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The Effect of the Somatic, Auditory, Visual, Intellectual Approach to Improve Students' Critical Thinking Skills in Work and Energy Topic

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ABSTRACT

The 21st-century learning underscores the significance of students' critical thinking skills, which are indispensable for problem analysis and solution finding. This study aims to determine the effect of the SAVI learning approach on enhancing tenth-grade students' critical thinking skills in physics subjects. Employing a quasi-experimental design with a non-equivalent control group, the study utilized the N-Gain test, homogeneity test, hypothesis test, and normalcy test for data analysis. The analysis results indicate that scores in the experimental class are superior to those in the control class. The N-Gain test for the experimental class yielded a data value of 0.54, indicating a medium-category improvement. Therefore, the SAVI approach positively influences students' critical thinking skills and facilitates their enhancement. The implications of this research suggest the potential efficacy of the SAVI approach in providing learning experiences to cultivate students' higher-order thinking skills. It is hoped that this approach can serve as an alternative learning activity to achieve learning goals and develop accompanying skills in the future.

Keyword: Approach, Critical Thinking Skills, Physics Learning, SAVI, Work and Energy

INTRODUCTION

The concept of 21st-century education emphasizes that students should possess high-level thinking skills (Chang et al., 2015). The 21st-century learning paradigm advocates for a range of competencies, including critical thinking and problem-solving abilities, creativity and innovation, as well as cooperation and communication skills (Susanti et al., 2023). This necessitates global efforts to cultivate students equipped with high-level thinking skills to serve as reservoirs of quality human capital. High-level thinking skills are imperative due to the current era's rapid information dissemination (Sutarno et al., 2018). Additionally, students are expected to actively nurture their potential for advanced cognitive abilities. Among these skills, Critical Thinking Skills (CTS) are crucial.

According to Yunin (2014), CTS is vital for efficient problem-solving in social, scientific, and practical domains. Similarly, Ariska (2021) describes CTS as direct thinking, focusing directly on the issue at hand. Consequently, CTS is an attainable skill involving evidence evaluation and targeted analysis of concepts and ideas to acquire pertinent knowledge about the world. CTS

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is indispensable for problem resolution, especially for tackling global issues and diverse real-life scenarios that may lack clear delineations between positive and negative aspects, necessitating the filtering of various influences and their adaptation to Indonesian culture. Therefore, fostering CTS among students is essential, with one avenue being through the study of Physics. Physics and CTS are intricately linked. Physics encompasses intricate concepts, necessitating students to grasp them comprehensively by solving problems, leveraging strong memory retention, and exercising critical thinking (Nurmahmuddin et al., 2023).

Based on observations of physics learning activities in tenth-grade classes specializing in mathematics and natural sciences in Tasikmalaya, it was noted that the teacher predominantly utilized the lecture method in teaching Physics. In this approach, the teacher delivers explanations of the material along with problem examples, assigns practice exercises, and gives students homework. However, the tasks assigned to students predominantly emphasize mathematical calculations. Another issue identified is the lack of active student engagement in Physics learning, as the teacher's methods do not sufficiently involve students in the learning process. An initial assessment of Critical Thinking Skills (CTS) through a test revealed that students' CTS in physics remains low. The data collected indicates the average percentage scores, as detailed in Table 1.

Table 1. Initial Test Results of Critical Thinking Skills

Indicator	Percentage	Category
Elementary clarification	67 %	Medium
Basic support	9 %	Very Low
Inference	4 %	Very Low
Advanced clarification	24 %	Very Low
Strategy and tactics	45 %	Low
Average	**30 %**	Very Low

Based on the provided table, it is evident that the indicator for making inferences has the lowest percentage, standing at 4%, indicating a very low level. Conversely, the indicator for providing simple explanations exhibits the highest percentage at 67%, falling within the moderate category. The overall average percentage from the conducted tests is 30%, underscoring the students' significantly low level of Critical Thinking Skills (CTS).

Effective learning approaches play a pivotal role in fostering success within the educational process, as evidenced by the development of the learning environment. Success in the learning process hinges upon various factors, including the teacher's proficiency in classroom management, instructional materials, pedagogical techniques, teaching aids, and other pertinent educational resources. One promising approach to cultivating students' critical thinking abilities is through the implementation of innovative teaching methodologies that facilitate the development of CTS. The Somatic, Auditory, Visual, and Intellectual (SAVI) learning approach is one such method.

The SAVI approach emphasizes students' active engagement in the learning process. As articulated by Suyatno (2009), this approach advocates for utilizing all sensory modalities available to students. Through the SAVI framework, students are encouraged to actively participate in various learning activities, such as conducting experiments, making observations, presenting acquired knowledge, and solving problems based on their understanding. Melinda (2017) further highlights that the SAVI approach instills in students a

propensity to question information rather than passively accepting it, fostering a critical mindset. Given this background, it becomes imperative to investigate the impact of the SAVI approach on enhancing students' critical thinking skills, particularly in the context of the work and energy topic.

METHOD

Research Design

Sugiyono (2019) emphasizes the necessity of a precise, understandable, and comprehensive research design, gradually established from the outset to serve as a step-by-step manual. In this study, a non-equivalent control group design was adopted. This design involves two non-randomly selected groups, both administered a pretest to determine any initial differences between the experimental and control groups. The research was conducted at a state senior high school in Tasikmalaya, West Java, Indonesia. Table 2 provides details of the non-equivalent control group design utilized in this investigation.

Table 2. Non-Equivalent Control Group Research Design

Group	***Pretest***	**Treatment**	***Post-test***
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Note:
O_1 : Pretest in the experimental class
O_2 : Post-test in the experimental class
O_3 : Pretest on control class
O_4 : Post-test on control class
X : Treatment with SAVI approach.

The data collection technique utilized in this research involves employing a learning implementation observation sheet, structured as a checklist, to evaluate the execution of each stage of the learning activity. Furthermore, a critical thinking skills test consisting of ten essay questions is administered to gauge students' competency in critical thinking.

Participants

This research was carried out at one of the State Senior High Schools in Tasikmalaya. The population for this research comprised all tenth-grade students majoring in mathematics and natural science, totaling four classes with 144 students in the 2022/2023 school year. The sample selection employed a purposive sampling technique based on specific criteria (Sugiyono, 2013). Two classes were selected as research samples, guided by the teacher's assessment that these classes demonstrated similar levels of understanding of the Physics subject matter. Furthermore, the pretest scores were also considered in selecting the two classes.

Instruments

Students' critical thinking skills are assessed using essay questions. The critical thinking skills test aims to measure the attainment of various aspects of critical thinking skills, both before and after the implementation of treatment, referred to as the pretest and posttest phases. The evaluation criteria for critical thinking skills align with the five aspects proposed

by Ennis, including providing simple explanations, building foundational skills, drawing conclusions, offering further explanations, and organizing strategies and tactics. The assessment method consists of essay-type questions covering 13 indicators of critical thinking skills. Subsequently, an expert validation process was conducted, resulting in 13 items categorized as valid, albeit requiring revisions. Following this validation, the revised questions were administered to students. Based on the results of instrument testing, which included validity calculations and reliability assessments, ten essay questions were determined to be valid for use.

Data Analyis

The data analysis techniques employed to assess the impact of the SAVI strategy on students' Critical Thinking Skills (CTS) in this study comprise: (1) Prerequisite tests: These include assessing normality using the chi-squared formula and examining homogeneity using the Fisher test; (2) Hypothesis testing: This involves utilizing the t-test formula to evaluate the significance of differences; (3) Determining the improvement of CTS after implementing the SAVI approach using N-Gain calculation (Rizal et al., 2022).

RESULTS AND DISCUSSION

Results

The research spanned one month, during which learning in the experimental class was conducted using the SAVI approach, while the control class utilized the scientific approach. The critical thinking skills test was administered twice: before and after the intervention, termed as the pretest and posttest, respectively. The average scores before and after the test are illustrated in Figure 1.

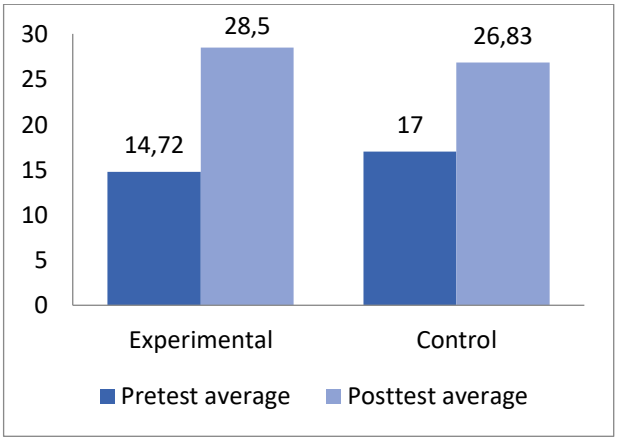

Figure 1. Average Score of Pretest and Posttest

Figure 1 illustrates that pretest Critical Thinking Skills (CTS) scores are initially low in both the experimental and control classes. Students may exhibit diminished confidence in their abilities and potential for CTS exploration, particularly as they have yet to delve into the work and energy topic. However, posttest data reveals divergent CTS outcomes between the two classes. This indicates that students in the experimental class, which received treatment with the SAVI approach, demonstrated superior critical thinking skills compared to those in the control class.

Following the collection of pretest and posttest data from both experimental and control classes, prerequisite tests were conducted. These included the normality test and homogeneity test. The normality test, performed using the Chi-square test with a significance level of 0.05, aimed to assess the normal distribution of research data. Results of the normality test analysis are presented in Table 3. Additionally, the homogeneity test, conducted using the Fisher test, aimed to ascertain the homogeneity of CTS test data, specifically the posttest scores between the experimental and control classes. Results of the homogeneity test analysis are displayed in Table 4. The prerequisite test outcomes indicate that both data sets were derived from normally distributed populations and exhibited homogeneous variances. Subsequently, hypothesis testing was conducted using the independent sample t-test. Results of the hypothesis testing analysis utilizing the t-test are presented in Table 5. Table 5 shows that the results of the calculation of hypothesis testing using the independent sample t-test with a significance level (α = 0.05) obtained $\mathbf{t_{count}} > \mathbf{t_{table}}$, namely 1.97> 1.67, then the conclusion is $\boldsymbol{H_0}$ is rejected and $\boldsymbol{H_a}$ is accepted. At a confidence level of 95%, it can be concluded that the SAVI approach affects students' CTS in the work and energy topic.

Table 3. Chi-Square Normality Test Results

Data	x^2_{count}	x^2_{table}	Conclusion	Analysis Conclusion
CTS posttest score (Experiment)	3.16	12.8	H_0 accepted	Samples have been taken from a normally distributed population
CTS posttest score (Control)	1.63			

Table 4. Fisher Homogeneity Test Results

Data	F_{count}	α	F_{table}	Conclusion	Analysis Conclusion
CTS posttest score (Experiment-Control)	1,33	0,05	1,77	H_0 accepted	All variances are homogeneous

Table 5. Independent Sample T-test Result

Data	t_{count}	α	t_{table}	Conclusion	Analysis Conclusion
CTS Posttest Score (Experiment-control)	1,97	0,05	1,67	H_a accepted	The SAVI approach affects CTS

Table 6. Comparison of Post-test Score Percentage per CTS Stage between Experimental and Control Classes

No	Aspects of CTS	Experiment Class		Control Class	
		Percentage (%)	Category	Percentage (%)	Category
1	Elementary clarification	67	Medium	65	Medium
2	Basic support	75	High	68	Medium
3	Inference	69	Medium	64	Medium
4	Advanced clarification	67	Medium	62	Low
5	Strategy and tactics	83	Very High	85	Very High
Average		72	High	69	Medium

The post-test data results from both the experimental and control classes can be further

elucidated by calculating the percentage of the average post-test score per aspect of CTS. These scores are derived from the post-test, which comprises 10 essay questions, and are presented in Table 6. Table 6 illustrates that the application of the SAVI approach enables the experimental class to enhance all aspects of CTS to the "high" category. Conversely, the control class, employing the scientific approach, achieved a "medium" category. The data in Table 6 validates that both learning approaches, SAVI and scientific, contribute to enhancing students' CTS. However, the efficacy of each approach differs between the experimental and control classes, with the SAVI approach proving more effective in improving students' CTS, as highlighted by Aristyaningsih et al. (2015), who advocate for the superiority of the SAVI approach over scientific methods in measuring student achievement.

Moreover, N-Gain analysis was conducted to assess the improvement of students' CTS, utilizing data from the pretest and post-test results of both classes. A summary of the N-Gain levels in the control and experimental classes is presented in Table 7. Additionally, Table 8 displays the N-Gain values for each aspect of the CTS indicator in both classes. From Table 8, it is evident that all N-Gain values in the experimental class fall within the medium category, whereas the control class has one aspect with a low N-Gain value. Each aspect of the experimental class' N-Gain value indicator surpasses that of the control class, indicating the superiority of the SAVI approach in enhancing students' CTS.

Table 7. N-Gain Recapitulation of Experimental and Control Classes

Group	*N-Gain* score	Category
Experiment	0.54	Medium
Control	0,42	Medium

Table 8. N-Gain Score of Each Aspect of CTS Indicator

CTS indicators	Experiment		Control	
	N-Gain	Category	*N-Gain*	Category
Elementary clarification	0,4	Medium	0,19	Low
Basic support	0,63	Medium	0,47	Medium
Inference	0,44	Medium	0,3	Medium
Advanced clarification	0,56	Medium	0,45	Medium
Strategy and tactics	0,7	Medium	0,65	Medium

Based on the statistical analyses conducted, both the SAVI and scientific approaches have a significant impact on students' critical thinking skills. To ascertain whether the SAVI approach surpasses the scientific approach, a factor analysis was performed. The results indicate that the principal factor contributing to the enhancement of students' critical thinking skills in both methodologies is the dynamic interaction between students and teachers. Notably, the SAVI approach creates an educational environment conducive to direct engagement between students and instructors. By emphasizing the utilization of diverse sensory channels (somatic, auditory, visual, intellectual) to access learning materials, the SAVI approach accommodates various learning styles and strives to provide multifaceted and personalized learning experiences. Conversely, the scientific approach prioritizes observation, experimentation, and the cultivation of conceptual understanding through the scientific method. Furthermore, the second factor identified pertains to the nature of instructional activities utilized in both pedagogical approaches. Factor analysis indicates that the SAVI

approach demonstrates greater efficacy in employing student-centered learning modalities, such as group discussions, which directly contribute to the development of critical thinking skills.

Discussion

The implementation of the SAVI approach in the experimental class significantly influences students' CTS regarding the work and energy topic, resulting in an observable improvement in their CTS. This effect can be attributed to the SAVI approach, which engages students' senses in the learning process, facilitating analysis, understanding, problem-solving, and conclusion drawing. Comprising Somatic (S), Auditory (A), Visual (V), and Intellectual (I) elements, the SAVI approach integrates physical and intellectual activities with sensory stimulation, aligning with Meier's theory (2000) that such holistic learning methods profoundly impact learning outcomes. Nurhayati (2014) suggests that employing the SAVI approach alongside the PBM model significantly enhances learning quality, as evidenced by Fitriyani et al. (2015) and Iskandar et al. (2016), who reported high CTS scores among students using the SAVI approach.

A comparison of pretest and post-test scores between the experimental and control classes reveals a substantial difference, with the experimental class outperforming the control class. The average pretest score in the experimental class prior to treatment was 14.72, rising to 28.5 post-treatment, while the control group's pretest score averaged 17.00, increasing to 26.83 post-treatment. These results indicate a notable disparity of 3.95 points between the experimental and control classes in both pretest and post-test averages, with the experimental class consistently exhibiting higher scores.

The effectiveness of the SAVI approach in teaching Physics, specifically the work and energy topic, is further substantiated by higher post-test scores and percentages of average post-test scores for each aspect of CTS compared to the scientific approach. Nasution (2017) supports this assertion, stating that the SAVI approach enhances CTS by fostering direct experiential learning. Similarly, Dewi (2019) suggests that the SAVI approach improves CTS, while Fauziyah (2019) notes that SAVI-based learning enhances creative thinking skills.

The implementation of the SAVI approach in experimental classes posed several challenges for researchers. One obstacle was the need for optimal preparation due to limited supporting tools, particularly projectors, to display problems for analysis. To address this, researchers sought alternative methods, such as creating SAVI-based worksheets containing stages from preparation to results, with problems presented in the worksheet during the preparation stage. Another challenge arose from large group sizes, leading to distractions and time constraints during activities. Researchers managed this by optimizing time management, reminding students of discussion deadlines, and overseeing discussions to ensure adherence to set timeframes. Despite these challenges, the research has limitations stemming from its small scope, focusing solely on one school population. Consequently, the generalizability of results is restricted to some students at different levels. Nevertheless, these findings can serve as a foundation for future research utilizing the SAVI approach or collaborating with other models, media, or learning strategies to have a more significant impact on improving students' higher-order thinking skills.

This research contributes to the education field by demonstrating the effectiveness of the SAVI learning approach in enhancing high school students' critical thinking abilities. It underscores the importance of pedagogical innovation in fostering cognitive development

and preparing students for success in the 21st century. Furthermore, it highlights the necessity for ongoing professional development opportunities for educators to effectively implement innovative teaching strategies. Overall, this research advances our understanding of effective teaching and learning practices and offers valuable implications for enhancing educational outcomes and equipping students for future challenges. While the SAVI approach offers diverse and engaging learning experiences, the scientific approach still holds potential for supporting critical thinking skill development. However, it is crucial to consider the learning context, student preferences, and learning objectives when selecting the most appropriate approach. In some instances, combining or adapting both approaches may yield the most effective results.

CONCLUSION

In conclusion, the Somatic, Auditory, Visual, and Intellectual (SAVI) approach has been shown to significantly impact students' critical thinking skills within the context of the work and energy topic for tenth-grade students majoring in mathematics and natural science. The findings from N-Gain analysis indicate that the experimental group, which received instruction through the SAVI approach, exhibited more substantial improvement in critical thinking skills compared to the control group. Specifically, the experimental group achieved an average N-Gain value of 0.54, indicating notable enhancement, while the control group demonstrated an average N-Gain value of 0.42, reflecting moderate improvement. These results underscore the potential effectiveness of the SAVI approach in fostering higher-order thinking abilities among students. Therefore, integrating the SAVI approach into educational practices presents a promising alternative to conventional teaching methodologies, offering diverse learning experiences tailored to nurturing critical thinking skills and other essential competencies vital for future success.

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