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ENHANCING MATHEMATICAL DISPOSITION THROUGH SCHEMA-BASED INSTRUCTION

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Abstract

ABSTRACT
Mathematical disposition is an essential aspect that influences students' confidence, persistence, and willingness to engage in mathematical problem solving. However, many students still demonstrate low levels of disposition, which limits their ability to learn mathematics effectively. This study aims to examine the effect of Schema-Based Instruction (SBI) on students' mathematical disposition. The research employed a posttest-only control group design involving 30 fifth-grade students at SD Negeri Pekayon 03 Jakarta Timur, who were divided into experimental and control classes. The experimental group received learning through SBI, while the control group was taught using conventional methods. Data on mathematical disposition were collected using a validated 40-item questionnaire and analyzed both descriptively and inferentially. The inferential analysis included normality, homogeneity, and independent sample t-test using SPSS version 29. The results showed that students taught with SBI had significantly higher mathematical disposition (M = 89.33, SD = 5.033) compared to those in the control group (M = 81.23, SD = 6.458). The independent sample t-test revealed a highly significant difference ($p < 0.001$) with a mean difference of 8.10 points and a 95% confidence interval (5.108–11.092) that did not cross zero. These findings indicate that SBI is effective in fostering students' confidence, persistence, flexibility, and reflective thinking in learning mathematics. The study suggests that Schema-Based Instruction can be an alternative pedagogical approach to enhance mathematical disposition in primary school mathematics classrooms.

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INTRODUCTION

Mathematics is a discipline that occupies a central position in education, serving not only as a tool for understanding quantitative phenomena but also as a means for practicing critical, logical, and systematic thinking (Lerman, 2020). Success in learning mathematics is not solely determined by students' cognitive abilities in understanding concepts and procedures, but is also greatly influenced by their mathematical disposition (Huda & Syafmen, 2021). Mathematical disposition encompasses attitudes, thinking habits, self-confidence, and a willingness to face challenges in mathematics learning (Awofala et al., 2022). Students with a positive mathematical disposition tend to view mathematics as a rewarding, enjoyable, and challenging subject, thus being more persistent in solving problems and able to persevere in the face of difficulties. Conversely, a low mathematical disposition often leads to students giving up easily, lacking confidence, and viewing mathematics as difficult and intimidating. Therefore, mathematical disposition is an important aspect that cannot be ignored in efforts to improve the quality of mathematics learning.

Despite the vital role of mathematical disposition, many students still exhibit a low disposition. Various studies report that students are often unmotivated to learn mathematics, experience high levels of anxiety about the subject, and exhibit negative attitudes such as reluctance to engage in discussions or work on challenging problems (Skilling et al., 2021). This situation not only impacts low academic achievement but also hinders the development of higher-order thinking skills, the primary goal of mathematics learning (Azid et al., 2022). Low mathematical dispositions are also closely related to students' tendency to view mathematics as a collection of formulas and procedures to be memorized, rather than as a thinking tool that can help them understand and solve everyday life problems (Kusmaryono et al., 2019). This indicates that mathematics learning, which is still oriented toward the end result (product) without considering the students' processes and affective experiences, has not been able to shift mathematical dispositions in a more positive direction.

The role of teachers is crucial because they are tasked not only with transferring knowledge but also with creating a learning environment conducive to fostering positive dispositions Janse van (Rensburg & Rauscher, 2022). The learning strategies used by teachers significantly influence how students view mathematics. Conventional approaches that emphasize repetitive practice without allowing for exploration and in-depth understanding often fail to spark students' curiosity and interest (Nilimaa, 2023). Therefore, learning innovations are needed that integrate cognitive and affective aspects simultaneously, so that students not only understand concepts but also develop confidence, motivation, and a positive attitude toward mathematics (Wu et al., 2022). In this regard, selecting the right learning strategy is a determining factor in successfully improving students' mathematical dispositions.

One approach believed to be able to address these challenges is Schema-Based Instruction (SBI). SBI is a learning strategy that focuses on identifying and using schemas to understand and solve mathematical problems (Clausen et al., 2021; Jitendra, 2019). This approach emphasizes the importance of students understanding the semantic structure of a problem, rather than simply relying on keywords or mechanical procedures (Xin, 2019). Through SBI, students are trained to recognize problem types, construct visual representations, connect key information, and systematically plan problem-solving steps (Hott et al., 2021). Thus, students not only acquire procedural skills but also develop in-depth conceptual understanding. SBI also encourages students to actively engage in the learning process, discuss, and reflect on their thinking, thus having the potential to foster a positive mathematical disposition.

The relationship between SBI and mathematical disposition can be explained through several aspects. First, SBI provides a meaningful learning experience because students do not simply memorize procedures but learn to understand the patterns and structure of problems (Cox & Root, 2020). This fosters self-confidence because students feel more in control of their thinking processes. Second, the use of visual schematic representations in SBI makes mathematics feel more concrete and understandable, thereby reducing anxiety and increasing interest (Mondal & Vijaykumar, 2025). Third, the collaborative and exploratory nature of SBI fosters a resilient attitude and perseverance in the face of challenges (Rahmasari et al., 2025). Thus, SBI not only contributes to improved problem-solving skills but also has the potential to improve overall mathematical dispositions.

Although various studies have examined the effectiveness of SBI in improving problem-solving skills, studies specifically highlighting its impact on mathematical dispositions are still relatively limited, especially in the Indonesian educational context. Most studies focus more on cognitive aspects such as conceptual understanding or procedural skills, while the equally important affective dimension is often overlooked. However, improving cognitive abilities without being accompanied by positive dispositional changes does not guarantee long-term learning success. Therefore, this research is relevant and important: to examine the extent to which the implementation of SBI can have a significant impact on students' mathematical dispositions.

Based on this background, this study aims to analyze the effect of implementing Schema-Based Instruction on students' mathematical dispositions. More specifically, this study seeks to answer the question: are there significant differences in mathematical dispositions between students learning using SBI and students learning using conventional methods? This research is expected to provide empirical evidence on the effectiveness of SBI, not only from a cognitive but also an affective perspective. The results are expected to contribute to the development of more holistic mathematics learning strategies and serve as a reference for teachers, researchers, and educational policymakers to strengthen students' mathematical dispositions at various levels of education.

METHOD

This study used a posttest-only control group design, in which an experimental group was given treatment in the form of learning with Schema-Based Instruction (SBI) and measurements were taken after the treatment to observe the changes that occurred (Hassan & Kalluvalappil, 2024; Jamaludin et al., 2022; Weber et al., 2020). In addition, there was a control group without treatment as a comparison group. This design was chosen because it is suitable for measuring the effectiveness of the learning approach on students' mathematical dispositions in different groups. The study was conducted in the even semester of the 2024/2025 academic year at a junior high school located at SD Negeri Pekayon 03, East Jakarta. Through this design, researchers were able to compare the mathematical dispositions of students who received learning with SBI and students who received conventional learning, thus obtaining a clear picture of the effect of SBI on mathematical dispositions. The following is a schematic of the research design used.

Table 1. Skema Posttest-Only Control Group Design

Group	Treatment	Posttest
E	X	O_1
C	-	O_2

Description:
E : Experimental Class
C : Control Class
X : Schema-Based Instruction Treatment
O1 : Experimental Class Posttest
O2 : Control Class Posttest

The subjects of this study were 30 fifth-grade students of Pekayon 03 Elementary School, East Jakarta, who were studying Plane Shapes. The subjects were selected purposively by considering the suitability of the learning materials to the curriculum learning outcomes, namely that students are able to recognize, analyze, and solve problems related to the properties and area and perimeter of plane shapes (Campbell et al., 2020). The characteristics of elementary school students at the concrete operational development stage make them relevant for the application of SBI, because this approach emphasizes the use of visual representations, problem grouping, and reflection in solving mathematical problems.

Data collection was conducted using a mathematical disposition questionnaire instrument designed based on mathematical disposition indicators, including: (1) a tendency to actively engage in mathematical processes; (2) self-confidence in facing mathematical material; (3) drive in overcoming mathematical challenges; (4) flexibility in problem-solving; and (5) the ability to reflect on and monitor the problem-solving process. The questionnaire consisted of 40 Likert-scale statements, encompassing both positive and negative statements. In addition to the questionnaire, observations were also conducted to monitor student engagement in the learning process, and interviews with several students provided supporting data regarding their experiences learning with SBI.

The data obtained were analyzed using descriptive and inferential approaches. Descriptive analysis was used to describe students' mathematical dispositions in each group, including score distribution, averages, and general trends in dispositions. Meanwhile, inferential analysis was used to test the research hypotheses. The first stage was prerequisite testing, consisting of normality and homogeneity tests, to ensure the feasibility of using parametric tests. After meeting the prerequisites, an independent sample t-test was conducted to compare the results of students' mathematical dispositions in the experimental and control groups. All analyses were conducted using SPSS version 29 software.

RESULTS AND DISCUSSION

Results:

This study compares the results of students' mathematical disposition measurements between grade 5A (experimental class) and 5B (control class) at Pekayon 03 Elementary School after participating in learning with the Schema-Based Instruction (SBI) approach and conventional learning. The data analyzed came from the post-test results in the form of a mathematical disposition questionnaire and were processed using SPSS software version 29. Descriptive statistical analysis was carried out to obtain an overview of students' mathematical disposition scores, including the mean, maximum value, minimum value, and standard deviation.

Table 2. Descriptive Analysis Results

Statistics	Experimental Class	Control Class
Mean	89.33	81.23
Minimum	80	67
Maximum	100	93
Std. Deviation	5.033	6.458

Based on Table 2, the results of the descriptive analysis show that students' mathematical disposition in the experimental class was higher than that in the control class. The experimental class, which followed the Schema-Based Instruction (SBI) approach, obtained an average score of 89.33 with a score range of 80–100 and a standard deviation of 5.033. Meanwhile, the control class, which followed conventional learning, only achieved an average score of 81.23 with a score range of 67–93 and a standard deviation of 6.458. This finding indicates that the implementation of SBI has a positive contribution in improving students' mathematical disposition compared to conventional learning. To ensure the feasibility of the data before conducting inferential analysis, prerequisite tests were conducted. One of them was data normality analysis using the Shapiro-Wilk test, which was chosen because it was appropriate for the number of research samples, namely 30 students in the experimental class and 30 students in the control class. The results of this test serve as the basis for determining whether the data is normally distributed so that it can be analyzed further with parametric tests, such as the independent sample t-test.

Table 3. Normality Test Results

Statistics		Kolmogorov-Smirnov			Shapiro-Will		
		Statistic	df	Sig.	Statistic	df	Sig.
Mathematical Disposition	Experimental Class	0.153	30	0.072	0.957	30	0.255
	Control Class	0.156	30	0.060	0.944	30	0.119

Based on the results of the Shapiro-Wilk normality test, the significance value in the experimental class was 0.255 and in the control class was 0.119. Since both significance values were greater than 0.05, it can be concluded that the post-test data on mathematics disposition in both the experimental and control classes were normally distributed. Thus, the assumption of normality was met, making the data suitable for further analysis using parametric statistical tests, such as the independent sample t-test. After the assumption of normality was met, the next step was to conduct a homogeneity test to ensure that the data variances in both groups were equal. This homogeneity test is important as a prerequisite before conducting a t-test, because the results will determine the validity of the use of the parametric test. The analysis was carried out using SPSS version 29 software, so that it could be determined whether the data variances in the experimental and control classes were homogeneous.

Table 4. Homogeneity Test Results

	Statistics	Levene Statistic	df1	df2	Sig.
Mathematical Disposition	Based on Mean	0.867	1	58	0.356
	Based on Median	0.841	1	58	0.363
	Based on Median and with adjusted df	0.841	1	52.535	0.363
	Based on trimmed mean	0.888	1	58	0.350

Based on the homogeneity test results in Table 4, a significance value of 0.356 was obtained, which is greater than 0.05. This indicates that the mathematical disposition data in the experimental and control classes are homogeneous, thus meeting the assumptions for further analysis using the t-test. With the normality and homogeneity assumptions met, inferential analysis can proceed to test the research hypotheses.

The analysis technique used in this study was the independent sample t-test. This test was chosen because it is appropriate for comparing the average mathematical disposition between two independent groups: fifth-grade students (the experimental class) who participated in learning with the Schema-Based Instruction (SBI) approach and fifth-grade students (the control class) who participated in conventional learning. The analysis was conducted using SPSS version 29 software to obtain accurate results. The following table presents the results of the t-test.

Table 5. T-Test Results

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Mathematical Disposition	Equal variances assumed	5.419	58	<.0001	8.100	1.495	5.108	11.092

The results of the hypothesis test using the independent samples t-test showed that the significance value (p) < 0.001, which means there is a very significant difference between the experimental class and the control class. The average score of students' mathematical disposition in the experimental class was 8.10 points higher than that in the control class. The 95% confidence interval (5.108 – 11.092) did not cross zero, thus strengthening the conclusion that the implementation of Schema-Based Instruction (SBI) has a positive and significant effect in improving the mathematical disposition of fifth-grade students at Pekayon 03 Elementary School, East Jakarta.

Discussion:

The implementation of Schema-Based Instruction (SBI) has been proven to have a positive impact on improving students' mathematical dispositions. Through systematic learning stages, students are actively involved in identifying, representing, comparing, and solving mathematical problems, thus developing each indicator of mathematical disposition. Consistent with Gunawan et al. (2025) and Zhang et al. (2021) opinion, schema-based learning connects cognitive and affective aspects, which impacts positive attitudes, self-confidence, and persistence in learning mathematics.

In the initial stage, students are trained to identify schemas (types of problems). The teacher guides students in analyzing examples of plane geometry problems, then students list familiar and new concepts and draw problem situation diagrams. This process directly engages students in understanding the problem structure, thus eliciting dispositional indicators of a tendency to actively engage in the mathematical process. This aligns with Björklund et al. (2020) and Chen (2025) argument that early involvement through identifying problem patterns can increase students' curiosity and attention to mathematics learning.

The next stage is familiarization with schematic diagrams. The teacher encourages students to create visual representations, either through class discussions or group work. This activity helps students present abstract information in a concrete way, making it easier for them to understand the relationships between elements in plane figures. This activity contributes to an indicator of confidence in facing mathematics material, as students feel capable of organizing information and solving problems with the help of diagrams. Purwadi et al. (2019) emphasized that visual representations in mathematics learning can reduce anxiety and increase students' confidence in understanding abstract concepts.

The next stage involves familiarizing themselves with situationally different but structurally similar problems. The teacher presents several plane figure problems that differ in context but share the same structural pattern. Students are asked to compare the similarities between these situations. This activity fosters an indicator of a driven disposition to overcome mathematical challenges, as students learn to face a variety of problems without giving up easily. In line with Xavier and Meneses (2022), the experience of discovering patterns behind diverse problems makes students more persistent, persistent, and motivated to find solutions.

In the stage of familiarizing themselves with situationally similar but structurally different problems, the teacher presents problems with situations that appear similar but require different solution strategies. Students then choose an appropriate scheme and provide arguments for their choice. This activity fosters indicators of flexibility in mathematical problem-solving, as students are required to adapt strategies to different problem structures. This aligns with Peltier et al. (2021) and Jung et al. (2022), who stated that flexibility in strategy selection is an important skill that can be developed through schema-based practice.

The final stage involves practicing problem-solving using various problem schemas. The teacher provides intensive practice that requires students to identify important features, draw schemas, determine relevant data, and select appropriate mathematical operations. At this stage, indicators of reflection and monitoring the problem-solving process develop, as students become accustomed to reviewing steps taken, evaluating strategies, and correcting errors. This aligns with the view of Waluya et al. (2022) that self-reflection in problem-solving is an essential part of developing a positive mathematical disposition.

Overall, each syntax within Schema-Based Instruction supports the development of students' mathematical dispositions. Schema identification promotes active engagement, schematic diagrams strengthen confidence, problem comparisons encourage persistence, schema selection fosters flexibility, and intensive practice develops reflective skills. The results of this study align with Alghamdi et al. (2020) and Boamah et al. (2025) emphasized that schema-based learning is effective not only for cognitive development but also for developing positive dispositions toward mathematics. Therefore, SBI can be recommended as an innovative approach to mathematics learning, particularly for plane geometry, to strengthen students' dispositions in the long term.

CONCLUSION

This study demonstrates that the implementation of Schema-Based Instruction (SBI) has a positive and significant impact on the mathematical disposition of fifth-grade students at Pekayon 03 Elementary School, East Jakarta, on the topic of plane figures. Students learning with SBI demonstrated more active engagement, higher self-confidence, persistence in facing challenges, flexibility in problem-solving, and improved reflection skills compared to students learning with conventional learning.

Thus, SBI can be recommended as an effective learning approach to improve elementary school students' mathematical disposition. This approach helps students understand problem structures more deeply while fostering positive attitudes toward mathematics. Future research is expected to test the effectiveness of SBI on other materials and at different levels to expand its contribution to the development of mathematics learning.

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