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Quantitative Study: Multimedia-Assisted SAVI Learning Model and Its Impact on Mathematical Problem-Solving Ability

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Abstract

In the 21st century, education focused on equipping students with abilities for lifelong learning and self-development, one of which was problem-solving ability. This ability was crucial in preparing students to solve real-life problems. The SAVI (Somatic, Auditory, Visual, Intellectual) learning model was one of the instructional models that could enhance students' mathematical problem-solving ability and could be integrated with technology use. This study aimed to examine the effect of the SAVI learning model assisted by multimedia on students' mathematical problem-solving ability. This research was a quasi-experimental study using the non-equivalent posttest only control group design. The sample consisted of classes X-1 and X-2 from a public high school in Magelang. The sample was selected by random sampling technique. The data obtained were processed using Independent Sample *t*–test and effect size. The results of the data analysis showed that there was a significant difference in students' mathematical problem-solving ability between the control and experimental groups. In addition, an effect size of 0.7 was obtained, indicating that the SAVI learning model assisted by multimedia had a large impact on mathematical problem-solving ability. This study recommended broader implementation and exploration in other subjects to enhance learning effectiveness.

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INTRODUCTION

Mathematics learning in the digital age faces various challenges, ranging from the technology access gap to the adaptation of effective teaching methods. Not all students have adequate devices and internet connections, thus causing disparities in material comprehension. In addition, teachers are required to master technology and integrate it into learning without compromising the essence of mathematical concepts. Distractions from digital media are also a challenge, where students tend to lose focus while learning (Zulfa & Mujazi, 2022). Therefore, innovative, interactive, and technology-based learning strategies are needed that can increase student engagement and strengthen their understanding of mathematical concepts in depth.

Learning mathematics by utilizing technology is inevitable. This is because: life today is in the 21st century, which is closely related to the era of the Fourth Industrial Revolution and Society 5.0 (Supa’at & Ihsan, 2023). Both of these eras rely heavily on the use of technology, making it an essential element of life in the 21st century. Advances in technology have transformed the expectations placed on teachers, who are now expected to help students develop 21st-century skills (O’Neal et al., 2017). Education in the 21st century focuses more on equipping students with the skills necessary for lifelong learning and self-development, rather than merely addressing the immediate needs of today's learners (Bedir, 2019). The skills emphasized in the 21st century are commonly referred to as the "4Cs" (Supena et al., 2021). These 4Cs represent critical thinking and problem-solving, creative thinking, collaboration, and communication skills (Yunizha, 2022).

The previous explanation highlights that problem-solving is a crucial ability that students must cultivate. This ability has become a major goal in mathematics curricula across many countries (Olivares et al., 2021; Özcan, 2016). Problem-solving ability help students tackle various challenges in everyday life (Özreçberoğlu & Çağanağa, 2018). Likewise, in the context of mathematics education, enhancing mathematical problem-solving ability is essential for tackling various mathematical challenges. The ability to solve problems serves as a clear indication of the value of mathematics, both in intellectual pursuits and in real-world applications (Căprioară, 2015). This indicates that mathematics is not only significant for enhancing logical and analytical thinking but is also highly applicable in real-world scenarios that require effective and creative solutions.

However, mathematical problem-solving ability in Indonesia remain at a low level. This is in line with the results of research conducted by Damayanti and Kartini (2022) which shows that there are only 15.70% of students who interpret the results of the calculations obtained in solving mathematical problems. Another study by Fauziah et al. (2022) also stated that students' problem-solving ability are in the low category. In additional, this is evident in the 2023 National Education Report Card released by the Ministry of Education, which indicated that high school students' numeracy skills scored an average of 41.14%. This report serves as an indicator of students' mathematical problem-solving ability, as there is a significant relationship between numeracy skills and mathematical problem-solving ability (Alfiah et al., 2020). Low numeracy skills often reflect inadequate mathematical problem-solving ability. Therefore, it is essential to continuously enhance problem-solving ability.

Previous research indicates that students' ability to solve mathematical problems still requires more attention. Budianto (2021) stated that this ability is low, which is thought to be the result of ineffective learning strategies, as the learning process tends to focus more on the role of the teacher and less on encouraging active participation from students. This finding aligns with the research of Krisdianti et al. (2023), which showed that students' mathematical problem-solving ability were categorized as medium. Similarly, Simatupang et al. (2019) revealed that most students exhibited problem-solving ability at a moderate level.

In addition to enhancing problem-solving ability, various other efforts are continuously being developed to ensure that students acquire 21st-century skills.

These initiatives aim to prepare students to compete effectively in a rapidly changing world and keep pace with technological advancements. One of the strategies is to establish a 21st-century learning environment (Alhamuddin et al., 2022). According to Iswanto (Iswanto, 2017, p. 10), a 21st-century learning environment is one that is aligned and synergized with the educational system to create learning experiences that cultivate 21st-century skills. It provides opportunities for students to learn in relevant and authentic contexts, supports collaboration among educators, ensures equitable access to quality learning tools, technology, and resources, offers learning designs for groups, teams, and individuals, and accommodates both in-person and online learning. The first step in implementing this 21st-century learning environment is to select an appropriate learning model and put it into practice. The effective implementation of the right learning model, coupled with the efficient use of technology, can foster a learning environment that stimulates interest, motivates students, and supports them in optimizing their potential (Tajudin et al., 2020).

One of the learning models that can be used for 21st-century education is the SAVI (Somatic, Auditory, Visualization, Intellectual) learning model. According to Sundari (2019), SAVI is a cooperative learning model, which encourages collaboration between students and teachers. This collaboration aligns with the principles of 21st-century learning. SAVI stands for Somatic (movement), Auditory (sound), Visualization (images), and Intellectual (concentration) (Rizqi & Nurjali, 2021). This learning model engages all students' sensory modalities in the learning process (Fajriah et al., 2020; Siagian et al., 2020). It requires focused thinking and should be practiced through logical reasoning, exploration, observation, discovery, creativity, concept development, problem-solving, and application in various contexts.

Several previous studies have highlighted the impact of the SAVI learning model on mathematical abilities, particularly in mathematical problem-solving ability. The findings of Retnowati et al. (2025) indicate that implementing the SAVI model is proven to be effective in enhancing students' mathematical problem-solving ability. Similarly, Wardani et al. (2025) reported that the SAVI learning model has a significant impact on students' problem-solving ability. Additionally, a study conducted by Syazali et al. (2022) confirmed that the SAVI learning model significantly improves students' problem-solving ability.

The rapid advancement of technology has led to innovations in learning models, including the SAVI learning model. The integration of SAVI with Android-based multimedia learning aligns with 21st-century education. However, its impact on students' mathematical problem-solving ability remains unclear. Therefore, this study aims to determine whether the integration of the SAVI learning model with multimedia has a significant effect on students' mathematical problem-solving ability.

RESEARCH METHODS

This research employed quantitative methods with a quasi-experimental approach. In this quasi-experimental design, two groups were selected: a control group and an experimental group. The control group was taught using a conventional learning model, while the experimental group was taught using the SAVI learning model assisted by multimedia. The research design utilized was a nonequivalent posttest-only control group design. The material covered was basic angle concepts, which served as a prerequisite for learning trigonometry. After the treatment, both classes were given a posttest to measure their mathematical problem-solving ability following the intervention..

The population in this study consists of Grade X students from a public high school in Magelang. From this population, two samples were selected using a random sampling technique. This sampling technique was chosen because the research population is relatively homogeneous so that each class has the same opportunity to be selected as a research sample (Machali, 2021). The samples used in this study were Grade X-1 as the control class and Grade X-2 as the experimental class. The control class (X-1) was taught using a conventional learning model, while the experimental class (X-2) was taught using the SAVI learning model assisted by multimedia. Each class selected as a research sample consisted of 32 students. After the treatment, both classes were given a posttest to assess their mathematical problem-solving ability.

The instrument used in this research is a test designed to measure students' mathematical problem-solving ability concerning the concept of angles. The test is in the form of an objective essay with the number of questions is three. The form of problem-solving item that are tested on students is presented in Table 1.

Table 1. Mathematical problem-solving ability item test

Item Test

1. Amar makes a triangle using cardboard. The angles of the triangle have a ratio of 3:4:5. Determine the smallest angle in degrees and the largest angle in radians of the triangle made by Amar!
2. Observe the following wall clock!

In the image, the minute hand is exactly pointing at 10, and the hour hand is pointing at 2. Rara and Riri are observing the movement of the minute hand on the clock. They imagine the angle covered by the minute hand if it moves from 1:50 PM to 3:30 PM. Determine the angle covered by the minute hand during this period when converted into degrees and radians!

3. Doni and Arya are playing with paper windmills. They run around to make the windmills spin. Doni's windmill rotates at a speed of 35 revolutions per minute, while Arya's windmill rotates at a speed of 42 revolutions per minute. Rifa estimates that the difference in the rotational speed of Doni’s and Arya’s windmills is 9/30 radians per second. Verify whether Rifa's estimation is correct!

Additionally, a non-test instrument in the form of a questionnaire was employed to validate the test. This questionnaire was administered to a validator to evaluate the suitability of the mathematical problem-solving ability test instrument for implementation. A research instrument is considered suitable for use if it is valid. In this regard, the instrument was first tested for validity. The test used in this study employed content validity, which was determined through the assessment of two validators who provided suggestions regarding the prepared test instrument. The validation results from the validators were then analyzed using the Aiken Index formula (Retnawati, 2016).

An instrument is considered valid and suitable for use if the validity index results fall within at least the medium validity category with a range of $V \geq 0.4$ (Retnawati, 2016). This validation is crucial for ensuring the accuracy and reliability of the test instrument, allowing the results obtained to be trusted and used as a basis for further analysis in the study. A quality instrument must meet the validity assessment standards (Lukman et al., 2023). The validation results from the two experts are presented in Table 2.

Table 2. The instrument content validity results

Overview	Posttest	
	$\sum S$	V
Material	30	0.75
Construction	18	0.75
Language	18	0.75
Total	66	0.75

Based on Table 2, the validity value of the mathematical problem-solving ability test instrument is 0.75. This value falls within the medium validity category, indicating that the instrument has a fairly good level of accuracy in measuring mathematical problem-solving ability. With a validity of 0.75, the instrument is considered suitable for use in research. This implies that the results obtained from using this instrument can be regarded as reasonably accurate and reliable for research purposes.

The instrument was ready to use. Furthermore, the data obtained using the instrument were analyzed by two types of statistical analysis: descriptive statistics and inferential statistics. Descriptive statistics are used to summarize the data by presenting the highest value, lowest value, average, variance, and standard deviation. In contrast, inferential statistical analysis is conducted through assumption tests and hypothesis tests. The assumption tests include normality tests and homogeneity tests, while the hypothesis tests assess the difference between two means. If the data meet the assumptions of normality and homogeneity, the analysis uses the Independent Samples *t*-test (Reid, 2013). The null hypothesis tested was that there was no difference in the average problem-solving ability test scores between students taught using the conventional learning model and those taught using the SAVI learning model assisted by multimedia. Furthermore, to determine the magnitude of the effect of the treatment using the SAVI learning model assisted by multimedia, an effect size test can be conducted.

After obtaining the effect size value, the next step is to interpret it based on Table 3.

Table 3. Interpretation of effect size

Effect Size	Interpretation
$d > 0.8$	Very large
$0.5 < d \leq 0.8$	Large
$0.2 < d \leq 0.5$	Medium
$0 < d \leq 0.2$	Small

RESULTS AND DISCUSSION

After the posttest was administered, the data obtained were analyzed using statistical methods, with the results as follows.

Table 4. Descriptive statistics of problem-solving scores

Description	Teaching Class	
	Conventional Model	SAVI Model
Highest score	100	100
Lowest score	10	46.67
Average	64.62	77.74
Variance	466.44	263.96
Standard deviation	21.60	16.25

Based on Table 4, both classes achieved the same highest score of 100. The lowest score in the control class was 10, whereas in the experimental class, it was 46.67. This indicates that the students in the experimental class had a higher minimum score compared to those in the control class, suggesting that the overall performance of students in the experimental class was better. Additionally, the average score of the experimental class, which utilized the multimedia-assisted SAVI learning model, was higher than that of the control class, which employed the conventional learning model. The average score difference between the two classes was 13.12.

The variance in the control class was 466.44, whereas in the experimental class, it was 263.96. The lower variance in the experimental class suggests that the students' scores were more consistent and closer to the mean compared to those in the control class. The standard deviation for the control class was 21.60, while the experimental class had a standard deviation of 16.25. The smaller standard deviation in the experimental class indicates that the students' scores were less variable, reflecting a more uniform level of performance compared to the control class.

Before proceeding to the hypothesis testing stage, it is essential to conduct assumption tests to ensure that the data meets the necessary criteria for further statistical analysis. The results of the assumption tests are presented in Table 5.

Table 5. Statistical analysis results: Normality, homogeneity, and *t*-test

Teaching Class	Normality	Homogenity	Independent Sample *t*-test		
	Sig.	*Sig.*	$t_{calc.}$	$t_{crit.}$	*Sig.*
Conventional model	0.200	0.289	-2.512	2.000	0.015
SAVI Model	0.069				

According to Table 5, The results of the normality test using the Liliefors test showed a significance value for the control class of 0.200, while for the experimental class, it is 0.069. Because both significance values exceed 0.05, we can conclude that the data from both classes follow a normal distribution. This indicates that the normality assumption is satisfied, meaning that the data in both classes do not exhibit significant deviations from a normal distribution. Furthermore, the results of the homogeneity test uisng the *F* test indicate that the significance value for both classes is 0.289. Because this significance value exceeds 0.05, we can conclude that the data from both classes satisfy the homogeneity assumption. This suggests that the variances of the two classes are equal. After verifying that the data on mathematical problem-solving ability meet the criteria for normality and homogeneity, the next step is to perform hypothesis testing. Since the assumption tests have been fulfilled, the appropriate test to use will be the Independent Samples *t*-test, and it can be seen that $|t_{\text{calc.}}| = 2.512 > 2.000 = t_{\text{crit.}}$. Therefore, there is a difference in problem-solving ability between the control group and the experimental group. In other words, the implementation of the SAVI learning model with multimedia support differs from that of the conventional learning model.

Then, to determine the magnitude of the effect of the treatment using the SAVI learning model assisted by multimedia in learning, the effect size calculation was performed based on the difference between the two groups. The average score of the control group is 64.62, while the experimental group has an average score of 77.74. The standard deviations of each group are 21.60 and 16.25, respectively. From these calculations, an effect size value of 0.7 is obtained. According to the effect size interpretation, this value falls into the large category, indicating that the SAVI learning model assisted by multimedia has a significant impact on mathematical problem-solving ability.

Based on the data analysis and hypothesis testing about the effect of multimedia-assisted SAVI learning model compared to conventional learning model on students' mathematical problem-solving ability, the findings are: i) there is a difference in mathematical problem-solving ability between students who use multimedia-assisted SAVI learning model and students who use conventional learning model, ii) based on the effect size calculation, the SAVI learning model assisted by multimedia has a large impact on mathematical problem-solving ability.

Students who received learning treatment with the SAVI model supported by multimedia demonstrated improved mathematical problem-solving ability. This improvement can be attributed to the syntax of the SAVI learning model, which encourages students to engage in problem-solving actively. Students have the opportunity to explore their abilities through the problems presented to them. Additionally, the model facilitates group discussions, allowing students to collaborate on solving problems and presenting their findings. This collaborative implementation fosters diverse perspectives, encouraging students to become more critical thinkers and, as a result, honing their mathematical problem-solving abilitiy.

Several previous studies have examined the impact of the SAVI learning model in mathematics education. Murti et al. (2019) stated that the SAVI model emphasizes collaboration among students in group discussions, creating significant opportunities for peer learning. Through this interaction, students can grasp the material more quickly and become more actively engaged in the learning process.

Furthermore, Sugesti et al. (2018) added that the SAVI model not only encourages students to listen to the teacher's explanation but also actively involves them in discovering mathematical concepts independently. This model provides students with the freedom to express their ideas through discussions with peers, thereby enhancing participation in learning. Additionally, Taneo (2017) emphasized that the SAVI learning model helps students become more active by engaging all five senses in the learning process, making learning more effective and meaningful.

The integration of multimedia in learning can significantly enhance students' mathematical abilities, particularly their problem-solving ability. The engaging features of multimedia capture students' interest, reducing boredom and facilitating their understanding of the material. This perspective is supported by Hu et al. (2021), who found that multimedia use positively impacts students' problem-solving ability. Furthermore, research by Mahuda et al. (2021) confirms that effective multimedia use can improve students' mathematical problem-solving ability. When multimedia is utilized effectively through images, videos, or other elements students find it easier to grasp mathematical concepts and apply them in problem-solving scenarios. This effectiveness arises because multimedia provides visual and auditory representations that help clarify information and reinforce students' understanding.

CONCLUSION

The results indicated that the data on students' mathematical problem-solving ability in both classes met the assumption tests for normality and homogeneity. Since the data satisfied these assumptions, the next step was to conduct hypothesis testing. The hypothesis test conducted was the independent samples *t*-test. Based on the results of data analysis, the results were obtained that a notable difference in problem-solving ability was observed between students taught with a conventional learning model and students taught with the SAVI learning model assisted by multimedia. Furthermore, based on the effect size calculation, the SAVI learning model assisted by multimedia has a large impact on mathematical problem-solving ability.

The findings of the study indicate that the SAVI learning model, enhanced by multimedia, positively impacts students' abilities to solve mathematical problems. The application of the SAVI learning model alongside multimedia can serve as an alternative to create a more interactive and enjoyable learning atmosphere, ultimately enhancing students' mathematical abilities. Additionally, the SAVI learning model, with the assistance of multimedia, can also be explored to improve mathematical abilities in other areas. This is due to the limitations in this study which lies in the scope of material that only focuses on the concept of angles, so the results do not necessarily apply to other materials.

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