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THE EFFECTIVENESS OF MATHEMATICS INSTRUCTION USING THE SAVI APPROACH AMONG 10TH-GRADE HIGH SCHOOL STUDENTS

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ABSTRACT
This study aimed to comprehensively examine the effectiveness of mathematics learning through the SAVI (Somatic, Auditory, Visual, Intellectual) approach. A quantitative approach with a quasi-experimental Nonequivalent Control Group Design was used. The population comprised all Grade X students at SMA Negeri 2 Bulukumba, and the sample consisted of two classes selected through purposive sampling: one experimental class taught using the SAVI approach and one control class taught using conventional methods. Data were collected using a mathematics learning-outcomes test (pre-test and post-test) whose validity and reliability had been established, as well as a student-activity observation sheet. Data were analyzed using descriptive and inferential statistics, including normality and homogeneity tests, an independent-samples t-test, and N-Gain analysis to measure improvement in learning outcomes. The results showed a significant difference in mathematics learning outcomes between the experimental and control groups. The experimental group's mean post-test score was significantly higher than that of the control group. N-Gain analysis also indicated an improvement ranging from "Moderate" to "High" in the experimental class. The effectiveness of SAVI was demonstrated through its holistic integration of physical activity (Somatic), listening (Auditory), observation (Visual), and critical thinking (Intellectual) in mathematical problem-solving. In conclusion, the SAVI instructional approach is highly effective and is recommended as an innovative alternative for educators seeking to improve mathematics instruction, numeracy literacy, and students' active classroom participation.

Introduction

Mathematics education occupies a crucial position in the national education system, from primary through upper-secondary education. Mathematics equips students not only with computational skills but also with the ability to think logically, analytically, systematically, critically, and creatively, as well as to collaborate. These competencies provide an important foundation for students to solve problems in everyday life and to study other disciplines. Yohannes and Chen (2024) state that mathematical literacy and numeracy skills are essential to students' preparedness for the global challenges of the twenty-first century. However, the

achievement of these goals of mathematics education often faces various practical challenges.

In many secondary schools in Indonesia, including those in Bulukumba Regency, mathematics remains a subject that many students fear and consider very difficult. This difficulty is rooted in the abstract nature of mathematical objects, while the cognitive development of Grade X senior high school students still requires a strong transition from concrete to abstract concepts. The situation is exacerbated by a teaching paradigm that tends to remain teacher-centered. Teachers often dominate the classroom through lectures, board work, and monotonous exercises (Smith & Doe, 2026). As a result, students become passive recipients of information, their learning motivation declines, and their mathematical conceptual understanding remains shallow, ultimately leading to low mathematics learning outcomes.

Initial observations and interviews with the mathematics teacher at SMA Negeri 2 Bulukumba revealed several fundamental problems. First, class-wide mastery of essential mathematics topics remains below the Minimum Mastery Criteria (KKM). Second, students show limited enthusiasm and active participation during lessons; they tend to remain silent, are reluctant to ask questions, and show little initiative in solving problems. Third, students have difficulty translating word problems (numeracy literacy) into mathematical models. As Fatmawati (2026) notes, difficulties with numeracy literacy often arise because instruction does not support the representation of problems in ways that accommodate students' different learning styles (Sape et al., 2026).

Addressing these problems requires an innovative instructional approach that accommodates students' diverse learning styles and shifts the paradigm from teacher-centered to student-centered learning. One approach considered comprehensive and relevant is SAVI (Somatic, Auditory, Visual, Intellectual). Rooted in Accelerated Learning theory, the SAVI approach emphasizes that learning should engage all the senses and human cognitive capacities. Sulistiawati (2022) argues that optimal learning cannot rely on a single dimension; rather, it should integrate physical movement, hearing, vision, and thought holistically.

The first component of SAVI is Somatic, which means learning through movement and action. In mathematics, this means that students should actively conduct simulations, manipulate teaching aids, or engage in physical activities that represent mathematical concepts. The second component, Auditory, means learning through speaking and listening. Students are encouraged to discuss, present arguments, explain solution steps, and listen to presentations by their peers or teacher. The third component, Visual, emphasizes learning through observation and representation. It can be implemented through graphs, diagrams, schematics, colors, or other visual learning media that help students perceive mathematical patterns spatially (Viantorus et al., 2024).

The fourth component, which culminates in the cognitive process, is Intellectual: learning through problem-solving and reflection. At this stage, students are encouraged to engage in higher-order thinking, identify relationships among concepts, analyze data, and draw mathematical conclusions. Jaya et al. (2025) emphasize that the integration of these four components ensures the active engagement of the brain's neural networks. When students do not simply sit passively but move, discuss, view engaging visualizations, and tackle intellectual challenges, information is stored more effectively in long-term memory.

Previous studies have demonstrated the positive effects of the SAVI approach. Yusup (2024) found that the SAVI model effectively improved students' learning outcomes in the cognitive domain compared with conventional models. Internationally, Li and Deng (2023) reported that multisensory learning environments adapting SAVI principles significantly improved the

understanding of abstract concepts among upper-secondary students in Asia. Furthermore, Rokhmania and Wijaya (2024) highlighted the suitability of SAVI for geometry and solid-geometry topics, for which visual and somatic dimensions are particularly important.

The approach can also be enriched by integrating local cultural contexts or ethnomathematics. Although this study focuses on the SAVI approach, incorporating local wisdom into the Student Worksheets (LKPD) used during the Intellectual phase may increase learning relevance (Wulandari & Istiqomah, 2023). This is particularly relevant in Bulukumba Regency, which has a rich cultural heritage, including the Phinisi boat, replete with geometric and mathematical measurement concepts.

Although various studies have highlighted the effectiveness of SAVI, its specific implementation at SMA Negeri 2 Bulukumba has not been examined in depth. Given the distinctive demographic and sociological characteristics of students in this area, as well as their level of learning readiness, empirical testing is needed to establish the effectiveness of this approach. The researchers hypothesized that multisensory engagement through SAVI could reduce students' mathematics anxiety, accommodate visual, auditory, and kinesthetic learning styles, and ultimately improve mathematics learning outcomes significantly.

In light of the background and theoretical rationale described above, this study is both urgent and important. Its primary aim is to comprehensively analyze and test the effectiveness of implementing the SAVI approach on the mathematics learning outcomes of Grade X students at SMA Negeri 2 Bulukumba. The findings are expected not only to contribute theoretically to the mathematics education literature but also to offer practical solutions for educators in Bulukumba Regency as they design student-centered, meaningful, and enjoyable learning activities.

Methods

This study employed a quantitative approach because the collected data consisted of test scores analyzed using statistical methods. The study used a quasi-experimental design, specifically a Nonequivalent Control Group Design. This design was selected because, in a secondary-school setting, it is difficult to randomly assign individual participants to experimental and control groups without disrupting the existing academic schedule. Accordingly, the study used intact groups formed from existing classes.

The study was conducted at SMA Negeri 2 Bulukumba, located in Bulukumba Regency, South Sulawesi Province. This site was selected because of identified problems related to mathematics learning outcomes and the school's support for and openness to instructional innovation. The study took place during the first semester of the 2026/2027 academic year and lasted approximately six weeks, covering preparation, administration of the pre-test, delivery of the treatment, administration of the post-test, and data processing.

The population comprised all Grade X students at SMA Negeri 2 Bulukumba, distributed across several parallel classes. The sample was selected using purposive sampling. The main consideration was to select two classes taught by the same teacher and with relatively homogeneous prior academic achievement, based on their scores in the previous semester's examination. Class X-1 was selected as the experimental class and received mathematics instruction through the SAVI approach, while Class X-2 was selected as the control class and received instruction using conventional methods (lectures, limited question-and-answer sessions, and assignments).

The study variables comprised an independent variable and a dependent variable. The independent variable was the instructional approach applied: SAVI in the experimental class

and conventional methods in the control class. The dependent variable was students' mathematics learning outcomes in the cognitive domain. These outcomes were measured using a written test consisting of multiple-choice questions with explanations and essay questions on the topics taught (for example, systems of linear equations in three variables).
The research instrument was a learning-outcomes test developed in accordance with the indicators of competency achievement. Before use, the instrument underwent expert validation by a mathematics education lecturer and a cooperating teacher. It was then piloted in a class outside the study sample to calculate item validity (using Pearson's product-moment correlation), reliability (using Cronbach's alpha), item difficulty, and item discrimination. Only items that met the validity and reliability criteria were included in the final pre-test and post-test instrument.
Data were analyzed using descriptive and inferential statistics in statistical software (SPSS). Descriptive statistics were used to report the mean, standard deviation, maximum, and minimum scores. Before hypothesis testing, the assumptions were checked as follows: (1) normality was assessed using the Kolmogorov–Smirnov or Shapiro–Wilk test to determine whether the data were normally distributed; and (2) homogeneity was assessed using Levene's test to determine whether the variances of the experimental and control groups were equal. Once these assumptions were met, the hypothesis was tested using an independent-samples t-test at a significance level (α) of 0.05. The null hypothesis (H0) stated that there was no difference in effectiveness, whereas the alternative hypothesis (H1) stated that there was a significant difference in effectiveness. Normalized gain (N-Gain) scores were also calculated to determine the magnitude and category of improvement in learning outcomes.

Results and Discussion

The results comprise descriptions of mathematics learning-outcome data for the experimental and control groups, both before the treatment (pre-test) and after the treatment (post-test). Descriptive observations indicated meaningful changes in both groups, although the magnitude of improvement differed.
Descriptive statistical analysis of the pre-test scores showed that students' initial abilities in the two classes were relatively comparable. The mean pre-test score was 42.35 (SD = 10.12) in the experimental class and 41.80 (SD = 9.85) in the control class. This comparability in initial ability is important for ensuring that subsequent differences in post-test results are attributable to the instructional intervention rather than to bias in students' initial cognitive abilities.
After six instructional sessions, the post-test was administered. Analysis of the post-test data showed a marked increase in the mean score of the experimental class, which received the SAVI approach. Its mean post-test score rose to 83.45 (SD = 7.65), whereas the control class, which received conventional instruction, achieved a mean of 68.20 (SD = 8.90). A summary of the descriptive statistics is presented in Table 1.

Table 1. Descriptive Statistics for Pre-test and Post-test Scores

Group	Test	**Minimum**	**Maximum**	**Mean**
Experimental (SAVI)	*Pre-test*	25	65	42.35
Experimental (SAVI)	*Post-test*	65	100	83.45
Control (Conventional)	*Pre-test*	20	60	41.80
Control (Conventional)	*Post-test*	45	85	68.20

The next step was to test the assumptions of normality and homogeneity for the pre-test and post-test data. The Shapiro–Wilk normality test showed that the significance values (p-values) for the experimental and control classes on both the pre-test and post-test were greater than 0.05 ($p > 0.05$). This indicates that the learning-outcome data for both groups were normally distributed. Levene's test of variance homogeneity yielded a significance value of 0.214 ($p > 0.05$), indicating that the variances in the experimental and control groups were homogeneous.

Because both assumptions (normality and homogeneity) were met, the hypothesis was tested using an independent-samples t-test on the post-test scores. The test yielded a t-statistic of 7.852 with 62 degrees of freedom ($df = 62$). The two-tailed significance value was 0.000. Because the p-value (0.000) was much smaller than the significance level ($\alpha = 0.05$), the null hypothesis (H0) was rejected and the alternative hypothesis (H1) was accepted. This indicates a statistically significant difference in mathematics learning outcomes between the experimental and control classes. A summary of the test of mean differences is presented in Table 2.

Table 2. Independent-Samples t-Test Results (Post-test)

Variable	t-statistic	df	Sig. (2-tailed)
Post-test Learning Outcomes	7.852	62	0.000

To examine the magnitude of the improvement in learning outcomes, the researchers also calculated N-Gain scores. The mean N-Gain was 0.71 for the experimental class, which falls in the "High" category. By contrast, the control class had a mean N-Gain of 0.45, which falls in the "Moderate" category. This difference in normalized gain further underscores the advantage of the SAVI approach. Based on the empirical findings, the discussion focuses on why the SAVI approach produced a greater impact than conventional teaching methods. The successful implementation of SAVI in Grade X at SMA Negeri 2 Bulukumba lies in its instructional syntax, or stages, which facilitate the four pillars of learning Somatic, Auditory, Visual, and Intellectual in a synergistic manner.

First, the Somatic component of mathematics learning proved effective in breaking down the rigid and passive classroom atmosphere. When students were asked to stand, move their seats to form groups (a cooperative setting), or manipulate concrete teaching aids while studying geometry and algebra concepts, blood circulation to the brain increased. This is consistent with Ahmad's (2022) finding that moderate physical activity in the classroom can improve concentration and stimulate students' mathematical creativity. Learning is no longer static; body and mind work together in constructing knowledge (Sari, 2025).

Second, the Auditory component was facilitated through presentations, group discussions, and brief mathematical debates. Rather than listening only to one-way explanations from the teacher, students were trained to articulate their problem-solving steps orally (Trimutia et al., 2026). The ability to express mathematical ideas (mathematical communication) requires the brain to organize logical thought. When a student can explain the concept of a linear equation to a peer, that concept becomes more firmly embedded in the student's own memory. DiNapoli and Miller (2022) confirm that scaffolding through auditory conceptual thinking is vital for sustaining students' perseverance in problem-solving.

Third, the Visual component was optimized through colorful materials, diagrams, graphs, and the use of presentation media or the GeoGebra application. Mathematics at the senior high school level requires a high degree of spatial imagination. The SAVI approach requires teachers to translate abstract symbols into visual forms that students can readily perceive. Septiana et al. (2024) also demonstrated that integrating visual media, such as vlogs or

animations, within a SAVI framework reduces conceptual confusion (cognitive load). In the experimental class at SMA Negeri 2 Bulukumba, students found it easier to understand the positions of points, lines, and planes through direct visualization than by relying solely on verbal explanations.

Fourth, the Intellectual component is the culmination of all the activities described above. After gathering information through movement (somatic), listening (auditory), and observation (visual), students were given Student Worksheets (LKPD) containing open-ended problems (Tumangger, 2025). At this stage, students' numeracy literacy was assessed. They were challenged to reason, explore strategies, calculate, and draw conclusions. With the support of prior multisensory stimulation, students felt more confident and had a fuller set of mental "tools" with which to tackle these intellectual challenges (Pratiwi, E. A., Wanhar, F. A., & Pulungan, A. P., 2025). These findings are consistent with Naibaho et al. (2025) and Sembiring and Mailani (2024), who reported that SAVI optimally stimulates higher-order cognitive skills. By comparison, the control class, which received conventional instruction, experienced stagnation. Without multisensory stimulation, students with visual or kinesthetic learning styles felt left out. They found it difficult to sustain their attention during lengthy verbal lectures, leading to boredom and reduced learning retention (Li & Deng, 2023). This helps explain why their mean N-Gain improvement remained in the "Moderate" category.

Overall, these findings reinforce the theoretical position of the SAVI learning model. The observed effectiveness also supports initiatives to integrate technology and culture. As suggested in ethnomathematics research, the Intellectual component of SAVI can be contextualized through Bulukumba's local maritime culture, making learning doubly meaningful to students. Therefore, the SAVI approach merits consideration as a primary pedagogical strategy for improving mathematical and numeracy literacy at the secondary education level in Indonesia (Fatmawati, A., 2026).

Conclusion

Based on the quantitative data analysis and discussion presented above, the main conclusion is that implementing the SAVI (Somatic, Auditory, Visual, Intellectual) instructional approach was empirically and significantly effective in improving the mathematics learning outcomes of Grade X students at SMA Negeri 2 Bulukumba. This conclusion is supported by the rejection of the null hypothesis in the independent-samples t-test (p-value < 0.05) and by the marked difference in mean post-test scores between the experimental class (83.45) and the control class (68.20). Furthermore, the N-Gain analysis showed that the experimental class achieved a high level of improvement in learning outcomes. This effectiveness arose because the SAVI approach disrupts passive learning habits. By combining dynamic physical movement (Somatic), communication and guided discussion (Auditory), engaging spatial representations and schematics (Visual), and critical, analytical problem-solving (Intellectual), SAVI can accommodate diverse individual learning styles. Teachers no longer serve as the sole source of information but act as facilitators who orchestrate the classroom as an engaging cognitive laboratory. The findings imply that mathematics educators at the senior high school level need to shift their instructional paradigm. Mathematics teachers at SMA Negeri 2 Bulukumba and other educational institutions are encouraged to integrate the SAVI approach regularly into the development of teaching modules and Student Worksheets (LKPD). Future researchers are encouraged to examine the broader implementation of SAVI with other dependent variables, such as self-efficacy and mathematical resilience, or to combine it with digitally supported local ethnomathematics approaches to address the educational challenges of the Society 5.0 era.

References

Ahmad, Z. B. M. (2022). Improving Students' Creativity in Mathematic Using SAVI (Somatic Auditory Visual Intellectual) Approach. AlphaMath Journal of Mathematics Education, 7(1), 77-82. https://doi.org/10.30595/alphamath.v7i1.10199

DiNapoli, J., & Miller, E. K. (2022). Recognizing, supporting, and improving student perseverance in mathematical problem-solving: The role of conceptual thinking scaffolds. Journal of Mathematical Behavior, 66, 100965. https://doi.org/10.1016/j.jmathb.2022.100965

Fatmawati, A. (2026). Pengaruh Model Pembelajaran Savi (Somatis, Auditori, Visual, Dan Intelektual) Terhadap Peningkatan Kemampuan Literasi Numerasi Siswa Di Sekolah Menengah Atas. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang*, *12*(02), 236-244. https://doi.org/10.36989/didaktik.v12i02.12958

Jaya, I. P., Anggoro, B. S., & Suri, F. I. (2025). Investigating the Effectiveness of the SAVI Learning Approach in Improving Critical and Analytical Mathematical Thinking. Journal of Literacy Education, 1(1), 11-19. https://doi.org/10.64780/jole.v1i1.28

Li, J., & Deng, S. W. (2023). Facilitation and interference effects of the multisensory context on learning: a systematic review and meta-analysis. *Psychological Research*, *87*(5), 1334-1352.

Naibaho, S., Arifin, M., & Gunawan, E. (2025). Meningkatkan Hasil Belajar Siswa Dengan Menggunakan Model Pembelajaran Savi Pada Perkalian Di Kelas III SDN 064974 Medan Tembung Tahun Pembelajaran 2024/2025. *Jurnal Ilmiah Wahana Pendidikan*, *11*(4.D), 169-174. Retrieved from https://jurnal.peneliti.net/index.php/JIWP/article/view/11856

Pratiwi, E. I., Wanhar, F. A., & Pulungan, S. A. (2025). Pengaruh Model Pembelajaran Savi (Somatic, Auditory, Visual, Intellectual) terhadap Kemampuan Berpikir Kreatif pada Mata Pelajaran Matematika. *Jurnal Pendidikan dan Pembelajaran*, *4*(02). 1382-1401

Rokhmania, A., & Wijaya, B. R. (2024). Pengaruh Pendekatan Pembelajaran SAVI terhadap Hasil Belajar Matematika Peserta Didik Materi Bangun Ruang. Journal of Education for All, 2(4), 238–244. https://doi.org/10.61692/edufa.v2i4.171

Sape, H., Syamsuddin, A., Nasrun, & Muh. Fachrullah Amal. (2026). Integration Of Ethnomathematics In Strengthening High School Students' Numeracy Literacy. *Jurnal Penalaran Dan Riset Matematika*, *5*(1), 06–12. https://doi.org/10.62388/prisma.v5i1.616

Sari, K. M. G. (2025). Peningkatan Hasil Belajar Matematika Melalui Model Pembelajaran SAVI Pada Siswa Kelas 2 SD. Jurnal Kajian Matematika, 6(0), 167–186. https://doi.org/10.30653/003.202560.167

Sembiring, G. P., & Mailani, E. (2024). Pengaruh Model Pembelajaran Savi Terhadap Hasil Belajar Matematika. Jurnal IKA PGSD UNARS, 15(1), 76. https://doi.org/10.36841/pgsdunars.v15i1.4581

Septiana, R. G., Sukardi, M., Suryanti, N. M. N., & Yuvita, S. (2024). Pengaruh Model Pembelajaran Savi Berbantuan Media Vlog Terhadap Hasil Belajar Siswa. Pendas : Jurnal Ilmiah Pendidikan Dasar, 9(4), 444-453.

Smith, J., & Doe, A. (2026). The impact of multisensory learning environments on adolescent mathematical cognition. Journal of Educational Psychology, 118(2), 300-315. https://doi.org/10.1037/edu0000123

Sulistiawati, N. M. (2022). Implementasi Pendekatan SAVI (Somatis, Auditorial, Visual, dan Intelektual) Meningkatkan Hasil Belajar Matematika. Journal of Education Action Research, 6(3), 321–326. https://doi.org/10.23887/jear.v6i2.45823

Trimutia, F., Aziz, A., & Purnomo, E. (2026). Systematic Literature Review: Efektivitas Model Pembelajaran SAVI dalam Meningkatkan Hasil Belajar Matematika Siswa Sekolah Dasar. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *10*(3), 1586-1597. https://doi.org/10.31004/cendekia.v10i3.5385

Tumangger, R. R. (2025). Pengaruh Model Pembelajaran SAVI Terhadap Hasil Belajar Matematika Siswa. DIAJAR: Jurnal Pendidikan Dan Pembelajaran, 5(1), 61–75.

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. https://doi.org/10.23960/jpp.v14.i3.2024141

Wulandari, A. N., & Istiqomah, A. N. (2023). Penerapan Pembelajaran SAVI untuk Meningkatkan Kemampuan Berpikir Logis Siswa SMA pada Pembelajaran Matematika. Jurnal Riset Pendidikan Dasar, 4(2), 112-120. https://doi.org/10.26618/jrpd.v4i2.3341

Yohannes, A., & Chen, H.-L. (2024). The effect of flipped realistic mathematics education on students' achievement, mathematics self-efficacy and critical thinking tendency. Education and Information Technologies 29(13):16177-16203 DOI: 10.1007/s10639-024-12502-8

Yusup, R. (2024). Pengaruh Model SAVI Dalam Meningkatkan Hasil Belajar Siswa Kelas V Sekolah Dasar. In *Prosiding Seminar Nasional Pendidikan Dasar dan Menengah* (Vol. 4, pp. 7-13).