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## The Effect of Schema-Based Instruction to Improve Mathematics Problem-Solving Ability of Elementary Students

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### ABSTRACT

*This research was motivated by the finding that fifth grade students at state elementary schools in Kupang City, East Nusa Tenggara still had difficulty solving problem solving questions. In fact, mathematical problem solving ability is one of the skills that needs to be taught to students since studying in elementary school. One effort to improve students' mathematical problem solving abilities is by implementing the Schema Based Instruction (SBI) method. The SBI method helps students map important information on schematics so they can plan appropriate problem solving solutions. This research aims to determine the effect of the SBI method on the mathematical problem solving abilities of fifth grade elementary school students. This research uses an experimental method with a posttest-only control group design. The research was conducted in class V at one of the state schools in Kelapa Lima District, Kupang City, NTT. The post-test results were tested using the T test and post hock to determine whether there was an influence of the SBI method on mathematical problem solving abilities. The research results show that the learning outcomes of students using the SBI method are higher than students who study using the expository method. The SBI method can be used as a reference learning method in elementary schools to improve mathematical problem solving abilities.*

**Keywords:** Schema Based Instruction; Mathematics Problem-Solving Ability; Elementary School

### ABSTRAK

Penelitian ini dilatarbelakangi oleh adanya temuan bahwa siswa kelas V sekolah dasar negeri di Kota Kupang, Nusa Tenggara Timur masih kesulitan dalam menyelesaikan soal pemecahan masalah. Padahal kemampuan pemecahan masalah matematika merupakan salah satu keterampilan yang perlu diajarkan kepada siswa sejak belajar di sekolah dasar. Salah satu upaya untuk meningkatkan kemampuan pemecahan masalah matematika siswa yaitu dengan menerapkan metode Schema Based Instruction (SBI). Metode SBI membantu siswa memetakan informasi penting pada skema sehingga mereka dapat merencanakan solusi penyelesaian masalah yang tepat. Penelitian ini bertujuan untuk mengetahui pengaruh metode SBI terhadap kemampuan pemecahan masalah matematika siswa kelas V sekolah dasar. Penelitian ini menggunakan metode eksperimen dengan desain penelitian adalah posttest-only control group desain. Penelitian dilakukan pada kelas V di salah satu sekolah negeri di Kecamatan Kelapa Lima, Kota Kupang, NTT. Hasil post-test diuji menggunakan uji T dan post hock

untuk mengetahui apakah terdapat pengaruh dari metode SBI terhadap kemampuan pemecahan masalah matematika. Hasil penelitian menunjukkan bahwa hasil belajar siswa dengan menggunakan metode SBI lebih tinggi dibandingkan siswa yang belajar menggunakan metode ekspositori. Metode SBI dapat digunakan sebagai salah satu referensi metode pembelajaran di sekolah dasar untuk meningkatkan kemampuan pemecahan masalah matematika.

**Kata Kunci:** Schema Based Instruction; Kemampuan Pemecahan Masalah Matematika; Sekolah Dasar

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## INTRODUCTION

Mathematics is one of the compulsory subjects for students from elementary education to higher education. Mathematics is a fundamental subject because arithmetic and logical reasoning are the basis of science and technology (Yeh et al., 2019). Mathematics also has a role in social life and professional environments and contributes to understanding everyday phenomena (Mrizkidirmansyah & Febriandi, 2023). Mathematics teaching and learning should focus not only on delivering concepts to students but also on engaging them in using those concepts to make meaning and understand the context of real daily life (Jediut et al., 2023). Students need to be taught to understand that various activities in daily life use mathematical concepts.

Mathematical problem-solving is one of the competencies in mathematics. Mathematical problem-solving is a process in which a person is exposed to mathematical concepts, skills, and processes to solve problems (Kopparla et al., 2019). This ability is related to the need for students to solve problems they face in everyday life and be able to develop themselves (Kurino et al., 2023). Without problem-solving skills, students only learn how to calculate, rather than learning why and when to use math skills (Root et al., 2017). One of the strategies for solving problems faced by students can be influenced by mathematical ability so differences in mathematical ability can also affect students' cognitive processes (Voica et al., 2020). Mathematical problem-solving can be solved by students if they have understood the given problem, can make a problem-solving plan, carry out the problem-solving plan, and do a recheck (Yapatang & Polyiem, 2022).

Problem-solving ability can be seen in students' ability to solve word problems (Root et al., 2017). Story problems are one of the most difficult types of problems faced by math learners (Vicente et al., 2022). Math problem-solving in the form of story problems is difficult for students because these problems require not only calculations but also linguistic understanding (Fuchs et al., 2021). This implies that students need to understand the use of words and sentences contained in problem-solving story problems. Problem-solving requires a process of understanding the text and using mathematical knowledge and operations (Öztürk et al., 2020). The ability of pupils to transfer schemas for problem-solving is influenced by three factors. In order to solve problems, students need to be able to: (a) comprehend and become proficient in problem-solving techniques; (b) create categories to group problems with comparable solution procedures; and (c) identify new problems that are connected to problems that have already been addressed (Skinner & Cuevas, 2023).

Based on the facts found in the field, there are still many grade V primary school students in Kelapa Lima Sub-district, Kupang City who have difficulty understanding problems when solving story problems. This can be seen from the results of student work when solving problems. Students do not understand the words written in the story problem so they are less able to state the information that is known and what is asked in the problem. Grade V students do not understand the problems in the problem so they make mistakes in planning problem solving. This can be seen from the results of student work. The wrong solution plan can be seen from the incorrect use of mathematical symbols to form an incorrect mathematical equation. Inappropriate problem-solving plans result in students making mistakes in the problem-solving process. The problem-solving process is related to students' ability to perform arithmetic operations. Some fifth-grade elementary school students are mistaken in the planning process which affects the results of problem-solving.

To overcome this problem, a learning model that can facilitate students to develop problem-solving skills is needed. Mathematical problem-solving requires skills to apply a variety of different strategies and solution models (Kaitera & Harmoinen, 2022a). An appropriate learning method is needed to help students develop different solution models for each problem-solving problem. Problem solving is the core and main process in the mathematics curriculum, meaning that learning problem solving prioritizes the process and strategies used by students in solving them rather than just the results (Nurfatanah et al., 2018). So that process skills and strategies in solving problems become basic abilities in learning mathematics. The Schema Based Instruction (SBI) method is a schematic diagram teaching model to encode information on problems that help solve problem-solving problems (Peltier et al., 2021). SBI is a cognitive-based approach to word problem solving that combines self-monitoring, explicit instruction, and heuristics (Clausen et al., 2021). It assists students in determining the kind of schema that a word problem represents so they may choose the best problem-solving technique to solve it. The SBI method helps students create cognitive structures from the information obtained on mathematical problem-solving problems (Jung et al., 2022). In SBI, students identify and complete schematic diagrams, identify solution plans, implement plans, and check their correctness (Desmarais et al., 2019). The indicators of problem solving ability used are being able to understand the problem, plan a solution strategy and implement the plan that has been made. The benefits of SBI include overcoming these challenges by employing explicit instruction to give students the conceptual knowledge required to solve problems; this benefits students of all ability levels at all educational levels (elementary through high school) in all kinds of mathematical problems (Suntari & Mairing, 2023).

This is supported by research that has been done before. Previous research was conducted by Skinner & Cuevas (2023) who applied SBI to the mathematics learning of third-grade elementary school students. The findings in this study indicate that the SBI method can help third-grade elementary school students develop problem-solving skills. This study has not combined the SBI method with other learning methods that can improve students' problem-solving skills. Another study was also conducted by Karayil & Praveen (2019) who used the SBI method to improve problem-solving skills in physics lessons at senior high school. the

results showed that students who studied using the SBI method had higher problem-solving skills than students who studied with conventional methods.

Different from the research that has been done before, in this study the Schema Based Instruction (SBI) method is used to improve the mathematical problem-solving ability of grade V elementary school students. this research is also different because it was conducted in one of the public schools in Kupang City, East Nusa Tenggara. This research is expected to be one of the references for educators to use the SBI method in improving the mathematical problem-solving ability of elementary school students.

## METHODS

### Type and Design

This study uses experimental research methods. Experimental research methods are research methods that use strict control of variables to test cause-and-effect hypotheses (Zahro & Utomo, 2024). Experimental research explains whether an intervention affects outcomes for one group compared to another group (Putra et al., 2022). Experimental groups and control groups in experimental methods are related to efforts to measure the effects of a treatment or manipulation of independent variables on dependent variables in a reliable way. In this research design, there is a control group and an experimental group. The experimental class was treated with the application of the Schema Based Instruction (SBI) method. While the control class did not receive treatment, where the teacher taught using the usual learning method, namely the expository method.

This study used an experimental research method with a posttest-only control group design. Posttest-only control group design is an experimental design in which the control group and treatment group are measured after the treatment is given (Kaitera & Harmoinen, 2022a). In this design, researchers collect data after treatment is given to the treatment group and control group to determine whether there is a difference between the two groups. The research design can be presented in the following table below:

Table 1. Desain Experiment Posttest-only Control Group Design

Group	Action	Posttest
R	X	O <sub>1</sub>
R	-	O <sub>2</sub>

### Data and Data Sources

This research was conducted on grade V students in one of the public schools in Kupang City, East Nusa Tenggara. The research was conducted in March-April 2024. The learning topics that students learn are multiplication and division of fractions. The mathematical problem-solving ability test instrument is in the form of an essay question with measurement criteria in the form of a rubric. This test was conducted to measure students' mathematical problem-solving ability before treatment and after treatment. The number of essay questions done by students is 6 items.

### Data collection technique

Data collection in the form of a post-test is given after students learn the material of multiplication and division of fractions. previously, validity and reliability tests were carried out on the post-test questions. researchers tested 10 essay questions for trial and calculated their validity and reliability in other classes that were not research samples. the results showed that 6 questions were valid to be given as post-test questions.

#### 1. Validity Test

The sample used for the validity test was 28 students, so  $df = n - 2$ ,  $df = 28 - 2 = 26$ . Based on the table  $r$  product moment at 5% significance obtained  $r_{tabel} = 0.374$ . The validity test results are listed in the following table below:

Table 2. Validity Test

Item	<i>r</i> <sub>hitung</sub>	<i>r</i> <sub>tabel</sub>	Description
1	0.476	0.374	Valid
2	0.378	0.374	Valid
3	0.225	0.374	Invalid
4	0.194	0.374	Not valid
5	0.648	0.374	Invalid
6	0.471	0.374	Valid
7	0.615	0.374	Valid
8	0.342	0.374	Invalid
9	0.479	0.374	Valid
10	0.187	0.374	Invalid

Based on the table above, it can be seen that 4 out of 10 questions were not used in the study because they were invalid.

#### 2. Reliability Test

The reliability test is calculated from the items that are declared valid, namely 6 questions. The reliability test is said to be reliable if the Cronbach Alpha value is  $> 0.60$ .

Table 3. Reliability Test

Cronbach's Alpha	N of Items
0.722	6

Based on the reliability test conducted using SPSS, obtained Cronbach Alpha value of 0.722 so it is said to be reliable. Reliability in this study means that the results of the question are consistent despite repeated measurements.

### Data analysis

Before analyzing the data, researchers used prerequisite tests in the form of homogeneity and normality tests. This prerequisite test was carried out before the research was carried out using the data from the math daily test results. Homogeneity test using Levene Statistic test. The criteria are valid if the significance ( $p$ )  $\geq 0.05$  then the data groups come from populations that have the same variance. Meanwhile, if the significance value ( $p$ )  $< 0.05$  then the data group comes from a population that has different variances. Based on the results of the homogeneity test, it is known that the significance value of  $0.286 > 0.05$ . So it can be concluded that the data group comes from a population that has a homogeneous variance.

The normality test in this study used the One-Sample Kolmogorov-Smirnov Test. The criteria are if the significance value  $> 0.05$  then the distribution is normal. Meanwhile, if the significance value  $< 0.05$  then it is not normally distributed. Based on the results of the normality test, it is known that the significance value is  $0.187 > 0.05$ . So it can be concluded that the residual value is normally distributed. Data analysis in this study used hypothesis testing consisting of observations of the application of the SBI method and the T-test. This T-test aims to determine the comparison of the significance value and the comparison of the *thitung* and *ttabel* values of the students' post-test results.

## RESULTS AND DISCUSSION

Students in the experimental class learned using the SBI method and students in the control class learned using the expository method. the post-test was given in the form of working on 6 essay questions after students learned the multiplication and division of fractions material. the post-test results were processed using the T-test to see if there was an effect of learning methods on the mathematical problem-solving ability of fifth-grade students. Data processing for the T-test using the SPSS 26 program. the results of the calculation can be seen in the table below:

Table 4. Uji-T

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Metode	Equal variances assumed	-4.021	38	.000	-4.950	1.231	-7.442	-2.458
	Equal variances not assumed	-4.021	30.650	.000	-4.950	1.231	-7.462	-2.438

From the table, the results of the T-test calculation using SPSS can be seen that sig (2-tailed) is 0.000. Sig value (2-tailed) is 0.000 then  $0.000 < 0.05$ , so it can be concluded that there is a

positive influence of learning methods on the mathematical problem-solving ability of fifth-grade elementary school students on the material of multiplication and division of fractions.

Furthermore, further tests were carried out to determine whether the mathematical problem-solving ability of fifth-grade students who learned using the SBI method was higher than those who learned using the expository method. The result can be seen in the table below:

Table 5. Post Hoc Test

	Group	N	Mean	Std.Deviation	Std. Error Mean
Post_Test	Ekspositori	28	72.5500	2.78104	.62186
	SBI	28	79.5000	4.75173	1.06252

Based on the test results above, the mean value  $\mu_B > \mu_A = 79.5 > 72.5$  so it can be concluded that the mathematical problem-solving ability of fifth-grade students who learn using the SBI method is higher than those who learn using the expository method.

The Schema Based Instruction (SBI) method is designed to develop understanding and organizational skills of information found in problem-solving story problems (Root et al., 2017). This helps students develop the first problem-solving skill which is understanding the problem. The SBI method helps students familiarize themselves with reading the problem and determining the important information needed to solve the problem. This information is then entered into the problem-solving scheme. Understanding the problem is an important first stage for students as this will help them design appropriate problem-solving strategies (Iffah & Masruroh, 2019).

The second indicator of problem-solving ability is planning problem-solving strategies. The SBI method can help students plan problem-solving strategies by creating schemes that match the important information in the problem (Hughes & Cuevas, 2020). Visualization with schemes will help students think of regular patterns that will help them solve problems (Kaitera & Harmoinen, 2022). This is to the developmental stages of the ability of elementary school students who easily remember and understand something if accompanied by a picture.

After students understand the known information and plan a problem-solving strategy, they can perform the appropriate math operations to solve the problem. Elementary school students need time to remember the necessary arithmetic operations so they need to be given time to practice. The SBI method facilitates students to practice because in the second and third syntax, students will be asked to identify problem-solving schemes that are by the question asked. This practice process provides time for students to sharpen their math problem-solving skills.

## CONCLUSION

Based on the research results and data analysis, it can be concluded that the Schema Based Instruction (SBI) learning method has a positive effect on elementary school students' mathematical problem-solving skills. Fifth-grade students in one of the public schools in Kupang City have better problem-solving skills than students who learn with the expository

method. They were able to determine important information in the problem, plan problem-solving strategies, and perform appropriate calculation operations to solve the problem. The results of this study can be used by teachers, lecturers, and educational practitioners that the SBI method can be applied to mathematics lessons at the elementary school level.

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