue to think that solving math word problems is a difficulty, it will be embedded in the minds of students. Khasanah, Supriyanto, & Susanto (2020) also stated the same thing, namely that most elementary school students have difficulty understanding the given math word problems. If students misperceive the word problems, then the solution process will not make sense. As a result, the sense of hopelessness in solving math word problems will be compelling to students if this happens more and more often (Khasanah et al., 2020). This condition is the cause of students' low ability to solve word problems and students will always consider math a difficult subject.

Problems often encountered in learning in elementary school are difficulties when solving math word problems, such as errors and mistakes in counting, difficulty in capturing and implementing mathematical formulas, and basic mathematical concepts (Apsoh, Setiawan, & Susanti (2022). From this phenomenon, teachers have the task of more concretely facilitating students' mathematics learning process so that students can more easily understand it. This is important because math is a structured science. To understand new concepts in learning mathematics, students must first understand previous concepts as a prerequisite (Mulyadin, Sowanto, & Dusalan, 2021). The benefit that can be obtained is the accuracy of using learning strategies to improve student learning outcomes, especially overcoming problems regarding students' difficulties in working on math word problems.

It is no less important to do a strategy in solving word problems, namely to find out students in solving problems on the subject of fractions before being applied, to find out the process of implementing problem solving strategies in solving word problems on the subject of fractions and to find out students' ability to solve word problems on the subject of fractions after applying the strategy. Word problems play an important role in elementary school mathematics education. In learning mathematics, not all problems can be called problems. When faced with a math problem, four possibilities can occur, namely, we (a) immediately have an idea of the solution but no interest in solving it, (b) have an idea of the solution and the will to complete it, (c) has no idea about the solution but wants to solve it, and (d) had no idea how to solve it and no interest in doing so. Of the four possibilities above, the (c) is a problem for learners (Murdiana, 2015).

In previous research Wickstrom, et.al. (2017) examined PST strategies to illustrate unit conception and area measurement in tiling tasks. What PST strategies were used to lay out tiles in a two-dimensional space with different sizes of tiles and what strategies implied PST conceptions of area measurement? There are six strategies in Wickstrom's research, namely: (1) applying long reasoning, (2) counting all the units, (3) counting all the units, (4) addition of parts, (5) comparing units, and (6) dividing the whole by the unit. However, it has not discussed solving word problems. Still, only the concept of units and area measurements then implemented on tiling tasks requires research on strategies for solving word problems related to arithmetic material.

In Wickstrom's research, strategies are categorized based on factual errors, namely difficulty determining what is known and what is asked in the tiling task, difficulty in focusing on solving area measurements and difficulty in understanding the problem. Meanwhile, conceptual errors in this study include difficulty understanding math story problems, difficulty focusing on math story problems and difficulty performing number operations, such as difficulty performing multiplication operations, especially if the numbers are tens and hundreds.

The purpose of using word problems is that the answers to multiple-choice questions can be determined by using a little logic and a process of elimination. Word problems, on the other hand, require more than just looking at the problem and figuring out the solution based on similar equations that have been solved before. Students need to be able to read the problem first, pull out the relevant information, solve the math equation and then think about how the answer makes sense in the context of the problem because it contains additional words, numbers and descriptions that seem irrelevant to the problem.

This research reports an empirical study of identifying the strategies of fifth-grade elementary school students in solving word problems by distributing tasks that can create a more varied strategy classification, thus affecting the developmental stage of a more detailed understanding of word problems. This research is expected to provide significant implications in mathematics education, especially in solving word problems. Among other things, educators or practitioners know the right strategies for teaching word problems, see the right teaching stages so that cognitive leaps do not occur, and know how they should teach so that they are synchronized with the development of students' understanding.

e-ISSN 2746-5594
p-ISSN 2746-5608

Research Methods

This research method uses a case study method. The case identified is the strategy of solving word problems by fifth-grade elementary school students. In this study, data collection instruments were used in the form of tests or tasks, interviews, observation, and documentation. Test instruments or tasks are used to measure students' abilities and as written evidence of strategies for solving word problems. Meanwhile, interviews were used to deepen information on word problem comprehension strategies orally. Observation is used to observe the implementation of solving students' word problems while working according to the solution strategy. Meanwhile, documentation was used to archive all relevant data collected during the research process.

The results of the subject's answers were grouped based on the characteristics of the solving strategy that appeared in the written task and observation, and then random interviews were conducted on each subject representing the type of strategy.

The subjects in this study were fifth-grade students of SDN Winong II, consisting of 19 male students and 13 female students. This subject is selected because the student has received lessons on number operations. This is done so that there is an intervention in solving student word problems.

Word problem solving task modified research by Cai (2000). This task is presented in Table 1. The modifications made in this task are in the form of word problems. Related to the above problem given to students is arithmetic. Students are asked to solve word problems by using their own solution strategies.

Table 1. Strategy Tasks for Solving Word Problems

Problem 1	Problem 2
Mira bought 4 books, 3 rulers, 2 scissors and some glue. Each book costs Rp. 3.250, a ruler Rp. 2,500 and glue Rp. 1.500. The scissors cost Rp. 1,500 more than the ruler. Mira paid with 4 thousand notes. Mira received a refund of Rp. 4.000. How much glue did Mira buy?	In an elevator with a capacity of 600 kg there are 5 people in it with a total body weight of 380 kg. Then outside the elevator 2 people will enter the elevator with 10 kg of luggage. What is the remaining capacity of the elevator?

Data analysis techniques used data reduction, presentation, and conclusion drawing or verification (Miles dan Huberman, 2018). Analyzing strategies for solving word problems was based on the indication of strategies by (Wickstrom et al., 2017). Table 2 shows an indication of strategies for solving word problems.

Table 2. Indicators of Strategies for Solving Word Problems

No	Strategy	Descriptor
1	Applying reasoning	Understand the problem given, then include known, asked, and answered elements
2	Multiplying a set of objects	Make plans according to procedures and lead to solutions

e-ISSN 2746-5594
p-ISSN 2746-5608

3	Sum the parts	Perform the sum distribution process to get the result
4	Divide the whole by the unit	Performs division that likens a set of objects to x. Then, the objects are divided into equal numbers in group y. The way to divide it is done repeatedly as many as y until it runs out. Each division is done equally to all units.

Results and Discussion

Before constructing strategies for solving word problems, the results of students' work on the Task of Solving Word Problems (TMWP) were grouped based on each strategy for solving word problems.

Task Strategy to Solve Word Problems 1

The most common word problem solving strategy used by students in word problem 1 was multiplying a set of objects. Table 3 shows the results of students' strategies in solving word problem 1. Meanwhile, Figure 1 shows an example of student work on word problem 1.

Table 3. Student Strategies in TMWP 1

No	TMWP Strategy 1	Number of Students
1	Applying reasoning	9
2	Multiplying a set of objects	15
3	Sum the parts	3
4	Divide the whole by the unit	5

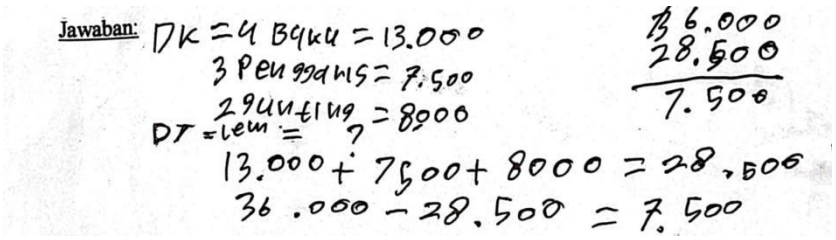

Figure 1. Strategy 1 for solving students' word problems in Task 1

The strategy of applying reasoning showed that many students failed to read the problem correctly and were confused in determining the calculation operation to be used. There are 9 students who use this strategy, including Ima. In completing the word problem 1 task, they did not use the unit formula given but immediately completed it in the form of addition only.

e-ISSN 2746-5594
p-ISSN 2746-5608

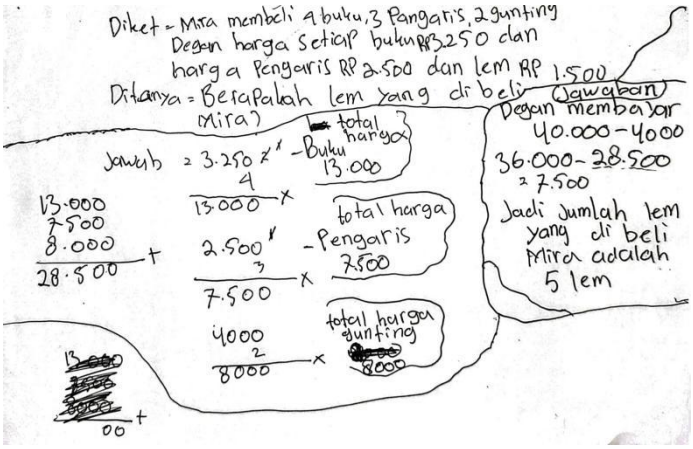

Figure 2. Strategy 2 for Solving Student Word Problems in Task 1

The strategy of multiplying a set of objects showed that students realized they had to multiply the number of items purchased by the price per item. Still, the method used varied because it was estimated according to their abilities. This strategy was used by 15 students, including Giska. Giska calculated the entire number of items with prices using known elements, so the strategy used was structured.

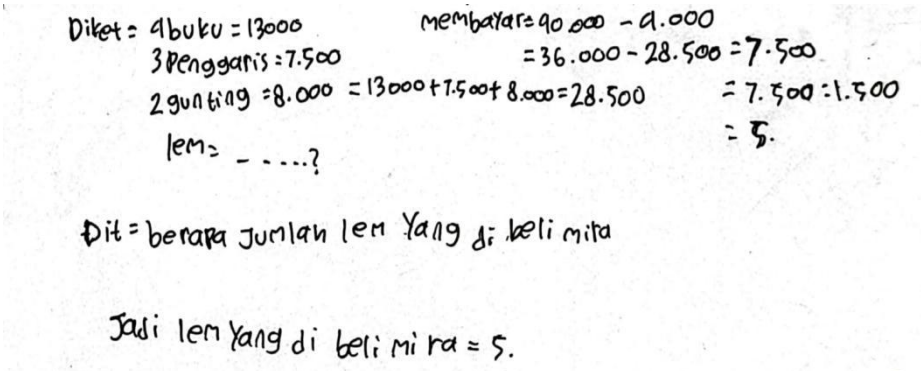

Figure 3. Strategy 3 for solving students' word problems in Task 1

The strategy of summing the parts shows that the total amount can be found with the help of a formula. There are 3 students who use this strategy, including Fahmi, it can be seen that the units are used correctly and the arrangement of the units is coherent.

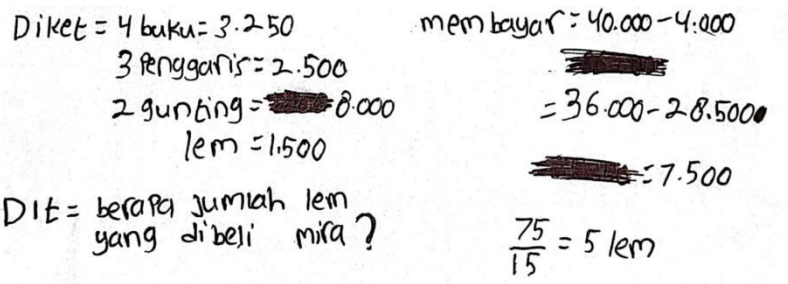

Figure 4. Strategy 4 for solving students' word problems in Task 1

e-ISSN 2746-5594
p-ISSN 2746-5608

The strategy of dividing the whole with units, in addition to using arithmetic formulas, students combine by using the help of stacked counting operations. Besides realizing that arithmetic is related to finding the unknown term (Un). In Task 1, this strategy was the most structured of the three previous strategies. There are only 5 students who can use this strategy, one of them is Affan.

Task Strategy to Solve Word Problems 2

In TMWP 2, the solution strategy that students used most often was two-dimensional measurement. Table 4 shows all the strategies that emerged and the number of students. Meanwhile, Figure 2 shows an example of students' work on TMWP 2.

Table 4. Student strategies in TMWP 2

No	TMWP Strategy 2	Number of Students
1	Applying reasoning	6
2	Divide the whole by the unit	14
3	Sum the parts	12

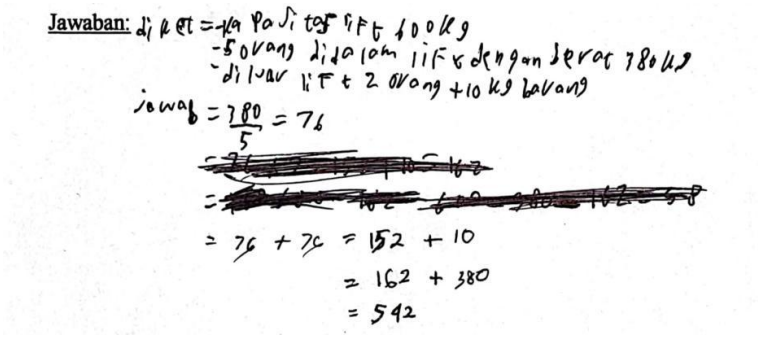

Figure 5. Strategy 1 for solving students' word problems in Task 2

The strategy of applying reasoning showed that many students failed to read the problem correctly and were confused in determining the calculation operation to be used. There were 6 students who used this strategy, including Fendi. In completing the word problem 2 task, they did not use the unit formula given but immediately completed it in the form of addition only.

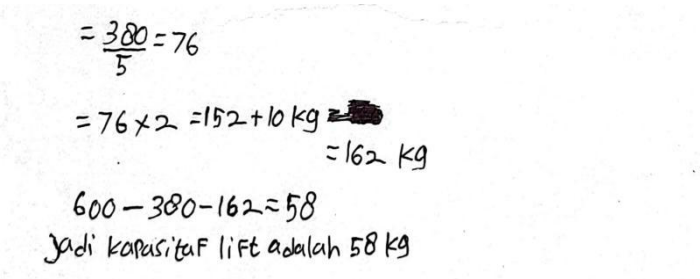

Figure 6. Strategy 2 for solving students' word problems in Task 2

In the strategy of dividing the whole with units, in addition to students using arithmetic formulas, students combine by dividing the total weight of people in the elevator by the number of 5 people (i.e., 380:5). Then students can assume

e-ISSN 2746-5594
p-ISSN 2746-5608

that the weight of 2 people outside the elevator is the same and finally divide by reducing the maximum capacity of the elevator with the sum result. Besides realizing that arithmetic is related to finding the unknown term (Un). There are 14 students who can use this strategy, one of them is Zevana.

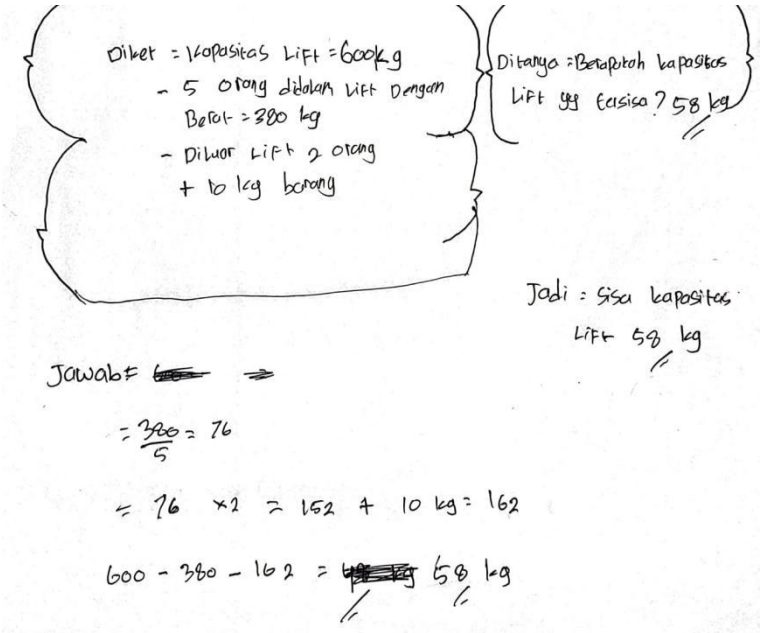

Figure 7. Strategy 3 for solving students' word problems in Task 2

The sum-of-the-parts strategy shows that the sum of the weight of 5 people inside the elevator with the weight of 2 people outside the elevator and the luggage (i.e., 380 + 152 + 10) can be found out with the help of the formula. There are 12 students who use this strategy, including Nauval, it can be seen that the units are used correctly and the arrangement of the units is coherent.

From the results of this study with previous research conducted by Wickstrom, there are differences in the relationship between problem-solving strategies. The focus of previous research, namely (1) The intended target is university students, (2) The problem studied was PSTs' strategy to illustrate unit conception and area measurement in tiling tasks. Meanwhile, this research focuses on (1) The intended target audience, grade-fifth elementary school students, (2) The problem studied is the strategy of solving word problems on arithmetic tasks. However, there are similarities in the results of previous studies, which show that the strategies used by the targets vary. It can be concluded that solving math problems does not have to focus on just one strategy but can be solved with other strategies.

The theoretical implication of this research is that it is useful in describing mathematical knowledge for teaching in the domain of word problem solving strategies related to arithmetic material at the elementary school level. In solving each problem, students are asked to produce a complete solution, explain the strategy or method used, and justify the solution obtained. Such visible written notes serve as evidence in analyzing the types of strategies and representations that students use.

Conclusions and Suggestions

Based on the data analysis and discussion above, it can be concluded that in solving word problems, the experience of elementary school students in receiving arithmetic material is very influential on the strategies students use. There are four strategies that students can use in solving word problems, namely applying reasoning, multiplying a set of objects, adding parts, and dividing the whole by the unit. However, there are differences in the strategies used by students based on each student's ability level. In solving word problems, elementary school students' experience receiving arithmetic materials affects the strategies students use. Students tend to have misconceptions about the meaning of word problems, which triggers confusion in determining the calculation operation to be used and difficulty in reading the problem correctly.

For educators at the elementary school level, for students to understand problem-solving strategies, word problem tasks should be given in stages, starting with using known, asked, and answered elements. The tasks given are related to arithmetic and can use mixed number operations or others. This will lead to understanding students' strategies for solving word problems. In addition, it can create alternatives to improve the ability to solve word problems by personal abilities in the form of mathematical modeling. Of course, this is also adjusted to the applicable curriculum and can generally be applied within the scope of elementary school.

References

Apsoh, Siti, Awan, & Susanti. (2022). Kesulitan Belajar Matematika dalam Menyelesaikan Soal Cerita pada Pembelajaran Daring. *JUPENJI: Jurnal Pendidikan Jompa Indonesia* 1(2), 31–41.

Cai, Jinfa. (2000). Mathematical Thinking Involved in US and Chinese Students' Solving of Process-Constrained and Process-Open Problems. *Mathematical Thinking and Learning* 2(4), 309–40.

Dewi, D. P. (2022). Optimalisasi Pemahaman Memaknai Kalimat pada Soal Cerita Menuliskan Bilangan Pecahan Dalam Modul Kelas III SD. pp. 445–52 in *ProSANDIKA UNIKAL (Prosiding Seminar Nasional Pendidikan Matematika Universitas Pekalongan)*. 3(2), 35-45.

Kashefi, Hamidreza, Alias, N.A., Kahar, M.F., Buhari, O., & Mirzaei, F. (2015). Visualisation in Mathematics Problem Solving Meta-Analysis Research. pp. 803–12 in *E-Proceeding of the International Conference on Social Science Research*.

Khasanah, Nurul, Supriyanto, D.H., & Susanto, S., (2020). Pengaruh Model Pembelajaran Kooperatif Tipe Cooperative Integrated Reading and Composition (CIRC) Terhadap Kemampuan Menyelesaikan Soal Cerita Matematika Kelas V. *Jurnal Pendidikan Modern* 5(2), 48–53.

Komalasari, Dea., M, & Wihaskoro, A.M., (2017). Mengatasi Kesulitan Memahami Soal Cerita Matematika Melalui Gerakan Literasi Sekolah Dasar.

Kribbs, Elizabeth E., & Rogowsky, B.A., (2016). A Review of the Effects of Visual-Spatial Representations and Heuristics on Word Problem Solving in Middle School Mathematics. *International Journal of Research in Education and Science*

2(1), 65–74.

Maarif, Hanafi, & Wahyudi, W., (2015). Eksperimentasi Problem Based Learning dan CIRC dalam Menyelesaikan Soal Cerita Matematika Siswa Kelas 5 SD. *Scholaria: Jurnal Pendidikan Dan Kebudayaan,* 5(2), 97–115.

Miles, Huberman, & A. Michael Huberman. 2018. Saldana. (2014). *Qualitative Data Analysis: A Methods Sourcebook* 3.

Mulyadin, Edi, Sowanto Sowanto, & Dusalan Dusalan. (2021). Pengembangan Perangkat Pembelajaran CIRC (Cooperative Integrated Reading and Composition) dalam Meningkatkan Pemahaman Matematis Pada Materi Perbandingan Siswa SMP. *Supermat : Jurnal Pendidikan Matematika* 4(1),40-51.

Murdiana, I. Nyoman. (2015). Pembelajaran Pemecahan Masalah dalam Pembelajaran Matematika. *Aksioma* 4(1),1–11.

Niak, Yandry, Mataheru, W., & Ngilawayan, D.A., (2018). Perbedaan Hasil Belajar Siswa Pada Model Pembelajaran Kooperatif Tipe CIRC dan Model Pembelajaran Konvensional. *Journal of Honai Math* 1(2),67–80.

Wickstrom, Megan H., Elizabeth W. Fulton, & Mary Alice Carlson. (2017). Pre-Service Elementary Teachers' Strategies for Tiling and Relating Area Units. *The Journal of Mathematical Behavior* ,4(8),112–36.