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Learning with Coping Strategies in Solving Multi-step Arithmetic Problems Towards Numeracy Skills

Nabhila Yosa[1], Mohammad Faizal Amir[2]*, Mahardika Darmawan Kusuma Wardana[3]

[1,2,3] Primary School Teacher Education Departement, Universitas Muhammadiyah Sidoarjo, Sidoarjo, Indonesia

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ABSTRAK

Kemampuan numerasi siswa sekolah dasar masih belum memadai dalam menyelesaikan masalah multi-step arithmetic. Penelitian ini bertujuan untuk menganalisis pengaruh pembelajaran dengan strategi coping dalam meningkatkan keterampilan numerasi siswa sekolah dasar dalam memecahkan masalah matematika multi-step arithmetic. Jenis penelitian ini menggunakan quasi eksperimen dengan desain pretest-posttest control group. Partisipan penelitian adalah 51 siswa kelas lima sekolah dasar yang dibagi secara random pada kelompok eksperimen dan kontrol. Pengumpulan data menggunakan tes dengan instrumen masalah multi-step arithmetic yang berorientasi pada numerasi. Analisis data pada penelitian ini menggunakan uji-t paired kemudian dilanjutkan dengan uji chi-kuadrat. Hasil penelitian menunjukkan strategi coping dalam memecahkan masalah multi-step arithmetic berpengaruh signifikan terhadap pencapaian peningkatan keterampilan numerasi primary students. Hasil penelitian ini berimplikasi pada sebagai initial bukti empiris bagi para pendidik dan penelitian berikutnya bahwa siswa sekolah dasar yang memiliki keterampilan numerasi yang belum memadai dapat ditingkatkan melalui strategi coping yang merupakan stimulisasi strategi dengan cara meniru dan memecahkan masalah multi-step arithmetic yang memiliki penyelesaian secara bertahap

ABSTRACT

The numeracy skills of elementary school students are still inadequate in solving multi-step arithmetic problems. This study aims to analyses the effect of learning with coping strategies in improving the numeracy skills of elementary school students in solving multi-step arithmetic problems. This type of research uses a quasi-experimental design with a pretest-posttest control group. The research participants were 51 fifth grade elementary school students who were randomly assigned to the experimental and control groups. Data collection using tests with multi-step arithmetic problem instruments those are oriented towards numeracy. Data analysis in this study used a paired t-test followed by a chi-square test. The results showed that coping strategies in solving multi-step arithmetic problems had a significant effect on the achievement of increasing primary students' numeracy skills. The results of this study have implications for initial empirical evidence for educators and subsequent research those elementary school students who have inadequate numeracy skills can be improved through coping strategies which are stimulation strategies by imitating and solving multi-step arithmetic problems that have gradual completion.

1. INTRODUCTION

Currently, many experts view the importance of numeracy skills for primary students (Aunio, 2019; Aunio & Räsänen, 2016; Niklas & Tayler, 2017; Söğüt et al., 2021). Currently, many experts view the importance of numeracy skills for primary students (Irawan & Surya, 2017; Khofifah & Ramadan, 2021). The achievement of numeracy skills plays a critical role in the development of learning and overall mathematics student learning outcomes (Aunio, 2019; Segers et al., 2015). This achievement includes students' success in solving problems and understanding numbers, time, patterns, symbols, and others (Cheong et al., 2017; Dessemontet et al., 2019). Numeracy skills are the ability to apply arithmetic operations and number concepts in real-world situations (Cheong et al., 2017; Megawati & Sutarto, 2021). Additionally, numeracy skills can be defined as the capacity to apply, interpret, and relate information pertinent to daily life (Awofala & Blessing, 2014; Hong et al., 2020). In a simple sense, numeracy skills are skills to understand mathematics in various contexts, solve a problem, and explain how to use mathematics (Aunio, 2019; Miller, 2018). Numeracy skills can also be defined as the ability to manipulate numbers and data in order to evaluate a statement or piece of information based on estimation and mental processes in real-world contexts (Malloy-Weir et al., 2016; Skwarchuk et al., 2014). Hence, numeracy skills can be seen

*Corresponding author.
E-mail addresses: faizal.amir@umsida.ac.id (Mohammad Faizal Amir)

as a skill in understanding mathematical concepts in the context of numbers and arithmetic skills that are applied in everyday life to solve a real-world problem.

In the practice of learning mathematics, there is a gap in light of the expectations and previous research results that have not been oriented to improving students' mathematical performance, including the numeracy skills of primary students. Several studies show that primary students do not yet have inadequate numeracy skills (Domike & Odey, 2014; Rakhmawati & Mustadi, 2022). Other studies confirm that primary students experience incomprehension in solving problems related to numeracy skills (Deringöl, 2019; Rudi et al., 2020). Several studies mention that this is motivated by primary students' lack of engagement with the learning process that involves numeracy (Colliver, 2018; Dessemontet et al., 2019; Godfrey & Mtebe, 2018). In addition, numeracy skills are difficult for primary students to achieve in the learning process (Aunio, 2019; Purpura et al., 2011). The low numeracy skills of these students can be seen when students use numbers, analyse, and interpret the information provided in various forms (Cheung et al., 2020; Niklas et al., 2016). Several other studies show that this problem is related to students' low literacy interest in mathematics (Aber et al., 2017; Miller, 2018). This is also motivated by the low understanding of students when receiving mathematics material at the time of learning (Harahap & Surya, 2017; Miller, 2018).

Meanwhile, a preliminary study at State Primary School 2 found that primary students had low numeracy skills, especially in terms of speed, distance, and time. In this case, students still cannot solve a problem related to multi-step arithmetic problems. In primary students learning problems, multi-step arithmetic problems can be said to be a word problem-solving process with several steps (Copur-Gencturk & Doleck, 2021; Deringöl, 2019; Wang et al., 2018). In solving multi-step arithmetic problems, students must go through several phases, including understanding the text well (Karabulut & Özmen, 2018; Umayah et al., 2019). Multi-step arithmetic problems are usually addressed to primary students (Powell & Fuchs, 2018; Roy & Roth, 2015). Multi-step arithmetic problems can be solved using a variety of strategies (Baek et al., 2017; Marciniak & Jankowska, 2020). Previous researchers have made an effort to improve students' numeracy skills in the process of learning (Hidayah et al., 2021; Saefurohman et al., 2021). These efforts can include combining words and numbers in conversation, applying mathematical concepts in various activities, improving numeracy skills through games, and training students with numeracy questions (King & Purpura, 2021; Skwarchuk et al., 2014). Thus, students' difficulties in solving multi-step arithmetic problems to improve numeracy skills with learning materials can be overcome by designing or choosing the right lesson. In this case, educators must provide opportunities for students to improve numeracy understanding and encourage them to build their mathematical knowledge through everyday problem-solving.

Learning with coping strategies is a learning strategy carried out by teachers who provide positive behavioral responses to students for problem solving (Mahvar et al., 2018; Simamora et al., 2018). The characteristics of coping strategies involve students in learning by being given a positive response to problem-solving and increasing students' critical thinking. Moreover, students can understand the discussion about student numeracy skills well, and they can apply the knowledge they have just discovered when the teacher explains in everyday life (Eren & Coskun, 2016; Siagian et al., 2019). Students are also expected to be adept at solving word arithmetic problems using coping strategies. Word arithmetic problems are word problems that are usually found in primary students, and the existence of these problems can be solved by combining coping strategies to improve students' numeracy skills (Lai et al., 2015; Roy & Roth, 2015).

The study of learning coping strategies in solving multi-step arithmetic problems can provide opportunities for students to understand the concept of multi-step problem solving, to develop arithmetic thinking skills, and to apply multi-step arithmetic problem-solving skills related to everyday life (Eren & Coskun, 2016; Herrero et al., 2019; Iseselo et al., 2016). Thus, it is hoped that through coping strategies in solving multi-step arithmetic problems, primary students can understand the problem and perform numerical calculations by imitating and solving steps in stages. So that primary students can avoid problems of understanding and numeracy errors. In addition, studies on coping strategies in solving multi-step arithmetic problems are still very limited. Previous study using coping strategies in solving arithmetic problems on the numeracy skill level of primary students but focused on single-step and multi-step comparisons on arithmetic problems (Nortvedt, 2011). Our study focuses on the application of coping strategies in solving multi-step arithmetic problems to determine the significance of its effect on numeracy skills for primary students. Consequently, the objective of this study is to analyses the impact of learning coping strategies in solving multi-step arithmetic problems on the numeracy skills of primary students.

2. METHODS

This research employs a quasi-experimental design with a pre-and post-test control group. The experiment was conducted in the fifth grade of State Primary School 2 Suko, a Sidoarjo, East Java school. The experiment procedure was carried out by randomly dividing the fifth-grade primary students, totaling 51, into 11 boys and 14 girls comprising the experimental group of 26 students, while the control group comprised 25 students (12 boys and 13 girls). The experimental group is a class that participates in learning mathematics by using coping strategies. At the same time, a second group is a control group that does not use learning with coping strategies. In both classes, questions were given to determine the level of numeracy skills at the beginning and end of learning. Data collection was carried out from January 2022 to March 2022. The initial data collection stage was to provide a numeracy-oriented multi-step arithmetic problems (MAP) test instrument. The MAP is in the form of word problems and consists of two task items in the form of essay questions, as show in Figure 1.

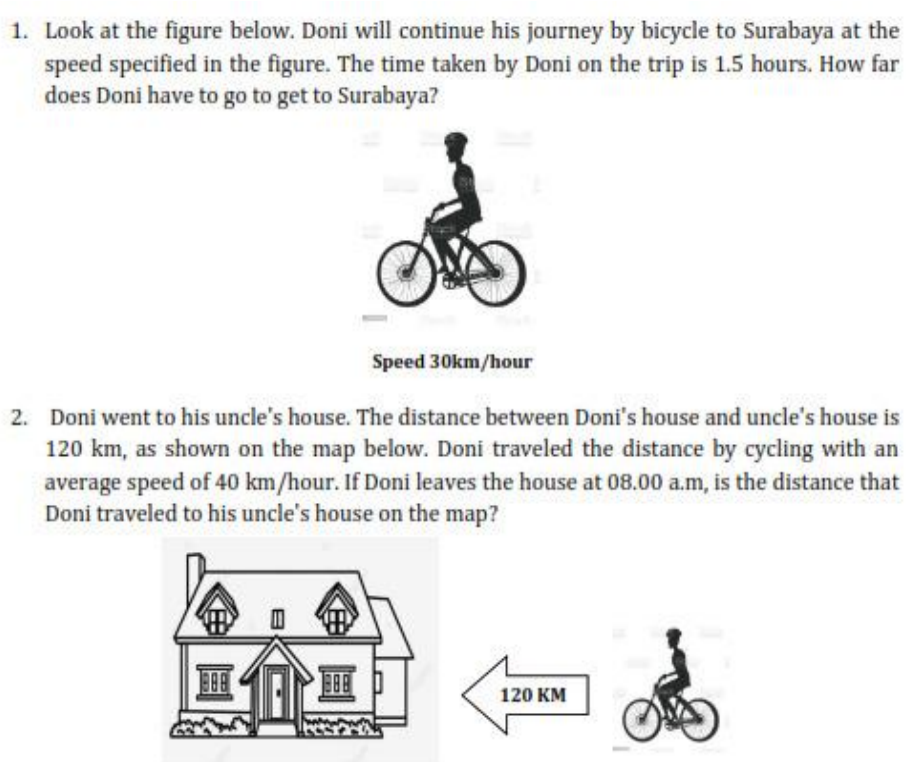

Figure 1. Multistep arithmetic problems

The adaptation made is to change the context of the problem into the material of speed and distance. Meanwhile, measuring students' numeracy skills is based on three main indicators: the use of numbers or symbols, information analysis, and decision making (Conoyer et al., 2016; Yustitia et al., 2021). Then the results of student work are converted into the categories of not able, quite capable, and able is show in Table 1.

Table 1. Numeracy Skill Indicators

Numeracy Indicators ⍰ Scoring		
2 (Able)	**1 (Quite Capable)**	**0 (Not Able)**
Using a variety of mathematical symbols or numerals to solve daily life problems.		
Students can use various numbers or symbols related to basic mathematics in solving daily life problems with the correct final answer.	Students can use various kinds of numbers or symbols related to basic mathematics in solving everyday life problems with the correct final answer.	Students are less able to use various numbers or symbols related to basic mathematics in solving daily life problems, and the final answer is wrong.
Analyzing data presented in different formats (tables, graphs, diagrams, charts and so on.)		

Numeracy Indicators Scoring		
2 (Able)	**1 (Quite Capable)**	**0 (Not Able)**
Students can analyze data presented in various formats (tables, graphs, diagrams, charts and so on.).	Students can analyze information in various forms (tables, graphs, diagrams, charts and so on.)	Students are less able to analyze information that is displayed in various forms (graphs, tables, charts, diagrams, and so on.)
Predicting and making decisions based on the analysis of data.		
Students can interpret all of the analysis's results to make accurate predictions and decisions.	Students can interpret all the results of the analysis to predict and make decisions correctly.	Students are less able to interpret all the analysis results to predict and make decisions correctly.

Data analysis in this study uses three stages with the help of SPSS 20 for windows. First, the researcher used descriptive statistics to calculate the pre- and post-test scores for the two classes. Second, the researcher calculated the correlation value between the pre-test and post-test using a paired sample t-test. Third is using the chi-square test to further identify the effect on students' numeracy skills after being given learning using coping strategies.

3. RESULT AND DISCUSSION

Results

The findings of this research began with the learning process for the two classes, namely, both the experimental and control groups were given essay questions as a pre-test to know how big the level of student learning outcomes in solving multi-step arithmetics problems. After doing the pre-test learning, The post-test for the two classes consisted of the identical questions as the pre-test. Table 2 is the data from the study in both the experimental and control groups.

Table 2. Pre-post Student Numeracy Skills

Classes	Pre-test Scores			Post-test Scores		
	Highest	**Lowest**	$\bar{x}$	**Highest**	**Lowest**	$\bar{x}$
Control	75	25	42,7	100	75	80.2
Experimental	75	25	47	100	50	83

Table 2 shows differences in students' average numeracy skills before and after the learning process. This is evidenced by the descriptive statistics for the control group, which has the highest and lowest pre-test scores of 75 and 25. Meanwhile, the highest and lowest post-test scores are 100 and 75. This is inversely proportional to the values in the experimental class before and after being given treatment. The experimental class's highest and lowest pre-test scores were 75 and 25. Meanwhile, the experimental class's highest and lowest post-test scores were 100 and 50. Meanwhile, the experimental and control classes' average values before and after being treated had very different results. This is demonstrated by the experimental class having a higher mean value than the control class. The average value of students' numeracy skills was 47 for the experimental class and 42.7 for the control group. These outcomes illustrate the differences in numeracy skills between the experimental and control groups. The results of the pre-test and post-test administered to students using a t-test to determine the efficacy of learning in solving multi-step arithmetic problems utilizing coping strategies for students' numeracy skills is show in Table 3.

Table 2. Paired Sample Test

	N	Correlation	Sig
Pair 1 pretest & posttest	25	0.068	0.746

Table 3 reveals that the pre-test and post-test scores are significantly different 0.746 (two-tailed) and a correlation value of 0.068 for learning outcomes in solving multi-step arithmetic problems. This table also shows the number of students, as many as 25. Thus, based on the above results, namely 0.746 > 0.05, there is a significant effect in solving multi-step arithmetics problems using coping strategies on the numeracy skills of grade 5 students. Then, to determine the significance of coping strategies on students' numeracy skills in Table 4.

Table 3. Chi-Square Test

Profil	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.524	3	0.210
Likelihood Ratio	6.324	3	0,097
Linear-by-Linear Association	3.108	1	0.078
N of Valid Cases	24		

Using the maximum alpha of 0.05, Table 4 displays a p-value of 4,524, or sig> 0.05. Based on the results of calculations using SPSS 20 for windows through chi-square, the analysis results using the chi-square test are sig. (2-sided): 0.210 > 0.05. So based, based on decision making. The conclusion is that H0 is acceptable and Ha is unacceptable, so there is an effect of learning coping strategies in solving multi-step arithmetics problems on the numeracy skills of fifth graders in primary schools.

Discussion

This study's findings indicate differences in the experimental and control classes' results in solving multi-step arithmetic problems after being given learning coping strategies. This is evident from the results of the two classes' average values. The results of another similar study show students' effectiveness when learning to use coping strategies (Baloran, 2020). Another study also found that the teacher's coping strategies during learning proved to provide a positive response to students (Cheung, 2010). It allows students to get maximum results in learning. Another study also shows that teachers more dominantly use coping strategies in solving a problem during the learning process (Freire et al., 2020). It is evidenced by the acquisition of maximum value when the teacher applies coping strategies in the learning process. Another study's results show that learning coping strategies is an alternative strategy for overcoming student learning outcomes in mathematics (Pogere et al., 2019). The study results also expect students to be more active in utilizing coping strategies in learning. Another study said that teachers also effectively applied coping strategies during the learning process at school (Skaalvik & Skaalvik, 2015). This is because coping strategies are less than optimal if done by parents to children in providing learning. Student learning outcomes become less than optimal when coping strategies are given by parents (Federkeil et al., 2020; Macintyre et al., 2020).

The next finding in this study is about the significant relationship between coping strategies and solving students' multi-step arithmetic problems. Previous studies' findings showed a significant relationship when coping strategies were given by imitating the teacher to students in solving multi-step arithmetic problems in stages (King-Sears et al., 2015). This is supported by the maximum performance of students in solving word problems in mathematics learning. The previous study showed the students' low understanding of word problem solving (Driver & Powell, 2017). Students feel there is a difficulty when solving word problems in mathematics. Many students are not interested in this learning. However, by providing coping strategies for learning mathematics, students are more active in solving word problems in mathematics. Another finding also says that, with coping strategies, students are more engaged and understand how to solve word problems in mathematics (Siagian et al., 2019). Another study also said that learning by combining coping strategies with students' skills to solve word problems can increase the effectiveness of student learning (Rokhman et al., 2019). So that students can understand the explanation or material regarding word problems or multi-step arithmetic problems. Another study demonstrates that students rarely solve mathematics word problems involving multi-step arithmetic (Roy & Roth, 2015). So that this problem can hurt student learning outcomes (Kercood et al., 2012; Miao et al., 2020). However, coping strategies can positively affect students' learning outcomes (Y. Hong et al., 2020; Ouyang et al., 2016).

The findings of this study resulted in a significant relationship between students' numeracy skills with coping strategies. This finding is almost the same as the previous finding, which found a significant correlation between students' coping strategies and their numeracy skills (Cheung & Kwan, 2021; Collie & Martin, 2017; Colmar et al., 2019). The study's findings on learning mathematics using coping strategies, primary students' numeracy skills can be enhanced by using coping strategies as an alternative to solve multi-step arithmetic problems gradually by imitating the completion steps by the teacher. However, the results of this study were limited to tests involving a minimal population. So that further research is recommended to test the significance of increasing numeracy skills by involving a wider population of primary students through the application of coping strategies in solving multi-step arithmetic problems.

4. CONCLUSION

Applying coping strategies significantly improves the numeracy skills of primary students in solving multi-step arithmetic problems. The results of this study are initial studies that can have implications for educators and researchers to use learning with coping strategies for students in order to further maximize numeracy skills and student learning outcomes by imitating the steps of solving problems first in solving problems, especially in multi-step arithmetic problems, which is done gradually.

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