International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Connecting Concepts to Context: Teachers' Perceptions and Attitude of the Science-Technology-Society (STS) Approach in Science Education

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A B S T R A C T :

The Science, Technology, and Society (STS) approach offers a more meaningful learning experience by combining scientific principles, technological progress, and societal challenges, promoting scientific literacy and encouraging critical thinking in students. This study aims to explore the perceptions and attitudes of science teachers towards Science, Technology and Society (STS) approach in science education. A descriptive-survey research design was used, with survey questionnaires administered to 15 science teachers. Data were analyzed using descriptive statistics and significant differences were calculated using a two-sample t test. The findings showed that teachers have a positive perception and attitude towards STS approach especially in improving their students' critical thinking skills and linking science to real-world issues. However, challenges such as limited resources, insufficient training, and time constraints hinder its full implementation. Thus, it is recommended that education stakeholders integrate STS into science curricula and teacher training programs to support science teachers and improve teaching practices.

Keywords: STS approach, Teacher Perception, Attitude, Science Education

1.Introduction

In the 21st century, science education has evolved beyond the traditional transmission of scientific facts, emphasizing the development of students' abilities to apply scientific knowledge to real-world contexts. The Science-Technology-Society (STS) approach serves as a pedagogical framework that integrates scientific concepts with technological advancements and societal issues, fostering scientific literacy and critical thinking among learners. This approach emphasizes the relevance of science in everyday life, encouraging students to engage with scientific content meaningfully (Akcay & Akcay, 2015).

The STS approach is grounded in constructivist learning theories, which posit that learners construct knowledge through experiences and reflections. By situating scientific concepts within societal and technological contexts, STS encourages students to explore the interconnectedness of these domains, promoting deeper understanding and retention (Çınar & Çepni, 2021). Furthermore, STS fosters the development of problem-solving skills, as students are often tasked with addressing real-world issues through scientific inquiry (Kamizi & Iksan, 2021).

Teachers play a pivotal role in the successful implementation of the STS approach. Their perceptions and attitudes toward STS significantly influence their willingness to adopt and integrate this approach into their teaching practices. Positive perceptions can lead to enthusiastic adoption, while skepticism or lack of understanding may hinder implementation (Mansour, 2015). Therefore, exploring teachers' perspectives is crucial for identifying potential barriers and facilitators to STS integration.

Several studies have investigated teachers' perceptions and attitudes toward the STS approach. For instance, Kamizi and Iksan (2021) found that Malaysian science teachers generally held positive attitudes toward STS, recognizing its potential to make science more relevant and engaging for students. However, the study also highlighted challenges such as limited resources and insufficient training, which impeded effective implementation. Similarly, Çınar and Çepni (2021) reported that while Turkish teachers acknowledged the benefits of STS, they faced obstacles related to curriculum constraints and lack of institutional support.

Research also indicates that teachers' demographic factors, such as gender and teaching experience, can influence their perceptions and attitudes toward STS. Kamizi and Iksan (2021) observed that male teachers were more likely to perceive technology as having a significant impact on society compared to their female counterparts. Additionally, teachers with more years of experience tended to have more positive perceptions of the integration of science, technology, and society in education. These findings suggest that tailored professional development programs may be necessary to address the diverse needs and perspectives of teachers.

The effectiveness of the STS approach in enhancing student learning outcomes has been well-documented. A meta-analysis by Acut and Antonio (2023) revealed that STS-based instruction significantly improved students' cognitive, affective, and psychomotor skills. Moreover, the approach was

found to be effective across various educational contexts and student populations. These findings underscore the potential of STS to transform science education by making it more engaging and applicable to students' lives.

Despite the demonstrated benefits of the STS approach, its widespread adoption remains limited. Barriers such as rigid curricula, lack of resources, and insufficient teacher training continue to impede its implementation (Mansour, 2015). Addressing these challenges requires a comprehensive understanding of teachers' perceptions and attitudes toward STS. By identifying the factors that influence teachers' willingness to adopt STS, stakeholders can develop targeted interventions to support its integration into science education.

Perception of Science and Technology on Society

Teachers' views on science and technology in education are diverse and often shaped by their teaching philosophies. Some lean towards a constructivist approach, emphasizing student-centered learning and real-life connections, while others maintain traditional methods that are more teacher-directed (Mansour, 2010). Science and technology hold significant value in society, offering tools that simplify everyday life and help students better understand real-world phenomena (Ersay, 2015). However, many students still have a limited grasp of scientific concepts, often struggling to connect these ideas to real-life applications and societal issues (Fakhriyah et al., 2017).

Studies on students' perceptions of the Science-Technology-Society (STS) approach show that it enhances academic achievement and strengthens understanding of scientific ideas. Compared to traditional methods, the STS model improves students' cognitive development and enables them to build better problem-solving and decision-making abilities (Primastuti & Atun, 2018). Teachers also find the STS strategy beneficial, as it encourages students to engage more deeply with current issues and understand the relevance of science in their surroundings.

The STS approach fosters a constructivist learning environment, where students collaborate, share perspectives, and solve real-life problems. Through this method, learners develop critical thinking and teamwork skills, while also gaining confidence in addressing personal and community-related issues grounded in scientific principles (Kapici et al., 2017). These teaching and learning practices reshape classroom dynamics by making science more meaningful and interactive.

Furthermore, STS-based learning materials, like specially designed textbooks, make science lessons more engaging and accessible. Such resources inspire teachers to be more creative and adaptive, while encouraging students to explore and investigate independently (Kartikasari, Roemintoyo, & Yamtinah, 2018; Tarntip & Chockchai, 2014). Since teachers play a crucial role in nurturing talent (Gagné, 2007), their strategies significantly influence students' interest and performance in science. In the context of Industrial Revolution 4.0, integrating science and technology into education is essential for national development, economic self-reliance, and preparing students with 21st-century skills.

1.1. Statement of the Problem

This study aims to explore science teachers' perceptions and attitudes toward the STS approach in science education. Specifically, it seeks to assess teachers' understanding of the STS framework, examine their attitudes toward integrating STS into their teaching practices, and identify the challenges they face in implementing STS-based instruction. The findings will provide insights into the current state of STS integration in science education and inform strategies to enhance its adoption.

- How do Science teachers be described in terms of sex, age, educational attainment, year of teaching experience, and grade level taught.
- How do the perception of science teachers towards the STS approach in science education to be described?
- What are the attitudes of science teachers toward integrating the STS approach in classroom instruction?
- Is there any significant difference between the teacher's perceptions and attitude regarding STS among Science teachers?

2. Methods

2.1 Research Design

The study sought to explore science teachers' perceptions and attitudes toward the STS approach in Science education. The descriptive-survey research design was employed in this research. According to Mugenda and Mugenda (2003), a survey is an attempt to collect data from members of a population to determine the current status of that population concerning one or more variables.

2.2 Data Sources

The primary data source for this research study was a structured questionnaire adapted from the works of Mansour (2010) and Aikenhead, Ryan, and Fleming (1989) on the Views of Science-Technology-Society (VOSTS). The questionnaire was designed to collect comprehensive data on teachers' perceptions and attitudes toward the STS approach in science education and was divided into three sections: Part A gathered demographic information of the respondents; Part B consisted of 21 items assessing teachers' perceptions of the STS approach; and Part C included 10 items measuring their attitudes. All items were rated using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was distributed to participating school and collected in phases, allowing respondents ample time to complete the questionnaire based on their availability. To ensure the instrument's reliability, Cronbach's Alpha was computed for each section, with results indicating high internal consistency and strong validity. The collected data were analyzed using descriptive statistics (percentage, mean, and standard deviation), while a two-sample t-test was employed to determine any significant differences between teachers' perceptions and attitudes toward the STS approach.

2.3 Research Procedure

The researchers employed a descriptive-survey method. A structured questionnaire was developed to assess the perceptions and attitudes of science teachers regarding the STS approach. The instrument included items focused on the perceived benefits, challenges, and practical applications of STS in classroom instruction. It was validated by experts in science education before administration. The survey was distributed to 15 Junior High School science teachers through both printed and digital formats, ensuring convenience and accessibility. Prior to data collection, informed consent was obtained from all participants, and their responses were treated with confidentiality. The collected data were then organized and subjected to descriptive statistical analysis, while significant differences in responses were determined using a two-sample t-test to provide insights into varying attitudes and perceptions.

3. Results and Discussion

Table 1 Demographic Profile of the Respondents

Demographic Variable	Frequency	Percentage
Sex		
Male	3	20
Female	12	80
Age		
21-25 years old	1	6.67
26-30 years old	2	13.33
21-35 years old	4	26.67
36-40 years old	3	20
41-45 years old	1	6.67
46-50 years old	2	13.33
55-60 years old	2	13.33
Educational Attainment		
Bachelor's Degree	14	93.33
Master's Degree	1	6.67
Doctoral Degree	0	0
Years of Teaching Experience		
1-5 years	3	20
6-10 years	3	20
11-15 years	4	26.67
16 years and above	5	33.33
Grade Level Taught		
Grade 7	4	26.67
Grade 8	4	26.67
Grade 9	3	20
Grade 10	4	26.67
Have you attended any training/workshop/seminar on STS-based teaching?		
Yes	3	20
No	12	80
Total	15	100

The table above shows the profile of the fifteen teacher respondents. The findings revealed that in terms of sex, most respondents were female, comprising 80% of the sample, while males accounted for 20%. The age distribution shows that most of the respondents are middle aged. The most common age group is 31-35 years old having a percentage of 26.67%, followed by 36-40 years old at 20%, 26-30, 46-50, and 55-60 years old at 13.33% each, and both 21-25 and 41-45 years old have the least number of respondents having 6.67%. Regarding educational attainment, the majority

of teachers have a bachelor's degree, accounting for 93.33% of the respondents, only one of the respondents earned a master's degree at 6.67%, and none have a Doctoral degree. This shows that only few teachers have pursued graduate studies. In terms of years of teaching experience, the majority has been teaching for 16 years and above having 33.33%. This is followed by those with 11-15 years comprising 26.67% of the sample, and both 1-5 years and 6-10 years at 20%. For grade level taught, the responses were almost evenly distributed. Four teachers were teaching grades 7, 8, and 10 having 26.67% while 20% of them were teaching grade 9 students. Lastly, when asked if they have attended any training, workshops, or seminar on STS-based teaching, only 20% said yes, while 80% said no. This means that most of the teachers have not yet received training related to STS-based teaching.

In a study conducted by Ngaewkoodrua and Yuenyong (2018), they found that workshops focused on the STS approach significantly helped teachers apply their learning to create and design STS lesson plans that promote inventive thinking.

Table 2 Teachers' Perception Toward STS Approach

Statement	Mean	Standard Deviation	Interpretation
I am familiar with the STS approach in Science education.	3.07	0.70	Neutral
STS helps students understand the relevance of Science in daily life.	3.53	0.74	Agree
The STS approach promotes critical and reflective thinking.	3.40	0.83	Neutral
STS makes Science lessons more engaging and interactive.	3.80	0.41	Agree
I believe STS improves students' scientific literacy.	4.67	0.62	Strongly Agree
STS is relevant to current local and global issues.	3.87	0.66	Agree
I often integrate STS in my teaching strategies.	3.07	0.26	Neutral
I believe STS should be embedded in the K to 12 Science curriculum.	3.87	0.35	Agree
STS helps connect Science with other disciplines like ethics, environment, and technology.	3.47	0.74	Agree
I can identify STS themes in the existing curriculum guide.	3.27	0.59	Neutral
Students are more motivated when STS topics are discussed.	3.80	0.41	Agree
STS helps students relate scientific concepts to societal problems.	3.47	0.74	Agree
I have sufficient resources to teach STS-related topics.	2.53	0.74	Disagree
STS supports inquiry-based and project-based learning strategies.	3.27	0.59	Neutral
I feel confident discussing the ethical issues in science through STS.	3.07	0.26	Neutral
STS encourages social responsibility among students.	3.20	0.41	Neutral
I feel STS teaching improves long-term understanding of concepts.	3.20	0.41	Neutral
Students can develop a deeper appreciation of science when STS is used.	3.33	0.62	Neutral
STS should be integrated even in lower grade levels.	3.20	0.41	Neutral
There is a need for more training on the implementation of STS.	5.00	0	Strongly Agree
I believe that STS is essential for 21st-century learners.	5.00	0	Strongly Agree
TOTAL	3.58	0.62	Agree

Legend: 1.00 – 1.80 = Strongly Disagree; 1.81 – 2.60 = Disagree; 2.61 – 3.40 = Neutral; 3.41 – 4.20 = Agree; 4.21 – 5.00 = Strongly Agree

The table presents findings on the perception of teachers towards the STS approach. The findings reveal that the teachers strongly agreed on the statements "I believe STS improves students' scientific literacy" (M = 4.67, SD = 0.62), "There is a need for more training on the implementation of STS" (M = 5.00, SD = 0), and "I believe that STS is essential for 21st-century learners" (M = 5.00, SD = 0). This suggests that teachers recognize the importance of the STS approach in scientific understanding and the need for professional development for its implementation. Findings also indicate that teachers believe STS enhances their student engagement especially in statements "STS makes Science lessons more engaging and interactive" (M = 3.80) and "Students are more motivated when STS topics are discussed" (M = 3.80), both falling to verbal interpretation of "Agree". Moreover, several items fall to the "Neutral" interpretation, such as I am familiar with the STS approach", "I often integrate STS in my teaching strategies", and "I feel confident discussing ethical issues through STS" all having mean of 3.07, and standard deviation of 0.70, 0.26, and 0.26 respectively. In contrast, the statement "I have sufficient resources to teach STS-related topics" has the lowest mean of 2.53 and standard deviation of 0.74, which falls to interpretation of "Disagree". This shows that many teachers feel under-resourced which may be a barrier to an effective implementation of the STS approach in science education.

Overall, the results show that many teachers has a positive perception towards the STS approach in science education especially in terms of its relevance and benefits for students, with an overall mean of 3.58 and standard deviation of 0.62, interpreted as "Agree".

Teachers are crucial agents of change in educational reform, and their beliefs often serve as precursors for initiating and embracing meaningful change in education (Vandeyar, 2017). Similar to the findings of this study, Kamizi and Iksan (2021) found that teachers have a positive perception toward science teaching that incorporates technology and real-world issues. They also agreed that using real-life examples made science lessons more

meaningful and relevant for students. In addition, a study by Rachmadtullah et al. (2022) measures the teacher's perception of the STS integration into learning, and it was found that teachers perceive this as beneficial for developing students' critical thinking skills especially in science and technology through real life experiences and various societal issues.

Table 3 Teacher's Attitudes Toward STS Approach

Statement	Mean	Standard Deviation	Interpretation
I enjoy teaching science when it is connected to real-world issues.	4.87	0.35	Strongly Agree
I am enthusiastic about integrating STS topics into my lessons.	3.80	0.41	Agree
I believe it is my responsibility to educate students about science and its societal impact	4.60	0.74	Strongly Agree
I feel motivated to use STS even without additional incentives.	3.47	0.74	Agree
I am open to learning new strategies to improve STS integration.	4.27	0.59	Strongly Agree
I find STS to be a meaningful approach in Science teaching.	4.73	0.59	Strongly Agree
I believe STS promotes the development of students' values and ethics.	4.27	0.46	Strongly Agree
I would recommend the STS approach to other Science teachers.	4.87	0.35	Strongly Agree
I enjoy attending seminars or workshops related to STS teaching.	3.53	0.74	Agree
I have a positive attitude toward the continued use of STS in the Science curriculum.	4.87	0.35	Strongly Agree
Total	4.33	0.50	Strongly Agree

Legend: 1.00 – 1.80 = Strongly Disagree; 1.81 – 2.60 = Disagree; 2.61 – 3.40 = Neutral; 3.41 – 4.20 = Agree; 4.21 – 5.00 = Strongly Agree

The table above shows the attitudes of teachers towards the STS approach. The findings show that science teachers have a strongly positive attitude toward the STS approach, with an overall mean of 4.33 and a standard deviation of 0.53, interpreted as "Strongly Agree". The statements "I enjoy teaching science when it is connected to real-world issues," "I would recommend the STS approach to other Science teachers," and "I have a positive attitude toward the continued use of STS in the Science curriculum"—all received a mean of 4.87, interpreted as "Strongly Agree". Other statements, such as "I believe it is my responsibility to educate students about science and its societal impact" and "I find STS to be a meaningful approach in Science teaching" with a mean of 4.60 and 4.73 respectively, also reflect strong agreement, emphasizing the perceived value of STS in shaping responsible and informed learners. Meanwhile, moderately high scores were seen in "I feel motivated to use STS even without additional incentives" (mean = 3.47) and "I enjoy attending seminars or workshops related to STS teaching" (mean = 3.53), both falling under the Agree category. These results show positive attitudes, though slightly more reserved, possibly reflecting practical considerations such as time, workload, or access to training opportunities.

Overall, findings show that teachers have a positive attitude towards STS approach in education with an overall mean of 4.33 and standard deviation of 0.50, which falls to interpretation of "Strongly Agree". Science teachers generally view STS as a meaningful, engaging, and valuable teaching approach that can enhance students' science literacy, critical thinking, and ethical understanding.

Fostering a positive attitude in teachers greatly contributes to building an effective personal learning environment for students (Khalid et al., 2015). Teachers' attitudes play a significant role in their acceptance of educational innovations. When teachers maintain a positive and open-minded approach to change, their teaching methods are more likely to align with the evolving educational landscape. Support from teachers is crucial for successfully implementing innovations in teaching and learning. Kamizi and Iksan (2021) found that most science teachers, regardless of their teaching experience, have a positive attitude toward STS approaches in science teaching, they use real-life examples and make connections within the STEM fields.

Table 4 Significant Difference between Teacher's Perception and Attitude Toward STS Approach

	Perception	Attitude
Mean	3.58	4.33
Variance	0.39	0.25
Standard Deviation	0.62	0.50
SEM	0.1353	0.1581
t	-3.3346	
Two-tailed P	0.0023	
d.o.f	29	
Standard Error of Difference	0.2249	

To determine whether there is a significant difference between science teachers' perceptions and attitudes toward the STS approach, a two-sample t-test was conducted using the mean scores from Likert-scale responses. The findings revealed that the means of teacher's perception and attitude toward STS approach are significantly different at $p<0.05$. The mean score for perception was 3.58, while the mean for attitude was notably higher at 4.33. This suggests that science teachers not only understand the value of the STS approach, but they also feel very positively about applying it in real

teaching situations. Furthermore, the results yielded a t-value of -3.3346 with a two-tailed p-value of 0.0023. Since the p-value is less than the standard significance level of 0.05, it can be concluded that there is a statistically significant difference between teachers' perception and attitude.

Several studies have shown that teachers' perceptions influenced their attitudes toward teaching and learning methods. According to Chand (2022), teachers view deep approaches to learning as those that enable students to retain newly learned information over a longer period and develop critical thinking and problem-solving skills. When teachers view these methods and reforms positively, they are more likely to support and adopt them on their own initiative, without needing pressure or instructions from their superiors (Kamizi & Iksan, 2021).

However, in contrast to the findings of this study, Kamizi & Iksan (2021) found that teachers' perceptions and attitudes towards the STS approach are at the same level. They all shared a strong willingness to improve their teaching, enhance their use of technology to provide clearer science concepts, and participate in professional development courses to contribute to the improvement of the education system.

4. Conclusion

In conclusion, respondents of the study were female, middle-aged, and held a bachelor's degree, with majority had been teaching for more than ten years. Findings found that science teachers hadn't had much training or been to many STS-related seminars or workshops, despite this, they still had a generally positive perception of the approach, particularly in terms of its potential to improve scientific literacy and its relevance to 21st-century learners. However, some reported challenges, particularly a lack of familiarity with the STS framework and insufficient resources to fully implement it in their classrooms.

On the other hand, science teachers expressed a strongly positive attitude toward integrating STS in their classrooms. They found the approach meaningful and aligned with their responsibility to connect science to real-world issues and societal impact. Notably, the statistical analysis confirmed a significant difference between teachers' perceptions and attitudes, indicating that while teachers may understand the importance of STS, their emotional and motivational readiness to implement it is even more favorable.

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