Study on the Effectiveness of the SAVI Model in Improving Problem-Solving Skills in Mathematics for Sixth Grade Students: A Focus on Independent Learning Aspects

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Abstract
Education in Indonesia faces challenges in improving learning quality, particularly in mathematics, where the SAVI (Somatic, Auditory, Visual, Intellectual) model offers an innovative and interactive approach to developing students' logical and analytical thinking skills. This study aims to analyze the effectiveness of the SAVI model in enhancing the mathematical problem-solving abilities of sixth-grade students, with a focus on aspects of independent learning. The research design used is a pre-experimental design, specifically the One Group Pre-test-Post-test Design. Data for this study were collected through problem-solving ability tests administered before and after the intervention. The pre-intervention test established a baseline for students' skills, while the post-intervention test measured improvements following the implementation of the SAVI model. The results show that the implementation of the SAVI learning model is effective in improving the mathematical problem-solving abilities of sixth-grade students, with an average score increase of 10 points from Pre-test to Post-test. The average N-Gain of 0.38 indicates progress in the moderate category, suggesting potential for further development. Each element of SAVI contributes significantly to student engagement and independence in learning. Therefore, several important recommendations, such as regular evaluations, assessments of academic achievement, and modifications to the implementation of this model, are necessary to achieve more optimal results in enhancing students' mathematical abilities.
Keywords: SAVI model, problem-solving skills, mathematics, independent learning

Abstrak
Pendidikan di Indonesia menghadapi tantangan dalam meningkatkan mutu pembelajaran, terutama dalam mata pelajaran matematika. Pendidikan matematika memiliki peranan penting dalam membentuk kemampuan berpikir logis dan analitis siswa. Kemampuan pemecahan masalah matematika merupakan salah satu keterampilan kunci yang harus dikuasai oleh siswa, terutama di tingkat dasar. Model SAVI (Somatic, Auditory, Visual, Intellectual) menawarkan pendekatan yang inovatif dan interaktif dalam pembelajaran Penelitian ini bertujuan untuk menganalisis efektivitas Model SAVI (Somatic, Auditory, Visual, dan Intellectual) dalam meningkatkan kemampuan pemecahan masalah matematika siswa kelas 6, dengan fokus pada aspek mandiri belajar. Rancangan penelitian yang digunakan adalah pra-eksperimental dengan desain penelitian yakni One Group Pre-test-Post-test Design. Data dikumpulkan melalui tes kemampuan pemecahan masalah yang diberikan sebelum dan setelah perlakuan. Hasil penelitian menunjukkan Penerapan model pembelajaran SAVI (Somatic, Auditory, Visual, Intellectual) terbukti efektif dalam meningkatkan kemampuan pemecahan masalah matematika siswa kelas 6, dengan peningkatan rata-rata skor sebesar 10 poin dari Pre-test ke Post-test. Rata-rata N-Gain sebesar 0,38 menunjukkan kemajuan dalam kategori sedang, menandakan potensi untuk pengembangan lebih lanjut. Setiap elemen SAVI berkontribusi signifikan terhadap keterlibatan siswa dan kemandirian dalam belajar. Oleh karena itu, beberapa rekomendasi penting, seperti evaluasi berkala, penilaian capaian akademik, dan modifikasi penerapan model ini, diperlukan untuk mencapai hasil yang lebih optimal dalam peningkatan kemampuan matematika siswa.
Keywords: Model SAVI, Kemampuan pemecahan masalah, Matematika, Mandiri belajar

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INTRODUCTION

Education in Indonesia faces several significant challenges in improving the quality of learning, particularly in mathematics. Education in Indonesia currently faces significant challenges in its efforts to improve learning quality, particularly in the subject of mathematics. Mathematics is not merely an academic subject; it is also a crucial foundation for developing the logical and analytical thinking skills necessary for everyday life and various professional fields. Enhancing students' problem-solving abilities, especially at the elementary level, is essential for preparing them to face more complex challenges in the future. Mathematics is not only the foundation of science and technology but also plays a crucial role in developing students' critical and analytical thinking skills(Jenita et al., 2023; Rambe et al., n.d.; Yasin, 2021). However, the low performance of students in this subject, as reflected in various research studies and international evaluations, indicates an urgent need for reform in teaching methods and learning approaches(Ristiyana et al., 2024; Safari & Nurhida, 2024). One of the main challenges is the reliance on conventional teaching methods. Many teachers tend to use lecture-based approaches with minimal interaction, which can lead to students feeling less engaged in the learning process(Beatty et al., 2022; Tambunan & Yang, 2022). This approach not only reduces student motivation but also limits their opportunities to understand mathematical concepts in depth.

Generally, the education curriculum in Indonesia, especially in mathematics, is considered overly dense and often irrelevant to students' needs(Arrafii, 2020; Clements et al., 2012; Suhendra, 2015). The curriculum should not only focus on mastery of material but also on developing critical and creative thinking skills necessary for everyday life. Pressure to meet high academic targets often results in students struggling to grasp fundamental concepts, ultimately fostering a negative attitude towards mathematics as a difficult and intimidating subject. Additionally, the lack of training and professional development for teachers contributes to the low quality of instruction. Limited educational resources, especially in remote areas, also hinder students' access to essential learning materials that support their understanding (Ferri et al., 2020; Maila & Ross, 2018; Stenman & Pettersson, 2020).

One alternative to address these issues is the implementation of the SAVI learning model. The SAVI model (Somatic, Auditory, Visual, Intellectual) emerges as an innovative and relevant approach in mathematics education, offering solutions to various challenges faced by students. By integrating different learning styles, this model enhances student engagement and helps them understand and solve mathematical problems more effectively.

The somatic element of the SAVI model plays a crucial role in encouraging hands-on experiences through physical activities, allowing students to engage actively in the learning process. Meanwhile, the auditory component emphasizes the importance of discussion and verbal communication, enabling students to share ideas and deepen their understanding of the material being taught. The use of visual media is also highly effective in clarifying concepts that may be difficult to grasp, making it easier for students to absorb information. Additionally, the intellectual aspect of this model encourages students to think critically and creatively in problem-solving, which are essential skills for addressing real-world challenges.

This research is particularly relevant in the context of mathematics education in Indonesia, where many students still struggle to understand mathematical concepts and develop problem-solving skills. By implementing the SAVI model, it is expected that students will become more motivated and engaged in their learning processes. Through the analysis of this model's implementation, more effective teaching methods for mathematics can be identified, ultimately enhancing student motivation and learning outcomes.

The primary objective of this research is to explore the effectiveness of the SAVI model in improving the problem-solving abilities of sixth-grade students in mathematics.

METHOD

This type of research is pre-experimental research. Pre-experimental research is a type of study that observes the effects of an intervention without a control group, making it difficult to fully establish causal relationships. In the context of applying the SAVI model (Somatic, Auditory, Visual, Intellectual), the researcher measures students' abilities before and after the intervention to identify any changes that occur. The research design employed is a One Group Pre-test-Post-test Design, where no control variable is present, and the sample is not selected randomly. This design is illustrated in Table 1 below:

Table 1. Pre-test and Post-test Analysis

Subject	Pre-test (O1)	Post-test (O2)
One Group	Pre-test score before SAVI model instruction	Post-test score after SAVI model instruction

Explanation: O1: Pre-test score taken before students were taught using the SAVI (Somatic, Auditory, Visual, Intellectual) model. O2: Post-test score taken after students were taught using the SAVI model.

This study was conducted at SDN Tambakmas 01 Kebonsari Madiun which involving the students within sixth grades as the sample. The research instruments include several key tools to measure the effectiveness of the SAVI model in improving students' mathematical problem-solving abilities. First, a Mathematical Problem-Solving Test (Pre-test-Post-test) is used to measure students' improvement, with the Pre-test conducted before the model implementation and the Post-test afterward.

The results are analyzed using the N-Gain test to determine the extent of the improvement. Second, a Learning Independence Questionnaire is designed to assess the students' level of independence in learning, using a Likert scale to gather information about students' attitudes and motivation. Additionally, an Observation Sheet is used to monitor students' activities during the learning process, with a checklist that includes indicators of engagement and collaboration. Data collection was carried out in two stages: Pre-test and Post-test. Data analysis involves evaluating the test results, as well as data from the questionnaire and observation sheets, which provide a comprehensive overview of the relationship between learning independence and students' problem-solving abilities after the implementation of the SAVI model. The N-Gain test is used to analyze the increase in problem-solving abilities, allowing researchers to measure the effectiveness of the intervention. Additionally, descriptive statistics will be employed to summarize the data, while inferential statistics may be utilized to determine the significance of the findings (grenn et al 2007).

RESULTS AND DISCUSSION

The following table outlines the stages of mathematical problem-solving along with their descriptions and indicators.

Table 2. Problem-Solving Stages Identification

Stage	Description	Indicator
Problem Identification	Students recognize and understand the type of mathematical problem they are facing, such as word problems, equations, or graphs.	- Able to read and comprehend the problem well, identifying the necessary mathematical operations. - Can mention relevant key information, such as numbers and relationships between data in the problem.
Information Gathering	Students collect data and information needed to solve the mathematical problem.	- Able to find the required data from textbooks, notes, or other relevant sources. - Can document information in a structured way, such as using tables to compare data or diagrams for visualization.
Solution Planning	Students plan the steps they will take to solve the mathematical problem.	- Able to devise a logical solution strategy, such as determining the initial steps before performing calculations. - Can select the appropriate method or formula to use, such as percentages, fractions, or basic operations.
Solution Implementation	Students execute the plan they have developed to find the solution to the mathematical problem.	- Able to implement the problem-solving steps correctly and thoroughly, ensuring no calculation errors. - Can calculate and produce the correct final answer, while also explaining the steps taken.
Evaluation and Reflection	Students evaluate the results and reflect on the process they went through.	- Able to explain the obtained results and compare them with the expected solution, and assess whether the answer makes sense in the context of the problem. - Can identify mistakes made, such as calculation errors or misinterpretation of the problem, and formulate improvement steps for future problem-solving.

The stages of mathematical problem-solving include five critical steps that help students solve problems systematically. The process begins with **problem**

identification, where students recognize the type of problem and identify the necessary mathematical operations and key information. In the **information gathering** stage, students search for relevant data from various sources and organize it in a structured manner for easier analysis. Next, in the **solution planning** stage, students design logical strategies, choose the appropriate methods or formulas, and determine the initial steps to take. The **solution implementation** stage involves applying the plan carefully to calculate and find the correct answer while explaining the process. Finally, in the **evaluation and reflection** stage, students assess the results obtained, compare them with the expected solution, identify errors, and develop improvement strategies for future problem-solving. This process ensures that mathematical problem-solving is thorough and effective. Below is a table summarizing the pretest and posttest scores for the mathematical problem-solving abilities of 6th-grade students, analyzed from the perspective of independent learning before and after the implementation of the SAVI model

Table 3. Recap of Pretest-Posttest Scores for Problem-Solving Abilities

No.	Group	N	Ideal score	value		Average
				Minimum value	Maximum Value	
1.	Pre tes	28	100	50	70	65
2.	Post tes	28	100	60	90	75

Based on the data presented, there is a significant improvement in students' mathematical problem-solving abilities after the implementation of the learning model. In the pretest phase, student scores ranged from 50 to 70, with an average of 65, indicating that while some students demonstrated a good understanding, there were still a number of students who struggled with solving mathematical problems. Following the intervention, the posttest results showed positive development, with the minimum score rising to 60 and the maximum reaching 90, while the average increased to 75. The average score improvement of 10 points from pretest to posttest, along with the shift in minimum and maximum scores, reflects the effectiveness of the applied learning model in helping students develop their skills. This can be seen in the accompanying graph.

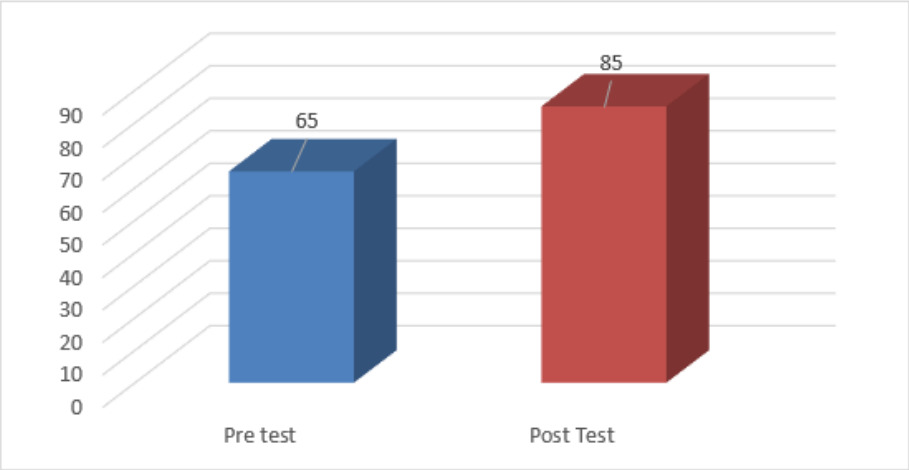

Figure 1. Student Problem-Solving Ability Scores

Tabel 4. Recap of Pretest and Posttest Scores with N Gain

No.	Group	N	Ideal Score	Value		N Gain
				Minimum value	Maximum Value	
1.	Pre tes	28	100	50	70	0.38.
2.	Post tes	28	100	60	90	

Based on the research data, there was an improvement in the mathematical problem-solving abilities of 6th-grade students after implementing the SAVI learning model. In the pretest, students' scores ranged from 50 to 70, indicating varying initial performance. After the intervention, posttest results improved with a minimum score of 60 and a maximum of 90, reflecting an increase in understanding. The average N-Gain of 0.38 falls into the moderate category, suggesting that while the SAVI model was effective, there is opportunity of further improvement to achieve optimal results. Overall, this model had a positive impact, though additional adjustments could be made to enhance its effectiveness.

The following table connects the analysis of the SAVI model in improving the mathematical problem-solving abilities of 6th-grade students, viewed from the aspect of independent learning:

Table 5. Elements of the SAVI Model and Their Impact on Problem-Solving and Independent Learning

Element of SAVI Model	Description	Impact on Problem-Solving	Effect on Independent Learning
Somatic	Physical activities through manipulatives and teaching aids.	Helps students understand concepts practically and relate them to real life.	Encourages students to be more active and enthusiastic in independent learning.
Auditory	Classroom discussions and presentations.	Facilitates the exchange of ideas and understanding through verbal interaction.	Enhances students' ability to express opinions and learn from peers.
Visual	Use of visual media such as diagrams, charts, and videos.	Simplifies understanding and helps students visualize solutions concretely.	Assists students in reflecting on their problem-solving processes independently.
Intellectual	Encourages critical and creative thinking in solving problems.	Develops analytical and evaluative skills in finding solutions.	Increases students' ability to formulate independent problem-solving strategies.

This table illustrates how each element of the SAVI model not only contributes to improving students' mathematical problem-solving abilities but also fosters independent learning. Through physical activities, discussions, the use of visual aids, and the

promotion of critical thinking, students become more engaged in the learning process, which in turn enhances their ability to learn independently.

Data analysis involves evaluating the test results, along with data from questionnaires, observations, and interviews, which provide a comprehensive overview of the relationship between learning independence and students' problem-solving abilities after the implementation of the SAVI model. The N-Gain test is used to analyze the increase in problem-solving abilities, allowing researchers to measure the effectiveness of the intervention. Additionally, descriptive statistics will be employed to summarize the data, while inferential statistics may be utilized to determine the significance of the findings.

The research results indicate a significant improvement in students' mathematical problem-solving abilities following the implementation of the SAVI learning model. In the pretest phase, student scores ranged from 50 to 70, with an average of 65. This reflects that while some students were able to grasp the concepts well, a portion still struggled with problem-solving. After the intervention, the posttest results showed positive development, with the minimum score rising to 60 and the maximum reaching 90, while the average score increased to 75. The average score improvement of 10 points from pretest to posttest indicates the effectiveness of the implemented learning model in helping students develop their problem-solving skills.

Furthermore, observational data revealed increased student engagement and participation during lessons, aligning with the principles of the SAVI model. Interviews with students highlighted their enhanced understanding and confidence in tackling mathematical problems. Responses from questionnaires indicated that students felt more motivated and independent in their learning process after the intervention.

An average N-Gain of 0.38 suggests that this improvement falls within the moderate category, indicating that although the SAVI model is effective, there is still room for further development to achieve more optimal results. The above research shares similarities with the study conducted by (Lubis, 2021) The implementation of the SAVI learning model has successfully led to a significant improvement in student learning outcomes in each cycle, indicating the effectiveness of this approach in mathematics education. Other studies have also supported these findings, demonstrating that innovative teaching methods can enhance student engagement and understanding in various subjects. These studies highlight the importance of incorporating diverse learning styles and interactive strategies to foster a more conducive learning environment, ultimately improving academic performance. Other research conducted by (Pasaribu et al., 2023) The results indicate a significant influence of the Somatic, Auditory, Visual, and Intellectual (SAVI) learning model on mathematical problem-solving abilities at MTs Nurul Iman Tanjung Morawa. This research reveals a clear difference in math learning outcomes between students taught using the SAVI model and those taught with direct instruction. Students who participated in the SAVI learning model achieved higher math scores compared to those who experienced direct instruction. This finding suggests that the SAVI approach, which integrates various learning styles, effectively enhances student engagement and aids in their understanding of mathematical concepts. The model allows students to learn through hands-on experiences (somatic), engage in discussions (auditory), utilize visual media, and think critically and creatively (intellectual). All these elements contribute to improved understanding and problem-solving capabilities among students. Moreover, the math learning outcomes for students in the class utilizing the SAVI model were significantly higher than those in the class using direct instruction. Additionally, the level of student independence in the SAVI class predominantly fell within the "Developing" (SB) qualification (Sumawardani & Pasani, 2016)

CONCLUSION

The implementation of the SAVI (Somatic, Auditory, Visual, Intellectual) learning model is effective in enhancing the mathematical problem-solving abilities of sixth-grade students, as evidenced by an average score increase of 10 points from pretest to posttest. With an average N-Gain of 0.38, this model demonstrates progress in the moderate category, indicating potential for further development. Each element of SAVI contributes significantly to student engagement and independence in learning. Therefore, several recommendations can be made based on these findings, including conducting regular evaluations to monitor student progress and the effectiveness of the SAVI model, implementing standardized assessments to evaluate students' mathematical competencies comprehensively, and adapting the SAVI model based on feedback from students and educators to better meet the needs of diverse learners. Additionally, providing professional development for teachers on effectively implementing the SAVI model will enable them to maximize its benefits in the classroom. Encouraging students to reflect on their learning experiences and problem-solving approaches can further foster a deeper understanding of their thought processes and strategies

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