Vol. 14, No. 03, pp. 2076-2087, 2024 DOI: 10.23960/jpp.v14.i3.2024141

Jurnal Pendidikan Progresif

e-ISSN: 2550-1313 | p-ISSN: 2087-9849
http://jurnal.fkip.unila.ac.id/index.php/jpp/

Enhancing Fourth-Grade Elementary Students Mathematical Reasoning Skills Through the SAVI Model

Verrill Adha Vi Viantorus*, Setiawan Edi Wibowo, & Fery Muhamad Firdaus
Department of Primary Education, Universitas Negeri Yogyakarta, Indonesia

*Corresponding email: verrilladha.2023@student.uny.ac.id

Received: 03 December 2024 Accepted: 20 December 2024 Published: 30 December 2024

Abstract: Enhancing Fourth-Grade Elementary Students Mathematical Reasoning Skills Through the SAVI Model. Objective: This study aimed to evaluate the impact of the Somatic, Auditory, Visual, Intellectual (SAVI) model on the mathematical reasoning skills of fourth-grade students in the context of fractions and to compare its effectiveness with the Numbered Heads Together (NHT) cooperative learning model. **Methods:** A quantitative research approach with a quasi-experimental design was adopted. The study population comprised 100 fourth-grade students at SD Muhammadiyah Bogor, from which 50 students were selected through purposive sampling. Class IV A served as the experimental group, employing the SAVI model, while Class IV B acted as the control group, utilizing the NHT model. Data collection was conducted through validated pretests and posttests using a mathematical reasoning test with established reliability. **Findings:** The data analysis indicated a significant improvement in the mathematical reasoning abilities of the experimental group, which achieved a "very good" category. In contrast, the control group using the NHT model reached only a "satisfactory" category. Statistical analysis produced a t-value of 13.416, exceeding the critical t-value, with a significance level below 0.05. **Conclusion:** The findings conclude that the SAVI model significantly enhances the mathematical reasoning skills of fourth-grade students in the context of fractions at SD Muhammadiyah Bogor.

Keywords: SAVI model, elementary education, mathematical reasoning.

To cite this article:

Viantorus, V. A. V., Wibowo, S. E., & Firdaus, F. M. (2024). Enhancing Fourth-Grade Elementary Students Mathematical Reasoning Skills Through the SAVI Model. *Jurnal Pendidikan Progresif*, *14*(3), 2076-2087. doi: 10.23960/jpp.v14.i3.2024141.

INTRODUCTION

Mathematical reasoning is an essential skill for the 21st century, necessary not only in mathematics education but also in daily life to solve complex problems logically and systematically. However, various studies indicate that students' mathematical reasoning abilities remain relatively low. Ahmad, et al., (2024) found that only about 17% of students in Indonesia could demonstrate a higher level of mathematical reasoning, reflecting a significant gap in mastering this skill. This low level of reasoning is caused by several factors, including teaching methods that fail to promote critical thinking, insufficient use of technology as an interactive learning medium, and a lack of opportunities for students to practice problem-solving in real contexts. These conditions highlight the need for innovative teaching approaches integrated with technology to enhance students' logical thinking and critical problem-solving skills, enabling them to face the increasingly complex challenges of the world.

In an era of rapid global development, learning approaches that integrate cognitive development and student engagement have become urgent. Traditional methods often fail to foster deep understanding and critical thinking, making innovation in teaching strategies essential Abidin, et al., (2020). One promising approach is the SAVI model (Somatic, Auditory, Visual, Intellectual), which combines various learning modalities to stimulate thinking and enhance student engagement. Ayal et al. (2016) found that the SAVI model effectively accommodates different learning styles through physical movement, auditory stimulation, visual input, and intellectual challenges, creating a more holistic learning experience. Furthermore, Biagioli (2020) found that the SAVI model can enhance students' mathematical reasoning through interactive and comprehensive learning experiences. However, while its effectiveness has been proven in traditional classrooms, research on the application of the SAVI model in digital learning environments, especially in Indonesian elementary schools, is scarce. This gap presents a significant opportunity to develop digital learning tools that can optimize the implementation of the SAVI model, making it more relevant in the context of modern education (Abosalem, 2016).

The urgency of this research lies in the need to adapt to the evolving digital learning environment, especially with the increasing use of technology in education. According to BPS (2020), the percentage of students accessing online learning platforms surged to 74.17% during the pandemic, reflecting a major transformation in teaching methods. Despite technology becoming an integral part of education, many students still face challenges in mastering complex mathematical concepts. This is often due to a lack of mastery of models that integrate digital learning, which can facilitate the development of their critical thinking and mathematical reasoning skills (English et al., 2022).

Mathematical reasoning is a crucial skill that requires active student participation in the learning process. Davidson et al. (2019) revealed that active learning methods, such as group collaboration and interactive problem-solving, tend to improve students' performance in mathematical reasoning tests. However, these methods are often not flexible enough to accommodate diverse learning styles. In this context, the SAVI model offers a solution with its holistic learning approach, combining physical, auditory, visual, and intellectual aspects to create a more effective learning experience (Melhuish et al., 2020).

Although the SAVI model has proven effective in traditional learning settings, its application in digital contexts remains underexplored, particularly at the elementary education level. This gap is significant, given the current curriculum's focus on developing Higher-Order Thinking Skills (HOTS), where students are required to analyze, evaluate, and create, rather than just recall information (Öztürk & Sarikaya, 2021). Previous research has shown that technology-based learning can enhance students' cognitive skills, but the specific impact of the SAVI model on mathematical reasoning in digital environments has not been thoroughly explored. By leveraging the strengths of the SAVI model and integrating it into digital learning platforms, this research aims to address this gap while contributing to the development of more adaptive, effective, and relevant teaching methods in the modern educational landscape.

Current research focuses primarily on the application of the SAVI model in face-to-face learning, without considering how this model can be adapted for digital platforms, even as education becomes increasingly digitized. The integration of technology with traditional teaching methods is crucial for creating more engaging and effective learning experiences. Salam et al., (2019) stated that while technology can enrich learning, its effective use in mathematics education to develop mathematical reasoning skills remains limited. This highlights the gap in research connecting digital technology with existing pedagogical approaches. Several studies have explored the use of the SAVI model to enhance critical thinking and mathematical reasoning skills, but most of these studies have been conducted in conventional learning settings, which have not fully explored the potential of digital platforms. In this digital age, the use of learning technologies can create more dynamic and interactive experiences, allowing students to become more actively engaged in learning. Noviarsyh et al., (2019) found that the use of technology in mathematics education can enhance student motivation and engagement, but no research has yet combined the SAVI model with interactive digital platforms, such as web-based learning applications. Additionally, a lack of deep understanding about how digital SAVI-based models can improve mathematical problem-solving skills in a more personalized and student-specific manner remains a challenge. Many studies show that collaborative learning strategies, such as those found in the SAVI model, are effective in improving problem-solving skills. However, to accommodate diverse learning styles, there is an urgent need to adapt the SAVI model within digital environments to allow each student to learn in a more personalized way (Cizek & Lim, 2023).

This study aims to develop and test a digital SAVI model as an innovative approach to improve mathematical reasoning in elementary school students. In an increasingly digitized educational world, technology provides opportunities to integrate the somatic, auditory, visual, and intellectual elements found in the SAVI model with technology-based learning tools, such as interactive learning applications and educational games. This approach aims to create a more dynamic and engaging learning experience, where technology is not only used to deliver content but also to activate student participation in deeper learning processes through various means, such as physical movement, discussions, visualizations, and critical thinking. By adding simple digital elements to the SAVI model, such as instructional videos for visual learning or interactive apps for intellectual activities, students can engage with the content in a more personalized and stimulating way.

One main focus of this research is the development of Higher-Order Thinking Skills (HOTS) in students for solving mathematical problems, which has become increasingly important in the current educational curriculum. Through the application of the digital SAVI model, it is hoped that students will become more engaged in mathematics learning that not only emphasizes concept mastery but also the skills of analysis, evaluation, and creation. This study seeks to demonstrate that the SAVI model, integrated with technology, can provide a more personalized learning experience that aligns with diverse learning styles and individual student needs.

The uniqueness of this study lies in the combination of proven pedagogical methods, such as SAVI, with advancements in educational technology. This enables the creation of a more holistic learning environment that can facilitate the improvement of mathematical reasoning and problem-solving skills, as well as support the development of HOTS in students. This model is expected not only to enhance mathematical skills but also to open up opportunities for further research on the use of technology in education, with a more flexible and engaging approach (Ahmad et al., 2020).

Moreover, this study aims to evaluate the extent to which the digital SAVI model influences the development of mathematical reasoning in students and how this model supports the development of more complex mathematical problem-solving skills. The results of this study are expected to make a significant contribution to the development of more engaging and effective mathematics teaching methods, which can be widely implemented in Indonesian schools. Thus, this study is not only relevant in the context of improving the quality of mathematics education but also provides broader insights into how technology can optimize teaching strategies in the digital age.

METHOD

Participants

This study involves fourth-grade students from Muhammadiyah Bogor Elementary School. The total population of students in this grade is 100. From this population, a sample of 50 students will be selected using purposive sampling. The selection criteria ensure that the students have similar academic levels and have not previously been exposed to the SAVI model or any structured mathematical reasoning training. The participants will be divided into two groups of equal size, with 25 students assigned to the experimental group and 25 to the control group.

Research Design and Procedures

The research employs a quasi-experimental design with a non-equivalent control group. The experimental group will receive treatment using the SAVI (Somatic, Auditory, Visual, Intellectual) model, while the control group will use the Numbered Heads Together (NHT) model. The study will proceed as follows:

Group Selection: The experimental and control groups will be drawn from different classes within the school. Efforts will be made to ensure that the two groups are comparable in terms of mathematical abilities and socio-demographic backgrounds.

Pre-Test: Both groups will undertake a pre-test designed to assess their initial mathematical reasoning skills in fractions. This test will establish a baseline for subsequent comparisons.

Treatment: The intervention will span five sessions, each lasting 45 minutes: *Session 1:* Both groups will be introduced to fraction concepts. The experimental group will engage in activities based on the SAVI model, incorporating physical movement, auditory cues, visual aids, and intellectual challenges. The control group will engage in group discussions using the NHT model. *Session 2:* Students will explore fraction concepts further. The experimental group will engage in interactive problem-solving activities, while the control group will collaborate through NHT-based discussions. *Session 3:* Both groups will apply fractions to real-life scenarios. The experimental group will incorporate technology into their activities, while the control group will participate in structured group discussions. *Session 4:* Students will practice adding and subtracting fractions. The experimental group will continue using SAVI techniques, and the control group will rely on peer discussions within the NHT framework. *Session 5:* The final session will consolidate fraction concepts through group challenges, with the experimental group utilizing SAVI-based activities and the control group completing tasks through the NHT model.

Post-Test: After the treatment, a post-test will be administered to evaluate improvements in the students' mathematical reasoning skills.

Instruments

The study employs written tests to measure mathematical reasoning skills. The test items, designed to evaluate the students' understanding of fractions, are adapted from validated sources. The content covers four key indicators:

1. Drawing logical conclusions from real-life problems.
2. Providing explanations using models, facts, properties, and relationships of fractions.
3. Estimating answers and solution processes for solving problems related to daily life.
4. Constructing valid arguments from fraction-related problems.

The instruments' validity will be established through expert review, while reliability will be assessed using Cronbach's Alpha to ensure consistency across the test items. Examples of questions include: *Fractions in Sharing Cake:* Sarah has 1/2 of a cake and wants to share it equally with her friend. Students are required to determine the fraction of the cake each person will receive by dividing the 1/2 cake into two equal parts. *Fractions in Sharing Pizza:* A pizza is cut into 8 equal slices. If 3 slices are eaten, students must calculate the fraction of the pizza that remains by subtracting the number of slices eaten from the total.

Data Analysis

Descriptive and inferential statistical methods will be used to analyze the collected data. The descriptive statistics will summarize students' pre-test and post-test scores. Inferential statistics, including paired t-tests, will be conducted to compare the effectiveness of the SAVI model against the NHT model in improving mathematical reasoning skills. Effect size calculations will be included to quantify the intervention's impact. Results will be presented in narrative form, highlighting the changes in students' mathematical reasoning abilities following the respective treatments.

RESULT AND DISCUSSION

Pretest Results

The table presents the pretest results for both the experimental group (SAVI) and the control group (NHT). The mean score for the experimental group was 58.93, with a standard deviation of 12.12, while the control group had a mean of 56.27 and a standard deviation of 11.84. The significance value (p-value) of 0.097 is greater than 0.05, indicating that there is no statistically significant difference between the two groups before the treatment. This suggests that the participants in both groups had similar initial abilities, which allows for a fair comparison of the impact of the teaching methods after the intervention.

Table 1. Pretest result

Group	Mean	SD	Sig. (2-tailed)
Experimental (SAVI)	58.93	12.12	0.097
Control (NHT)	56.27	11.84	

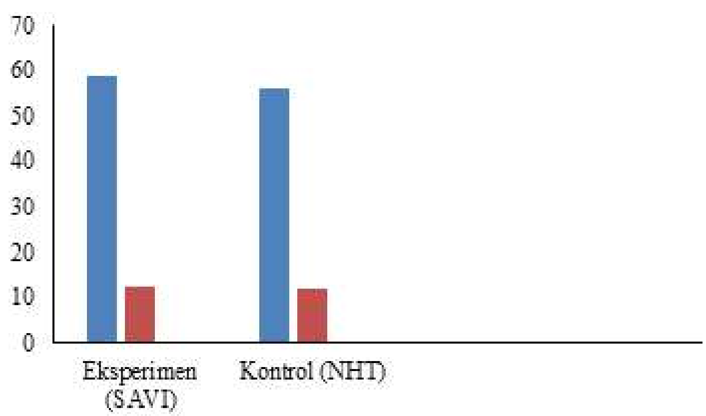

Figure 1. Pretest result

Posttest Results

Table 2. Posttest result

Group	Mean	SD	Sig. (2-tailed)
Experimental (SAVI)	78.47	10.23	0.001
Control (NHT)	68.20	11.17	

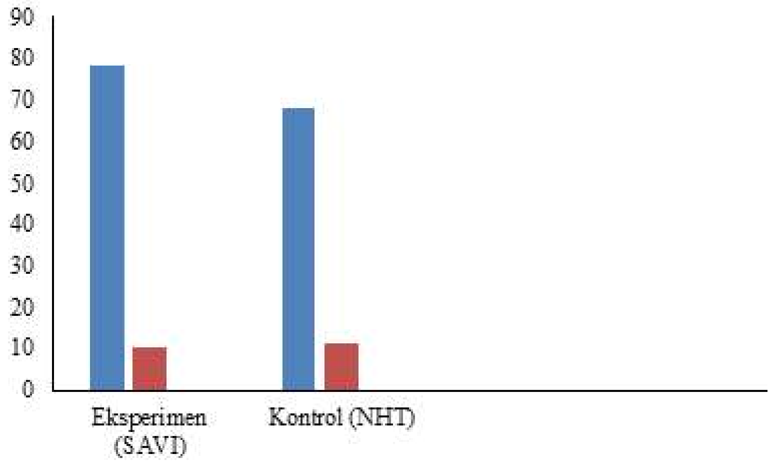

Figure 2. Posttest result

The posttest results show a significant difference between the experimental and control groups. The experimental group, which used the SAVI model, had a mean score of 78.47 with a standard deviation of 10.23, while the control group using the NHT model scored an average of 68.20 with a standard deviation of 11.17. The significance value (p-value) of 0.001 is less than 0.05, indicating that the difference between the two groups is statistically significant. This suggests that the SAVI model had a positive impact on the students' learning outcomes compared to the NHT model.

Mean Pretest and Posttest Scores with Score Ranges

Table 3. Mean pretest and posttest scores with score ranges

Group	Mean Pretest	Pretest Range (Min-Max)	Mean Posttest	Posttest Range (Min-Max)
Experimental (SAVI)	58.93	40 - 80	78.47	60 - 95
Control (NHT)	56.27	35 - 75	68.20	50 - 85

The table showing the mean pretest and posttest scores, along with the score ranges for each group, provides a clearer picture of the changes in learning outcomes after the treatment. In the experimental group, which used the SAVI learning model, the mean pretest score was 58.93, with a score range from 40 to 80. After the treatment, the mean posttest score increased to 78.47, with a range from 60 to 95. This indicates a significant improvement in students' reasoning ability after the SAVI model was implemented. On the other hand, in the control group, which used the NHT learning model, the mean pretest score was 56.27, with a score range from 35 to 75. After the treatment, the mean posttest score of this group increased to 68.20, with a range from 50 to 85. Although there was an improvement in the control group, the increase in the experimental group was more substantial, demonstrating the effectiveness of the SAVI learning model in enhancing students' learning outcomes.

Paired Sample T-Test Result

Based on the paired t-test results presented in Table 9, there is a significant difference between the pretest and posttest scores on mathematical reasoning ability. The mean pretest score was 59.84, while the mean posttest score increased to 83.84. With a sample size of 25 students, the t-test result shows a significance value (p-value) of 0.000, which is less than 0.05. This indicates that the increase in scores after the intervention is statistically significant. This analysis suggests that the use of the SAVI learning model has a significant impact compared to the cooperative NHT learning model on fraction material. Therefore, the implementation of the SAVI model has proven to be effective in improving students' mathematical reasoning abilities (Sutarni et al., 2021).

Table 4. Paired sample T-Test result

Aspect	Pretest	Posttest
Mean	59.84	83.84
N	25	25
Sig. (2-tailed)	0.000	
Analysis	0.000 < 0.05	
Description	There is a significant effect of using the SAVI model compared to the NHT model on the topic of fractions.	

The implementation of the SAVI model (Somatic, Auditory, Visual, Intellectual) involves four stages that integrate physical, auditory, visual, and intellectual activities. Each stage significantly contributes to enhancing students' mathematical reasoning abilities, particularly in understanding fractions.

Somatic Activities

In this stage, students engage in physical activities such as manipulating fraction strips, arranging paper pieces representing fractional values, and matching equivalent fractions using manipulatives.

Physical activities help students construct their understanding of fractions through direct, hands-on experiences. This approach aligns with the findings of Winter, et al., (2021), which emphasize that physical involvement in learning processes enhances memory retention and cognitive engagement, particularly in mathematics education. Hands-on activities provide a concrete foundation for abstract concepts, making learning more meaningful and effective, especially for students with kinesthetic learning preferences.

Additionally, the somatic stage encourages active participation and reduces passivity during lessons. By physically handling learning materials, students not only grasp the relationships between different fractions but also build confidence in applying their knowledge to solve problems.

Auditory Activities

In the auditory phase, the teacher facilitates group discussions where students articulate their thought processes and strategies for solving fraction problems. Through verbal explanations, students explain how they conceptualize and approach mathematical tasks.

Group discussions promote collaborative learning and encourage students to engage with abstract mathematical concepts verbally. According to Wagiran, et al., (2022), auditory engagement helps students process and retain information more effectively. Discussions foster critical thinking and allow students to clarify misconceptions by articulating their reasoning.

Additionally, hearing their peers' strategies enables students to explore alternative ways of solving problems, enhancing their analytical abilities. Auditory activities also cultivate communication skills and deepen students' understanding of mathematical language, which is essential for expressing ideas clearly and logically.

Visual Activities

Visual representations are central to the SAVI model. In this stage, teachers use diagrams, charts, fraction models, and pictures to help students visualize the concepts of addition and subtraction of fractions. Visual tools such as pie charts, number lines, and bar models are utilized to represent fractional values and operations effectively.

Visual learning aids help students bridge the gap between concrete experiences and abstract reasoning. Students, especially those with a preference for visual learning, benefit from seeing the relationships between different fractions represented graphically. Research by Ruck (2022) highlights that visual representations improve problem-solving skills and conceptual understanding.

Through visual activities, students develop the ability to interpret and analyze mathematical information presented in various forms. This strengthens their ability to generalize concepts, recognize patterns, and apply their knowledge to new contexts. Visual tools also make complex concepts more accessible and reduce cognitive load, enabling students to focus on problem-solving rather than deciphering abstract ideas.

Intellectual Activities

The intellectual stage involves students solving challenging fraction problems individually or in groups. These activities require higher-order thinking skills, such as analysis, synthesis, and evaluation. Students are encouraged to connect their understanding of fractions to real-life situations and justify their solutions logically.

Intellectual engagement enables students to integrate prior knowledge with new concepts, fostering deeper understanding and application. This phase aligns with Vygotsky's theory of scaffolding, which emphasizes the importance of supporting students' cognitive development through progressively challenging tasks. Intellectual activities encourage students to think critically, solve problems independently, and reflect on their learning processes.

By solving non-routine problems, students are pushed to apply their reasoning skills creatively. They learn to explore multiple strategies, assess the efficiency of different approaches, and articulate their solutions clearly. Intellectual activities also nurture perseverance and resilience, as students work through challenges to find solutions.

Discussion

The findings of this study align with Kappenberg & Licandro (2023), which demonstrate that the implementation of the SAVI model is effective in enhancing students' critical thinking and problem-solving abilities, particularly at the elementary school level. Rahman et al. emphasize that the integration of physical and visual activities in mathematics learning helps students grasp abstract concepts more easily. For example, in the topic of fractions, the use of manipulatives such as paper strips, physical objects, or concrete images allows students to connect mathematical concepts with real-life experiences. This active learning approach is well-suited to elementary school students, who are still in the concrete operational stage of cognitive development according to Piaget's theory.

A similar study by Yildirim et al., (2024) also supports the effectiveness of the SAVI model at the elementary school level. They found that the SAVI approach outperformed conventional teaching methods by engaging all four aspects of student learning somatic, auditory, visual, and intellectual simultaneously. For elementary school students, combining physical activities like cutting, arranging, or manipulating visual aids with verbal instructions and diagrams makes learning more engaging and easier to understand. This also helps build students' motivation, which often depends on enjoyable approaches that involve multiple senses.

In this study, the SAVI model was successfully implemented because the teacher was able to systematically facilitate activities, present learning challenges appropriate to students' abilities, and encourage active participation (Rijal & Arifah, 2020). The application of the SAVI model in the experimental group showed a significant improvement, with an average score increase of 24 points, whereas the control group only experienced an increase of 8.56 points. This indicates that the SAVI model is highly compatible with the characteristics and abilities of elementary school students.

However, Iskandar et al., (2016) suggest that the effectiveness of the SAVI model may decrease if students have low motivation or if the learning environment is not supportive. In the context of elementary education, the success of the SAVI model is highly influenced by the teacher's role in designing engaging learning activities and providing full support to students. A conducive learning environment, such as a classroom equipped with manipulative media and an interactive learning atmosphere, is key to the success of this model.

On the other hand, the application of the Numbered Heads Together (NHT) model in the control group showed lower results (mean posttest = 68.20). The NHT model, which focuses on group cooperation, has limitations when applied at the elementary school level, especially in mathematics topics that require an understanding of concrete concepts. This is due to several factors: the lack of concrete manipulatives in NHT makes it difficult for elementary students to understand abstract concepts like fractions. According to Svensäter & Rohlin (2023), elementary students still need concrete and visual aids to build understanding. In NHT, the main focus on group discussion often does not involve manipulative activities that help students see concepts in a tangible way (Mauliza, 2020). Uneven student involvement becomes a challenge in the NHT model. In elementary school, there are often differences in students' levels of understanding and participation within the group. More passive students tend to follow the discussion without fully grasping the concepts being studied.

Toivola et al., (2023) state that effective collaboration in elementary schools must include mechanisms to ensure that every student has an active role in the learning process. Therefore, the results of this study reinforce the conclusion that the SAVI model is more effective than NHT in enhancing elementary school students' mathematical reasoning abilities (Prayekti & Utomo, 2019). The SAVI approach, which emphasizes hands-on experiences, physical activity, visual learning, and critical thinking, aligns well with students' developmental needs. Meanwhile, although the NHT model is useful for fostering cooperation, it tends to offer fewer concrete and individual learning experiences for elementary school students (Rahayu & Suningsih, 2018).

The results of the paired t-test in this study also support the conclusion that the SAVI model significantly improves students' mathematical reasoning abilities. The approach, which integrates somatic, auditory, visual, and intellectual activities, enables students to connect mathematical concepts with direct experiences, strengthening their understanding. Thus, the SAVI model has proven to be more effective than the NHT model in improving mathematics learning outcomes, especially in the topic of fractions at the elementary school level.

CONCLUSION

This research examined the impact of the SAVI learning model on students' mathematical reasoning ability, compared to the NHT model. The findings indicated that students in the experimental group, who were taught using the SAVI model, showed significant improvement in their reasoning abilities, with a notable increase in posttest scores. This suggests that the SAVI model is effective in enhancing students' learning outcomes, particularly in the context of mathematical reasoning. The results emphasize the importance of innovative and engaging teaching methods in improving student performance, highlighting how active learning models can make a positive impact on educational outcomes.

The implications of this study for education are significant, as it demonstrates that incorporating models like SAVI can lead to enhanced student engagement and achievement. By focusing on active participation and varied learning styles, teachers can better cater to diverse student needs and improve learning experiences. However, the study also has limitations. The sample size of 25 students in each group may not fully represent larger or more diverse student populations. Additionally, the study was conducted in a specific subject area (mathematics), which may limit the generalizability of the findings to other subjects. Future research could explore the effectiveness of the SAVI model across different disciplines and with larger, more varied groups of students.

REFERENCES

Abidin, Z., Utomo, A. C., Pratiwi, V., & Farokhah, L. (2020). Project based learning - literacy in improving students' mathematical reasoning abilities in elementary schools. JMIE (Journal of Madrasah Ibtidaiyah Education), 4(1), 39–52. https://doi.org/10.32934/jmie.v4i1.170

Abosalem, Y. (2016). Assessment techniques and students' higher-order thinking skills. International Journal of Secondary Education, 4(1), 1–11. https://doi.org/10.11648/j.ijsedu.20160401.11.

Ahmad, I., Sharma, S., Singh, R., Gehlot, A., Gupta, L. R., Thakur, A. K., Priyadarshi, N., & Twala, B. (2024). Inclusive learning using industry 4.0 technologies: addressing student diversity in modern education. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2330235

Ahmad, S., Andika, R., Hendri, S., & Kenedi, A. K. (2020). Training program on developing hots's instrument (the improving abilities for elementary school teachers. Digital Press Social Sciences and Humanities, 6, 10. https://doi.org/10.29037/digitalpress.406376

Ayal, C. S., Kesuma, Y. S., Sabandar, J., & Dahlan, J. A. (2016). The enhancement of mathematical reasoning ability of junior high school students by applying mind mapping strategy. Journal of Education and Practice, 7(25), 50–58.

Biagioli, F. (2020). Ernst Cassirer's transcendental account of mathematical reasoning. Studies in History and Philosophy of Science Part A, 79, 30–40. https://doi.org/10.1016/j.shpsa.2019.10.001

Cizek, G. J., & Lim, S. N. (2023). Formative assessment: an overview of history, theory and application. In International Encyclopedia of Education(Fourth Edition)(pp. 1–9). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.09002-3.

Creswell, J. W. (2012). Educational research : Planning conducting and evaluating quantitativ and qualitative Research. Pearson Educational Inc.

Davidson, A., Herbert, S., & Bragg, L. A. (2019). Supporting elementary teachers' planning and assessing of mathematical reasoning. International Journal of Science and Mathematics Education, 17(6), 1151–1171. https://doi.org/10.1007/s10763-018-9904-0

English, N., Robertson, P., Gillis, S., & Graham, L. (2022). Rubrics and formative assessment in K-12 education: A scoping review of literature. International Journal of Educational Research, 113, 101964. https://doi.org/10.1016/j.ijer.2022.101964.

Iskandar, D., Hamdani, A. R., & Suhartini, T. (2016). Implemetation of model savi (somatic, audiotory, visualization, intellectual) to increase critical thinking ability in class iv of social science learning on social issues in the local environment. JETL (Journal Of Education, Teaching and Learning), 1(1), 45. https://doi.org/10.26737/jetl.v1i1.35

Kappenberg, A., & Licandro, U. (2023). More than words–how second language learners initiate and respond during shared picture book reading interactions. Early Child Development and Care, 193(11–12), 1287–1300. https://doi.org/10.1080/03004430.2022.2088740

Mauliza. (2020). Improving students ' learning result using numbered heads together model. International Journal for Educational AndVocational Studies, 2(3), 301–303.

Melhuish, K., Thanheiser, E., & Guyot, L. (2020). Elementary school teachers' noticing of essential mathematical reasoning forms: justification and generalization. Journal of Mathematics Teacher Education, 23(1), 35–67. https://doi.org/10.1007/s10857-018-9408-4

Noviarsyh Dasaprawira, M., Zulkardi, & Susanti, E. (2019). Developing mathematics questions of Pisa type using Bangka context. Journal on Mathematics Education, 10(2), 303–314. https://doi.org/10.22342/jme.10.2. 5366.303-314

Öztürk, M., & Sarikaya, Ý. (2021). The relationship between the mathematical reasoning skills and video game addiction of Turkish middle schools students: A serial mediator model. Thinking Skills and Creativity, 40, 843–855. https://doi.org/10.1016/j.tsc.2021.1 00843

Prayekti, H., & Utomo, U. (2019). The effect of numbered heads together (NHT) Model assisted with audio visual media on the learning outcomes of identifying story elements of students grade V. Journal of Primary Education, 8(2), 232–237.

Rahayu, S., & Suningsih, A. (2018). The effects of type learning model numbered head together and think pair share. International Journal of Trends in Mathematics Education Research, 1(1), 19–21. https://doi.org/10.33122/ijtmer.v1i1.27

Rijal, S., & Arifah, N. (2020). The implementation of savi (somatic, auditory, visual and intellectual) to increase the students' english structure skill at english education department. English Education/ : Journal of English Teaching and Research, 5(1), 25–31. https://doi.org/10.29407/jetar.v5i1.14236

Ruck, J. (2022). Elementary-level learners' engagement with multimodal resources in two audio-visual genres. Language Learning Journal, 50(3), 328–343. https://doi.org/10.1080/09571736.2020.1752291

Salam, M., Ibrahim, N., & Sukardjo, M. (2019). Effects of instructional models and spatial intelligence on the mathematics learning outcomes after controlling for students' initial competency. International Journal of Instruction, 12(3), 699–716. https://doi.org/10.29333/iji.2019.1 2342a

Sutarni, N., Arief Ramdhany, M., Hufad, A., & Kurniawan, E. (2021). Self-regulated learning and digital learning environment: Its' effect on academic achievement during the pandemic. Cakrawala Pendidikan, 40(2), 374–388. https://doi.org/10.21831/cp.v40i2.40718

Svensäter, G., & Rohlin, M. (2023). Assessment model blending formative and summative assessments using the SOLO taxonomy. European Journal of Dental Education, 27(1), 149–157. https://doi.org/10.1111/eje.12787

Toivola, M., Rajala, A., & Kumpulainen, K. (2023). Pedagogical rationales of flipped learning in the accounts of Finnish mathematics teachers. Pedagogies: An International Journal, 18(4), 767–787. https://doi.org/10.1080/1554480X.2022.2077341

Wagiran, W., Suharjana, S., Nurtanto, M., & Mutohhari, F. (2022). Determining the e-learning readiness of higher education students: A study during the COVID-19 pandemic. Heliyon, 8(10). https://doi.org/10.1016/j.heliyon.2022.e11160

Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of Covid-19. Irish Educational Studies, 40(2), 235–246. https://doi.org/10.1080/03323315.2021.1916559

Yildirim, A., Stjernkvist, M. P., Hilden, R., Fröjdendahl, B., & Oscarson, A. D. (2024). Developing summative assessment literacy: Novice language teachers' perceptions in Sweden and Finland. Review of Education, 12(2). https://doi.org/10.1002/rev3.3487