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Integrating Socio-Scientific Issues to Foster Critical Thinking Skills in Science in Sto. Niño

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ABSTRACT

In the 21st century, critical thinking is recognized as a fundamental skill in science education, enabling students to analyze evidence, make informed decisions, and engage responsibly with societal issues. This quantitative study employed a descriptive-correlational design to examine the integration of socio-scientific issues in science instruction and its influence on students' critical thinking skills in Sto. Niño, South Cotabato. The study also aimed to provide a basis for proposing context-sensitive strategies for effective classroom implementation. Findings revealed a high level of integration of socio-scientific issues across all instructional domains, with real-life relevance, classroom discussion strategies, interdisciplinary approaches, and the use of authentic materials strongly evident. Regarding students' critical thinking skills, the highest proficiency was observed in analyzing scientific arguments, demonstrating strengths in identifying evidence, evaluating reliability, recognizing biases, and assessing argument strength. Problem-solving skills, evaluative thinking, and decision-making reflected good competency but indicated areas for further development. Overall, students exhibited a generally high level of critical thinking skills, with analytical reasoning as the strongest area. Furthermore, socio-scientific factors showed only a weak and non-significant relationship with students' critical thinking skills, suggesting that instructional practices play a more significant role in developing these skills than socio-scientific conditions. The study concluded that connecting science learning to real-world contexts, encouraging discussions, integrating multiple disciplines, and using authentic resources effectively foster critical thinking. Recommendations included implementing output-oriented instructional strategies and structured interventions to enhance problem-solving, decision-making, and evaluative thinking, thereby promoting meaningful and socially relevant science education.

Keywords: instructional strategies, analytical reasoning, educational interventions, student engagement

INTRODUCTION

Background of Study

In the 21st century, critical thinking has emerged as an essential competency in science education, enabling students to analyze evidence, make informed decisions, and engage in responsible citizenship. However, a growing concern in educational systems is the inability of many students to apply critical thinking in real-life situations, particularly in complex issues that blend scientific knowledge with ethical, cultural, environmental, and political considerations. This issue becomes even more pressing in the context of global challenges such as climate change, pandemics, biodiversity loss, and technological advancements, where citizens are required to make informed choices grounded in scientific understanding.

Globally, integrating socio-scientific issues (SSIs), real-world dilemmas involving science and society, has been effective in promoting critical thinking and scientific literacy (Sadler et al., 2019). Studies have shown that addressing controversial and ethically charged topics such as climate change, genetic engineering, and public health encourages students to evaluate multiple perspectives and develop reasoning skills (Zeidler & Nichols, 2021).

In the Philippines, however, science instruction remains largely content-driven, with limited integration of SSIs in the classroom (Cruz & Dizon, 2020), a gap in higher-order thinking skills. In the South Central Mindanao region, science education is further challenged by contextual limitations, including a lack of culturally relevant materials and inadequate teacher training in inquiry-based and SSI approaches (Lopez et al., 2022).

In South Cotabato, particularly in the municipality of Sto. Niño, these challenges are evident, and local science educators seek innovative strategies to cultivate critical thinking among learners amid curriculum demands and resource constraints. This study addresses the gap in localized research on SSI-based pedagogy in secondary science education and its role in enhancing students' critical thinking. Aligned with the United Nations Sustainable Development Goal 4—Quality Education—this research aimed to contribute to inclusive and equitable education to empower learners with the skills needed for lifelong learning and societal participation.

Despite curricular reforms, traditional teaching practices often emphasize rote memorization and the recall of factual knowledge rather than the development of reasoning, argumentation, and reflective judgment. As a result, learners are inadequately prepared to address socio-scientific dilemmas that demand critical engagement with science in their everyday lives.

Therefore, integrating socio-scientific issues (SSIs) into science education is increasingly recognized as a powerful pedagogical approach to bridge this gap and cultivate a generation of scientifically literate and critically minded individuals.

The goal of the study was to assess the integration of socio-scientific issues in science instruction to foster critical thinking skills among secondary and elementary school students in Sto. Niño, South Cotabato, as a basis to propose context-sensitive strategies for effective classroom implementation.

Statement of the Problem

This study aimed to assess the integration of socio-scientific issues in science instruction to foster critical thinking skills among secondary and elementary school students in Sto. Niño, South Cotabato, as a basis to propose context-sensitive strategies for effective classroom implementation.

Specifically, the research problem revolved around understanding the following key questions:

1.To what extent is the Integration of Socio-Scientific Issues in Science Education, in terms:
- 1.1Relevance of Real-Life Issues;
- 1.2. Classroom Discussion Strategies;
- 1.3.Interdisciplinary Approach; and
- 1.4.Use of Authentic Materials?

2. To what level is the students` Critical Thinking Skills in Science, in terms of:
- 2.1. Analyzing Scientific Arguments;
- 2.2. Problem-Solving Skills;
- 2.3. Decision-Making; and
- 2.4. Evaluative Thinking?

3. Is there a significant relationship between the Integration of Socio-Scientific Issues in Science Education and the students` Critical Thinking Skills in Science among secondary and elementary schools in Sto. Niño?

METHODOLOGY

Research Design

The study is quantitative, specifically a descriptive-correlational study to assess the integration of socio-scientific issues into science instruction to foster critical thinking skills among secondary and elementary school students in Sto. Niño, South Cotabato, as a basis for context-sensitive strategies for effective classroom implementation.

According to Bhandari (2021), a correlational research design investigates relationships between variables without the researcher controlling or manipulating any of them. Further, a correlation reflects the strength and/or direction of the relationship between two (or more) variables. The direction of a correlation can be either positive or negative. Correlational research

involves gathering data quickly from natural settings. That helps you generalize your findings to real-life situations in an externally valid way.

Respondents of the Study

The respondents of this study were the selected 50 secondary and elementary science teachers in Sto. Niño, Division of South Cotabato, for the school year 2025–2026. Science teachers were chosen as the respondents because they play a central role in implementing science curricula and integrating instructional approaches that promote critical thinking skills among learners. Their experiences, pedagogical practices, and perceptions provide valuable insights into the extent to which socio-scientific issues (SSIs) are incorporated into science instruction and how such integration influences students' critical thinking development.

Teachers are considered key agents in educational reform because they directly translate curriculum goals into classroom practice and create learning environments that foster higher-order thinking skills (Darling-Hammond et al., 2020). Furthermore, science teachers are in a unique position to facilitate discussions of socio-scientific issues, which require learners to evaluate evidence, consider multiple perspectives, and make informed judgments regarding real-world problems (Sadler, 2011). Consequently, obtaining data from science teachers allows the researcher to gather relevant and reliable information regarding the implementation of SSI-based instruction in both elementary and secondary education settings.

The inclusion of both elementary and secondary science teachers also provides a broader perspective on the integration of socio-scientific issues across different educational levels. This enables the researcher to examine similarities and differences in instructional practices, challenges, and opportunities in fostering critical thinking skills among learners. According to Creswell and Creswell (2021), selecting respondents who possess direct knowledge and experience related to the phenomenon under investigation enhances the credibility and relevance of the research findings.

Sampling Technique

A simple random sampling technique was used to select 50 secondary & elementary teachers in Sto Niño, South Cotabato Division, for the school year 2025–2026.

Simple random sampling is one of the most widely accepted probability sampling methods because it gives each member of the population an equal chance of being selected, minimizing selection bias and ensuring that the sample is representative of the larger teacher population (Taherdoost, 2017; Creswell & Creswell, 2021).

Research Instruments

This study employed a researcher-made survey questionnaire and a five-point Likert Scale evaluated by a panel of experts.

To assess the extent to which the Integration of Socio-Scientific Issues in Science Education, the scale below was used:

RATING	RANGE OF MEANS	DESCRIPTIVE RATING	INTERPRETATION
5	4.20-5.00	Agree	Very Great Extent
4	3.40-4.19	Fairly Agree	Great Extent
3	2.60-3.39	Neutral	Moderate Extent
2	1.80-2.59	Fairly Disagree	Low Extent
1	1.00-1.79	Disagree	Very Low Extent

Another rating scale was used to assess the level of the students` Critical Thinking Skills in Science:

RATING	RANGE OF MEANS	DESCRIPTIVE	INTERPRETATION
5	4.20-5.00	Agree	Excellent
4	3.40-4.19	Fairly Agree	Good
3	2.60-3.39	Neutral	Fair
2	1.80-2.59	Fairly Disagree	Weak
1	1.00-1.79	Disagree	Very Weak

Data Gathering Procedure

To ensure reliable and authentic findings, the researcher adhered to a methodology aligned with the study to determine the relationship between the Integration of Socio-Scientific Issues in Science Education, and students` Critical Thinking Skills in Science among secondary & elementary schools in Sto. Niño, South Cotabato Division.

Initially, the study's implementation required the endorsement of the DepEd-Division Superintendent and the CGS Dean, with their respective signatures on a formal document.

An additional letter of authorization was sent to the school principals and Science teachers. To ensure the accuracy of the data collected for this study, a survey questionnaire was utilized, developed, and assessed. The researcher employed a random sampling using self-generated random number tables to select participants for the study.

The study underwent ethical considerations. The researcher sought approval from the EWMCI Research Ethics Committee (EREC).

Provided that the health protocol was adhered to, the researcher initiated the face-to-face dissemination of the Survey Questionnaire. The outcomes derived from the distributed survey questionnaire were compiled, assessed, and analyzed.

Scope and Limitations

The study explored how socio-scientific issues (SSI) in science instruction could enhance the critical thinking skills of secondary and elementary school learners.

The participants included selected science teachers in Sto. Niño, who were directly involved in SSI-based lessons during the 2025–2026 school year. Employing a quantitative research design, specifically a correlational approach, the study investigated teaching strategies, student responses, and classroom interactions to understand the processes and outcomes of SSI integration.

The research was delimited to secondary and elementary schools within Sto. Niño and to science topics where SSI could be applied, and it would examine learners' critical thinking development as influenced by these targeted interventions. The study aimed to provide insights into effective teaching practices and instructional strategies that foster critical thinking, highlighting the relevance of SSI in preparing students to analyze complex real-world problems scientifically and ethically.

RESULTS AND DISCUSSIONS

In the 21st century, critical thinking has become one of the most essential competencies in science education, enabling learners to evaluate evidence, solve problems, make informed decisions, and participate responsibly in societal issues that are increasingly shaped by science and technology. Recognizing this importance, the present study employed a quantitative descriptive-correlational design to assess the integration of socio-scientific issues (SSIs) in science instruction and its relationship to students' critical thinking skills in Sto. Niño, South Cotabato. The findings served as a basis for developing context-sensitive strategies for effective classroom implementation.

The results revealed that the integration of socio-scientific issues in science instruction was highly evident across all domains, yielding a grand mean of 4.53. Among the dimensions, real-life relevance obtained the highest mean score, followed by classroom discussion strategies and interdisciplinary approaches, while the use of authentic materials also demonstrated strong integration. This finding suggests that science teachers actively connect scientific concepts to real-world issues and encourage learners to examine societal concerns through scientific lenses.

The prominence of real-life relevance supports the assertion that contextualized learning enhances student engagement and promotes meaningful understanding of scientific concepts. According to Sadler et al. (2019), socio-scientific issues become effective learning tools when students perceive their direct relevance to everyday life and societal concerns. Similarly, Zeidler (2014) emphasized that SSI-based instruction provides authentic contexts that encourage students to apply scientific knowledge beyond the classroom, thereby strengthening scientific literacy and civic responsibility. The strong ratings in classroom discussion and interdisciplinary approaches further indicate that teachers recognize the value of dialogue, argumentation, and multiple perspectives in science learning, which are fundamental characteristics of SSI pedagogy (Zeidler & Nichols, 2021).

Regarding students' critical thinking skills, the findings showed that learners achieved the highest mean score in analyzing scientific arguments (M = 4.20, Excellent). This result indicates that students demonstrate strong abilities in identifying evidence, evaluating source credibility, recognizing biases, and assessing the validity of scientific claims. Such findings align with the work of Facione (2020), who identified analysis and interpretation as foundational components of critical thinking. The ability to evaluate arguments is particularly important in contemporary society, where individuals are constantly exposed to scientific information, misinformation, and competing claims through digital media.

The domains of problem-solving skills (M = 4.16, Good), evaluative thinking (M = 4.10, Good), and decision-making (M = 4.06, Good) also obtained favorable ratings, indicating that students generally possess strong critical thinking abilities. However, the slightly lower means suggest that learners may still require additional opportunities to engage in complex problem-solving situations and decision-making tasks that involve uncertainty and competing viewpoints. According to OECD (2019), critical thinking develops most effectively when students are challenged to solve authentic problems, evaluate alternative solutions, and justify decisions using evidence-based reasoning. Therefore, while students exhibit satisfactory levels of competence, further instructional support may strengthen these higher-order cognitive processes.

The overall grand mean of 4.13, interpreted as Good, indicates that students possess a generally high level of critical thinking skills in science. This finding is consistent with studies emphasizing that inquiry-based and discussion-oriented science instruction contributes positively to learners' analytical reasoning and reflective thinking (National Research Council, 2012). The strong performance in analytical reasoning suggests that students are capable of engaging with scientific information critically, although continued exposure to authentic socio-scientific dilemmas may further enhance their evaluative and decision-making capabilities.

Interestingly, the correlational analysis revealed that the integration of socio-scientific issues had only a weak and statistically non-significant positive relationship with students' critical thinking skills ($r = 0.191$, $p = 0.180$). Although the relationship was positive, the result indicates that SSI integration alone may not be sufficient to significantly influence students' critical thinking abilities. This finding suggests that other variables, such as teaching effectiveness, instructional strategies, learner motivation, prior knowledge, classroom environment, and socioeconomic factors, may also contribute substantially to the development of critical thinking skills.

The absence of a significant relationship contrasts with numerous studies that have reported positive effects of SSI-based instruction on critical thinking and argumentation skills (Sadler et al., 2019; Zeidler & Nichols, 2021). One possible explanation is that while socio-scientific issues are integrated into instruction, the depth and quality of implementation may vary across classrooms. SSI pedagogy requires sustained discussion, inquiry, reflection, and evidence-based argumentation to produce meaningful cognitive gains (Zeidler, 2014). Consequently, superficial exposure to socio-scientific topics may not necessarily translate into measurable improvements in critical thinking.

Moreover, critical thinking is a multifaceted construct that develops over time through repeated opportunities for analysis, reflection, and problem-solving. According to Facione (2020), critical thinking is influenced by both cognitive and dispositional factors, including curiosity, open-mindedness, and intellectual perseverance. Therefore, strengthening students' critical thinking may require a more comprehensive instructional approach that combines SSI integration with inquiry-based learning, collaborative problem-solving, and reflective practice.

Overall, the findings indicate that socio-scientific issues are highly integrated into science instruction and that students demonstrate commendable levels of critical thinking skills. However, the weak and non-significant relationship between these variables suggests that educators should explore additional pedagogical strategies to maximize the potential of SSI-based instruction in fostering higher-order thinking. Future interventions may focus on deepening classroom discourse, strengthening argumentation activities, and providing authentic opportunities for learners to engage in complex socio-scientific decision-making processes.

Conclusion

The following conclusions were made considering this study's findings:

It was concluded that connecting science learning to real-world contexts, encouraging discussion, linking multiple disciplines, and using authentic resources effectively engage students and enhance their understanding, highlighting the importance of multidimensional strategies in promoting meaningful and socially relevant science education.

Further, while students demonstrate robust critical thinking skills overall, educators can enhance learning by incorporating more real-world problem-solving tasks, decision-making scenarios, and reflective evaluative exercises. These strategies can strengthen weaker domains

and ensure that students not only understand scientific concepts but also apply them effectively in complex and practical contexts.

Finally, it was concluded that while students are capable of critical engagement with scientific concepts, their critical thinking is more influenced by learning experiences and instructional practices than by socioeconomic factors, highlighting the importance of pedagogical strategies that actively foster analytical, problem-solving, and evaluative skills in science education.

Recommendations

Considering the findings of the study, the following were recommended:

1. DepEd may implement programs that ensure students not only learn science concepts but also demonstrate measurable improvements in problem-solving, decision-making, and evaluative thinking, such as through national science challenges, competitions, or project-based assessments.

2. School Administrators may encourage science teachers to integrate socio-scientific issues such as environmental concerns, health issues, climate change and technological ethics into daily science lessons to promote deeper understanding and critical thinking among learners.

3. Curriculum Planners may design a curriculum that emphasizes output-oriented learning, requiring students to generate authentic work—such as research reports, solution proposals, or data-driven analyses—that can be assessed for problem-solving, decision-making, and evaluative thinking.

4. Teachers should encourage students to engage in SSI-based investigating projects and problem-solving activities to strengthen their ability to connect science learning with real-life issues and innovation.

5. Future Researchers may conduct studies that measure tangible student outcomes from specific instructional interventions, such as improved performance in decision-making tasks or evaluative assessments, to guide evidence-based improvements in science education.

Compliance with Ethical Standards

In preparation for implementation, all plans and recommendations were presented to East-West Mindanao Colleges Inc to ensure compliance with prescribed procedures and protocols. Within the context of the research on investigating the integration of socio-scientific issues in science instruction to foster critical thinking skills among secondary and elementary school students in Sto. Niño, South Cotabato, which served as a basis for context-sensitive strategies for effective classroom implementation, it was imperative to emphasize the paramount importance of

ethical considerations. Before commencing this study, the following ethical principles will be highlighted:

Informed Consent: Before participation, consent was obtained from all school heads involved in the study. They must possess a comprehensive understanding of the study's objectives, methodologies, potential risks, and benefits. Furthermore, participation remained entirely voluntary, allowing the participants to withdraw from the study at any juncture without adverse consequences.

Anonymity and Confidentiality: To safeguard identities and responses, rigorous measures were followed to ensure anonymity and confidentiality. Rather than using actual names, pseudonyms or codes were used to uphold the participants' privacy. The collected data was securely stored with access restricted solely to the research team.

Avoiding Harm: Delicate subjects, such as the challenges inherent in their roles, were discussed with potential emotional and psychological impact on participants. Strategies were in place to minimize distress, and a support system was readily available to assist participants.

Researcher-Participant Relationship: The researcher maintained a professional and respectful rapport when engaging with the school heads. Any actions that might harm the participants were scrupulously avoided, ensuring their utmost dignity and respect throughout the research process.

Data Protection: Adherence to data protection regulations and laws was observed to safeguard the participants' personal information. Stringent measures were employed to ensure the secure storage and transmission of data.

Voluntary Participation: Participants were assured that their participation in the study was devoid of any coercion or external pressure.

Researcher Bias: The researcher remained vigilant regarding potential biases that might influence data collection and analysis, upholding objectivity and transparency throughout the research endeavor.

Institutional Approval: Before initiating the study, the researcher sought ethical clearance from the pertinent institutional review boards or ethics committees.

Honesty and Integrity: The research findings were reported truthfully and accurately, free from manipulation or distortion to align with preconceived notions or biases.

Cultural Sensitivity: The researcher demonstrated cultural sensitivity by respecting local customs, beliefs, and practices in the research setting, refraining from imposing external values on participants.

Inclusion and Diversity: The study's structure prioritized inclusivity and diversity, encompassing a wide spectrum of socio-scientific issues in science instruction to foster critical thinking skills among secondary school students in Sto. Niño, South Cotabato, which served as a basis for context-sensitive strategies for effective classroom implementation.

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Declaration AI Tools Utiization

I do hereby declare the use AI tools, such as Chat GPT and Grammarly for grammar checking and sentence organization purposes only.

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