

Socio- Scientific Issues-Based Instruction (SSIBI): Effects on Students' Conceptual Understanding and Interest in Biology

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Received: 5 May 2026

Revised: 29 Jun 2026

Accepted: 1 Jul 2026

Abstract. Incorporating scientific issues into the curriculum may equip the students with the knowledge and skills necessary for personal development, societal engagement and professional success. Accordingly, this study aimed to investigate the effects of Socio- Scientific Issues- Based Instruction (SSIBI) on the conceptual understanding and interest in biology of the Grade 11 students of Datu Palawan Disomimba Memorial National High School. This study used mixed- method design. The data gathering involved three phases: pre-intervention, intervention, and post- intervention. The findings of the study revealed that there was improvement in the level of conceptual understanding. It also resulted to high interest. Furthermore, there was a significant difference between the control and experimental groups' interest and significant relationship between the students' conceptual understanding and interest in biology. In addition, the students perceived that the instruction could promote positive social interaction; and active participation and enhance critical thinking which develop decision- making skills. The SSIBI was found to be effective in enhancing the conceptual understanding of the students and could optimize students' interest. Hence, educators and curriculum makers in partnership with the Department of Science and Technology were suggested to plan and formulate guidelines to integrate SSIBI in the curriculum and implements programs in education.

Keywords: SSIBI, conceptual understanding, interest and biology

1. Introduction

The Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) is a region that comprises numerous students but has limited resources. Schools in these rural areas do not receive much support from the government. Although the Philippines is doing its best to provide free education to its people, literacy—especially in science—remains minimal among students. Modernization in teaching may provide answers to the growing student population and improve instruction specifically in science pedagogy.

Moreover, science educators repeatedly emphasize the need to make students competent in socio-scientific reasoning. Young people must be prepared to participate in socio-scientific controversies. Students should be actively engaged in exposing socio-scientific issues and bringing attention to environmental concerns. Thus, they must be

involved in various SSI that affect their lives. Zo'bi (2014) stressed that students must have a better understanding of the relationship between science, technology, and society. This knowledge can empower every citizen to make informed decisions in daily life. Consequently, this preparation creates citizens who are both scientifically and technologically developed.

SSIs are crucial in education because scientific expertise continues to be highly regarded in society. Education can effectively engage with real-life issues relevant to survival. This approach is utilized in science education to promote scientific literacy, emphasizing the ability to apply scientific and moral reasoning to real-world situations. Therefore, SSIBI may improve science education within the classroom.

In light of this, the effects of Socio-Scientific Issues-Based Instruction (SSIBI) on the conceptual understanding and interest in biology among Grade 11 students at Datu Palawan Disomimba Memorial National High School (DPDMNHS) were investigated. This school is situated twenty-six (26) kilometers away from Marawi City, the Capital City of Lanao del Sur. It is in the first district of Lanao del Sur and has a large annual enrollment. This significant enrollment is unmatched by the growing demand for science education, not to mention the limited equipment in science laboratories. Additionally, students at this school are often passive learners, dependent on what their teachers provide.

This study was conducted in response to The Department of Education (DepEd) Order RA 7079, which aims to promote and strengthen ethical values, encourage creative thinking, and develop the moral character and personal discipline of Filipino youth. The order envisions fostering students' critical thinking through meaningful and relevant activities. Specifically, this study sought to answer the following questions:

1. What are the levels of the students' conceptual understanding in the control and the experimental groups before and after the intervention?
2. Is there a significant difference in the mean scores of control and experimental groups of students' conceptual understanding before and after the intervention and their mean gain scores?
3. What are the control and experimental group of students' interests in biology before and after intervention in terms of a). positive feelings b). perceived personal values c). independent and voluntary reengagement?
4. Is there a significant difference between the control and experimental groups of students' interests in biology before and after the intervention in terms of a). positive feelings b). perceived personal values c). independent and voluntary reengagement?
5. Is there a significant relationship between conceptual understanding and interest in biology of the students in the control group and experimental group in terms of a). positive feelings b). perceived personal values c). independent and voluntary reengagement?
6. What are the perceptions of students in using Socio- Scientific Issues- Based Instruction in teaching and learning biology.

Constructivist theories were utilized as the theoretical framework for this study. Constructivism is one of the most influential learning theories in science education (Arslan, 2007). Since it is considered a major philosophical referent for science education reforms, constructivism has significantly influenced teacher education and pedagogy (Mathews, 1997). It is a theory that posits learners construct knowledge rather than passively receive information. Consequently, constructivist teaching strategies have a profound effect in the classroom (Powell et al., 2009). Constructivist teaching strategies and practices represent the next important step in educational reform.

The principles of constructivism encompass different positions: Social Constructivist Theory, Cognitive Constructivism, and Radical Constructivism.

Social Constructivism Theory

Social constructivism theory was pioneered by Lev Vygotsky. According to this theory, as stated by Macleod (2019), learning is a collaborative process, and knowledge develops from individuals' interactions with their culture and society. All knowledge is socially constructed, as learning is inherently a social activity. Social activity is something we engage in together, through interaction with each other, rather than as an abstract concept (Dewey, 1938).

Vygotsky believed that community plays a central role in the process of "making meaning." For Vygotsky, the environment in which children grow up influences both how they think and what they think about.

Cognitive Constructivism

Cognitive constructivism, developed by Jean Piaget, as stated by Macleod (2019), professes that knowledge is actively constructed by learners based on their existing cognitive structures. Therefore, learning is relative to learners' stage of cognitive development. Subsequently, cognitive teaching using cognitive constructivism aims to assist students in assimilating new information into existing knowledge and enabling them to make appropriate modifications to their existing intellectual framework to accommodate that information.

Radical Constructivism

Another theory is radical constructivism, established by Ernst von Glasersfeld (1974). Glasersfeld (1974) stated that all knowledge is constructed rather than perceived through the senses. This is a theory of knowing that provides an approach to questions about reality, truth, language, and human understanding. The two basic principles of radical constructivism are: (1) knowledge is not passively received through the senses but is actively constructed by the cognizing subject (the learner), and (2) the function of cognition is the organization of the experiential world rather than the discovery of an independent reality. Learners build new knowledge on the foundations of their existing knowledge.

Conceptual Framework

This study focused on the effects of SSIBI on the conceptual understanding and interest in biology of Grade 11 students of Datu Palawan Disomimba Memorial National High School. The relationship between how independent variable affects the dependent is shown in the Figure 1 below. The arrow indicates that the teaching strategy using Socio-Scientific Issue-Based Instruction in the experimental group and the conventional instruction in the control group may affect the conceptual understanding and interest of the students in biology. It also shows that the dependent variables: conceptual understanding and interest may have a relationship with each other.

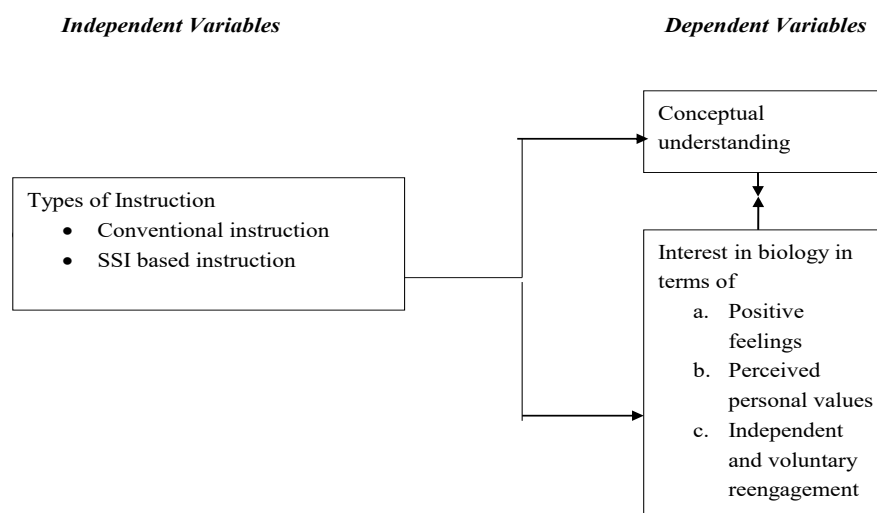


Figure 1. Schematic Diagram that Shows the Variables of the Study and their Interrelationship

2. Review of Related Literature and Studies

This outlines the comprehensive literature and studies that served as foundational references for the present study. The topics were presented thematically to provide the readers vivid information about each topic or theme.

Socio- Scientific Issues (SSI) and Practice

The current generation is distinguished by remarkable developments in technology. As the human population continues to grow, sustainability issues arise, causing concern for human well-being. Science consistently provides life-improving bases of knowledge for society. Consequently, this integration of science into society often creates controversial issues. Addressing environmental concerns necessitates promoting literacy through Socio-scientific Issues (SSI).

Historically, the SSI literature base has grown extensively over the past 15 years. Innovations in SSI represent a long history of rational attempts to improve science education for the vast majority. Accordingly, SSIs have varied meanings but can be broadly defined as problems related to science and society. Through SSI, educators present students with social or moral problems that prompt them to utilize their critical thinking skills. This involves analyzing and synthesizing scientific information to defend a particular position. It highlights the application of moral and scientific reasoning to real-world scenarios. Subsequently, SSI has considerable potential to improve science education in both elementary and secondary classrooms. SSI classroom instruction represents a teaching approach that anchors a comprehensive real-world societal issue with conceptual, procedural, or technical links to science for learning (Sadler, 2004; Wongsila & Yuenyong, 2019). Socio-scientific Issues-based instruction has emerged as an effective way for students to contextualize their science learning within a complex social and political framework. This strategy exposes students to real-world scenarios to help strengthen social development while simultaneously enhancing science knowledge (Yuenyong & Wongsila, 2019).

Studies consistently show a positive effect on using Socio-scientific Issues-based instruction (SSIBI). As cited by Shoulders and Mayer (2013), research in science education has described improvements in areas of scientific literacy through real-world examples and case studies of scientifically based issues. Additionally, Robottom and Simonneaux (2012) revealed that SSI, as an educational approach, most strongly elicited positive emotions such as pride, strength, determination, interest, and alertness. Rahayu (2017) also noted that learning with SSI involves applying science and technology to

issues affecting social life, which can increase students' reasoning ability and environmental awareness.

Sagmeister et al. (2021) studied "Students' experiences of working with an SSI-based curriculum using role-playing to negotiate resistance." Their findings indicated that role-playing in an SSI scenario offers a learning opportunity for students, focusing on both scientific epistemology and personality. It enables students to potentially gain and improve their understanding of multiple perspectives, which, in turn, facilitates a more robust retention of acquired knowledge et al. (2019), understanding SSI in the context of health improves health awareness. Ba. Nurtamara deo et al. (2022) summarized research findings on using socio-scientific issues (SSI) in teaching science and found that it significantly impacts science teaching. They also revealed that SSI had a large effect on students' content learning, competence, decision-making, and reasoning skills.

Akyol et al. (2022), in their investigation into the effect of SSI-based instruction on students' academic achievement in Turkey, demonstrated that SSI had a strong and significant impact on students' academic achievement. Additionally, Paristri et al. (n.d.) studied the impact of SSI on students' critical thinking skills, showing that incorporating SSI significantly improved students' critical thinking skills. They also emphasized that the controversial nature of SSI and its relevance to society generate interest among students.

Moreover, Gutierrez (2014) mentioned in her study that using socio-scientific aspects of science sparks students' interest and builds their responsibility in exploring the practical utility of science and the potential of technology in human development.

Students' Conceptual Understanding in Biology

Conceptual understanding is a term defined in numerous ways and used extensively in educational literature, though its full meaning may not be completely grasped by many educators. It can be considered synonymous with terms like theoretical, hypothetical, or philosophical, aiming to explain facts or events. Conceptual understanding reflects a student's ability to reason in contexts involving the careful application of concepts, definitions, relationships, or their representations. Learning with understanding is essential for student success. It helps students explain new problems they encounter in the future. It also allows them to apply and adapt scientific ideas to new situations.

Facts and concepts can form a web, helping students connect scientific concepts with their experiences. Therefore, achieving conceptual understanding requires students to organize facts and ideas into a meaningful scientific framework. When students can organize ideas into meaningful results, conceptual understanding emerges. Reforms in science education at all levels clearly indicate a shift in its goals: from merely creating a knowledge base of scientific facts to fostering a deeper understanding of major scientific concepts. Tanner and Allen (2005) described students as having familiarity with or knowledge of a mass concept, but with limited depth of understanding (National Center for Education Statistics, 2004).

To demonstrate understanding, students must not only possess fundamental knowledge but also be able to explain, interpret, and apply that knowledge in terms of their own understanding and the understanding held by others. For example, when one truly understands, that understanding enables the answering of questions such as, "Why is that so?", "What explains such events?", and "How does this work?" Students also demonstrate conceptual understanding (CU) when they can provide evidence that they recognize, identify, and apply principles, and know and apply facts and definitions.

Students may sometimes fail to achieve complete learning in science and biology. However, if misconceptions and their sources are identified, educators and students can more easily develop a better conceptual understanding. Conceptual explanations are defined as those that identify a cause or reason for a certain subject, often by referring

(either explicitly or implicitly) to a mental model of that subject. It is such conceptual explanations that can lead to conceptual understanding.

Teaching does not automatically produce understanding. As Konicek-Moran and Keeley (2015) stated, communication is an important aspect of teaching, but if instruction primarily focuses on presenting information, it ignores how the student makes sense of that information. Additionally, a crucial aspect of conceptual understanding is its capacity to promote the retention of lessons learned (Tan et al., 2020).

Biology subjects often consist of many concepts and topics that need to be memorized. Biology can become difficult when concepts and biological events are invisible, meaning they are too abstract, and students are forced to memorize biological facts with limited study time (Yuenyong & Wongsila, 2019). Students typically rely on what the teacher discusses during classes and may not be eager to develop their own learning. As a result, students have difficulty answering test questions about concepts because their knowledge is limited to what the teacher has provided. In contrast, Konicek-Moran and Keeley (2015) stated that a student who understands a concept will be able to think, use what they learn, and express it in their own words. They can describe similarities related to that learning. In other words, students have constructed their own concepts, which is precisely what is meant by conceptual understanding.

Furthermore, biology learning has distinct characteristics compared to learning in general. It is a process of interaction between students and the objects they learn. Biology becomes more meaningful when students directly observe the objects they are studying. However, not all physiological symptoms and phenomena can be observed directly. Wardyaningrum (2019) identified the factors that lead to student difficulties as the large number of topics, the abstract nature of study objects, and limited learning time. This is evident in students' learning outcomes.

When students possess conceptual understanding (CU), their knowledge extends beyond isolated facts and methods. They grasp *why* an idea is important and the contexts in which it is useful. Students who lack a conceptual understanding of concepts will struggle with higher order thinking and may also lack a sense of ownership over the ideas and processes they are working with.

Musa (2013) studied the effect of the 5E Learning Cycle model on students' conceptual understanding and critical thinking. This constructivist-based teaching approach, where educators guide students to inquire, discover facts, and formulate concepts based on their prior knowledge, showed positive effects, resulting in an increased conceptual understanding of environmental concepts. This aligns with Ditucalan's (2017) findings, which indicated that a differentiating instructional method was more effective in progressing students' achievement and conceptual understanding, as well as in tapping into their interest in science, compared to traditional teaching methods.

Similarly, Sunggod's (2012) study on the use of an issue-oriented approach demonstrated improved student achievement in biology. Another significant finding of this study was the identification of student misconceptions on selected biology topics, thereby increasing students' conceptual understanding. Meanwhile, H. Tayeb (2016) emphasized in a study on shop-work oriented instruction that to elevate students' conceptual understanding to its highest level, instruction must consistently include cognitive activities. These activities should require students to reflect on their views and understandings, often through reflection questions posed at the end of each topic. Additionally, the study stressed that after every shop-work activity, an enrichment discussion could be conducted to reconcile students' conceptual understanding with correct and standard scientific concepts.

Phanphech et al. (2019) study presented the effectiveness of the *Predict-Observe-Enact* (POE) strategy in fostering conceptual understanding among secondary vocational students. Enacting involves more than simple "learning by doing" or hands-on learning. In

a scientific context, enacting means acting out scenarios or testing hypotheses and predictions. This can be relevant for "if-then" scenarios or "what-happens-if" scenarios. Hypothetical scenario enactments (Phanphech et al., 2019), provide learners with the opportunity to perform simple experiments as a type of experiential learning.

Haug (2014) explored how to teach for conceptual understanding in science within an integrated inquiry-based science and literacy curriculum. The results showed that students need to practice using scientific words and concepts to effectively discuss their empirical findings and further their conceptual understanding. The findings of this study contribute to the growing understanding of how to teach inquiry-based science in a way that fosters conceptual understanding, highlights the importance of teaching the language of science, and illustrates how the integration of science and literacy supports student learning. For this purpose, students require support in making sense of the concepts.

Students' Interest in Biology

Interest is the drive that causes an individual to want to learn more or become involved in something. It's akin to the eagerness and compassion one might feel towards attending school daily, which makes learning, especially in science, more exciting. Interests reflect preferences for certain activities over others and can guide career choices (Uitto et.al., 2006). Knekta et al. (2020) highlighted that interest is a complex concept, varying in meaning for different people. Boosting students' disciplinary interest has long been considered a crucial mechanism to enhance student success and retention in Science, Technology, Engineering, and Mathematics (STEM) education. Focusing on understanding student attitudes and their relationship to context is vital for increasing retention rates.

Evidently, Rowland et al. (2019) stated that comprehending how students develop an interest in biology and the roles this interest plays in biological contexts could help instructors and researchers boost motivation and persistence among STEM students. However, how interest has been defined or measured in biology education research remains unclear. Interest is a key component of academic achievement and is considered an important aspect of motivation. As such, interest is seen as a vital part of science education.

Interest can be intrinsic, meaning students engage in an activity because they genuinely enjoy it, or extrinsic, where students participate due to external rewards that may follow. For instance, Pacifi and Thomson (2011), as cited by Knekta et al. (2020), showed that pre-medical students are motivated more by the desire to help others than by an innate interest in learning science.

Interest has been described by motivational and learning theories as a concept comprising affective, cognitive, and behavioral components. Low disciplinary interest poses a potential threat to motivation. Therefore, biology educators must consider students' interest in biology as a key factor for their motivation, persistence, and success. Moreover, interest is a relationship between an individual and an object (Uitto et al., 2006). It can be differentiated into individual interest and situational interest. Individual interest develops gradually and influences one's knowledge and values over time, while situational interest is a response to something in the environment and is thought to have a short-term impact. Conversely, individual interest is believed to be stable.

Students participate more and exhibit creative practices in science when they are interested (Tsbari et al., 2010). Identifying students' interests in biology can help teachers better engage their pupils and meet their needs. When allowed to pursue their own interests, students participate more, stay involved for longer periods, and demonstrate creative practices in scientific endeavors. Furthermore, interest has also been found to influence future educational training and career choices.

Biology is often one of the most popular science subjects among students and adults, especially among females. Ayalon (1995), as cited by Tsabari et al. (2010), described biology as a "feminine niche" in science. Likewise, building interest in biology content is a challenge faced by biology education, particularly at the undergraduate level. Students may be drawn to the subject not because of an inherent interest in biology itself, but due to other outlying interests or career goals.

A classroom environment lacking personal relevance for students often leads to low levels of motivation and a general lack of interest in biology as a discipline. Conversely, exploring ethical perceptions in biological studies can stimulate student interest while simultaneously developing their social responsibility. Furthermore, engaging in authentic, especially controversial, debates on socio-scientific issues has the potential to significantly promote student interest in science education.

Creativity in teaching is vital for making instruction more effective and engaging (Jeffrey & Craft, 2010). Thus, innovations in teaching are likely significant in making lessons easier and more lively for students. According to Wai et al. (2020), students' attitude toward biology is a main requirement to support teaching and learning of the subject. This attitude is considered essential for predicting behaviors such as having interest or a lack thereof, pursuing the subject further, or even choosing it as a profession.

Trumper (2006) concluded in a study that a negative attitude towards a subject leads to a lack of interest. Furthermore, a positive attitude toward science "leads to a positive commitment to science that influences lifelong interest and learning in science" (Simpson & Oliver, 1990). When one is interested in an activity, they are favorably inclined to attend to it. Student enrollment is influenced by their interest. As noted by Sjöberg (1983), much of what people in the industrialized world do in their daily lives is likely partly governed by their interests.

Nwafor et al. (2018) revealed a generally low student interest in the study of Biology in secondary schools. Ali et al. (2014), as mentioned in Nwafor's study, agree that Biology has consistently recorded low student enrollment and low interest, leading to poor academic achievements. Therefore, proper measures must be considered to enhance this low level of student interest in biology. Incorporating interest-based activities into biology subjects and using computers in biology learning can trigger student interest.

Li (2011) investigated several practical ways to inspire student interest in learning biology. Biology educators should focus on cultivating, stimulating, and solidifying students' interests in biology, thereby activating and maintaining their enthusiasm for learning the subject. Only by arousing students' interests in learning biology can enthusiasm for learning be enhanced, helping them to better master biological knowledge and techniques, and to form scientific spirits and attitudes. When students are interested in a certain field, they may pay special attention to it, observe carefully, memorize well, and think actively.

Onu et al. (2020) conducted a study on improving biology students' interest and achievement through a collaborative instructional strategy and concluded that it should be adopted as a teaching method. This is because positively affecting students' interest in biology leads to increased student attention and motivation in studying biology, which significantly improves their achievement. Pratiwi et al. (2018) considered multiple intelligence-based learning as an approach that increases students' concept mastery and generates interest in learning subject matter. Multiple intelligence-based activities were designed based on different intelligences, such as logical-mathematical, verbal-linguistic, visual-spatial, and interpersonal intelligence.

Manishimwe et al. (2022) found that a favorable learning environment with resources and activities that capture students' attention greatly attracts their interest in the lesson. This is because students' attitudes toward a subject reflect their interest. Inquiry-based learning, with its similarity to SSI-based instruction, is a teaching method that creates an

environment where students interact with each other. This raises student interest, which greatly improves their attitude towards science learning. Similarly, Collins et al. (2019) investigated the role of informal science education in fostering biology interest, highlighting the impact of extracurricular activities, science camps, and museums in shaping students' interest in biological sciences.

Moreover, Höft et al. (2018) revealed that interest in upper secondary school fosters sophisticated conceptual understanding through investigative, social (discussing with classmates), enterprising, and networking (debating) activities, which can further elicit student interest. Likewise, Davis et al. (2019) explored the impact of inquiry-based learning on student engagement and interest in biology revealed the effectiveness of innovative teaching methods, such as inquiry-based approaches, in improving students' interest and learning outcomes.

In summary, the development of critical thinking, interest, and motivation is crucial for science education. Educators often implicitly assume that understanding scientific content is the primary goal of science education. Globally, students must become critical thinkers while exploring societal issues. The interaction of science and society, with the integration of controversial issues termed Socio-scientific Issues (SSI), is increasing in prominence.

Indeed, the use of Socio-scientific Issues in education serves as an approach to make science learning more relevant to students' lives. It can be engaging and worthwhile, arousing students' emotions while emphasizing the nature and practice of science. Consider the case of the COVID-19 pandemic, which brought about a controversial issue regarding compulsory vaccination among people. This is an SSI question—a decision-related question discussed internationally, for which there is no single right or wrong answer. SSIBI is an active approach to education that encourages students to be critical thinkers, mindful of their environment. It highlights the use of Socio-scientific Issues in the teaching and learning process. Therefore, SSIBI can be highly useful in making students more aware of their society while learning science, particularly in their biology subject.

3. Methodology

The study employed mixed methods research design to determine the effects of Socio Scientific Issues-Based Instruction to the students' conceptual understanding and interest in biology. The quantitative part includes the mean scores, mean gain, and the relationship between the conceptual understanding and interest in biology of the students. While the qualitative part focused on the students' perceptions on the use of SSIBI from interviews that were carefully scrutinized. These qualitative data were used to determine supplementary effects of SSI-based instruction on student behavior during biology learning.

The study was conducted at Datu Palawan Disomimba Memorial National High School (DPDMNHS) in Tamparan, Lanao del Sur.

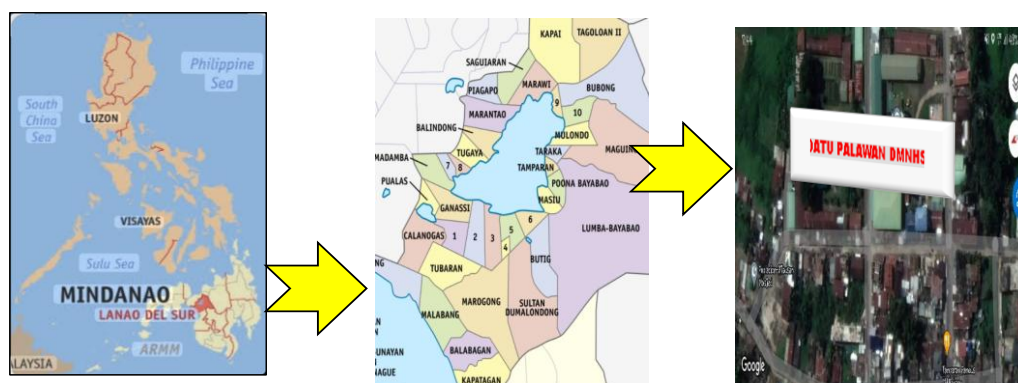


Figure 2. Map of Lanao del Sur showing the location of the Research Locale, DPDMNHS at Tamparan, Lanao del Sur

The study participants were Grade 11 senior high school students from two sections of DPDMNHS for the School Year 2023-2024. Grade 11 students were selected due to their existing familiarity with genetic engineering topics from junior high school and their awareness of various societal issues that could integrate with biology concepts.

The data gathering procedure comprised of three distinct phases: the pre-intervention phase, the intervention phase, and the post-intervention phase. Each phase involved carefully planned actions and observations to ensure the study's integrity. The pre-intervention phase encompassed essential activities conducted before the intervention began, including the preparation of research instruments, the designing of lesson plans, and the securing of necessary permissions. After the administration of the pretest, the intervention period commenced. The SSIBI approach was directed to the experimental group and conventional instruction on the control group.

The Socio-scientific Issues-Based Instruction (SSIBI)

The Socio-scientific Issues-Based Instruction (SSIBI) approach utilizes societal issues to enhance students' science comprehension and, more importantly, incorporates social dilemmas to foster better individual engagement with Socio-scientific Issues (SSI) in the classroom. Each session was allotted 60 minutes within their class program.

Initially, the teacher-researcher reviewed the previous lesson and employed questioning strategies to ascertain students' prior knowledge and capture their attention. Misconceptions were corrected at that moment through direct instruction or classroom discussion. The teacher-researcher then randomly assigned groups and provided each with a particular viewpoint to defend. Students were presented with articles integrating social or moral dilemmas, prompting them to utilize critical thinking skills through in-group discussions. This strategy exposed students to real-world scenarios while simultaneously enhancing their scientific knowledge. Role-playing activities were also conducted by the students. The teacher provided additional information to increase the accuracy of student responses and discussed the topic using scientific language. Evaluation was given after the lesson, and assignments were provided for follow-up activities at home. A multiple-choice test with an explanation component was used as an assessment to determine their conceptual understanding. At the end of each session, students were asked to write in their journals about their realizations or difficulties encountered during the session, guided by provided questions. The flow of SSIBI is illustrated in Figure 3 on the next page.

The Conventional Instruction

The conventional instruction carried out in the control group adhered to the Most Essential Learning Competencies (MELC) under the K-12 curriculum, also with a 60-minute allotment per session. The teacher-researcher reviewed the previous topic with the

class and motivated them to listen. A pre-activity was provided before the presentation of the new lesson. The teacher primarily lectured, discussing content written on the blackboard, while students listened passively. After the discussion, the teacher-researcher recapped the lesson and administered an evaluation in the form of a quiz or assignment at the end of the class. The different teaching instructions are shown below.

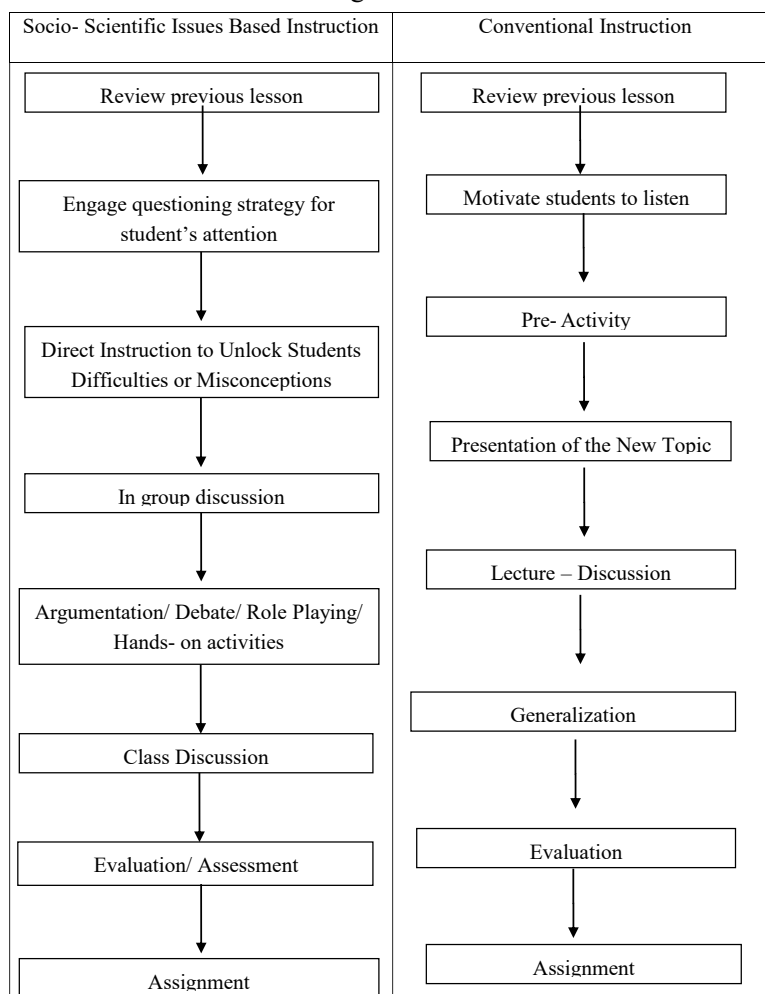


Figure 3. Comparison of the Two Types of Instruction

After the intervention, a post-test was administered to both the experimental and control groups. Each group consisted of 28 student participants. The post-test had the same content as the pre-test. The collected data was then analyzed and interpreted by a statistician.

Research Instruments and Their Validity

The instruments used in this study were the Conceptual Understanding Test (CUT), Biology Interest Questionnaire (BIQ), Interview Guide, Students' Journal, and Field Notes. These instruments were used to determine the students' conceptual understanding and interest in biology.

Biology Conceptual Understanding Test (BCUT). The BCUT is a researcher-constructed test designed to measure students' conceptual understanding of biology. It was developed based on the senior high learning competencies outlined in the K to 12 curriculum.

Table 1. Categorization of Students' Level of Conceptual Understanding

Raw Score	Level of Conceptual Understanding
292- 420	High
211- 291	Moderate
Below 211	Low

Note. DepEd grade transmutation (2024)

Biology Interest Questionnaire (BIQ). The biology interest scale was adopted from Knekta et al. (2020). In this survey, the students were asked to rate their interest in biology. The questionnaire includes 33 items from three different aspects of interest: students' (1) positive feelings towards biology, (2) perceived personal value of biology, and (3) independent and voluntary reengagement in biology-related content and activities. These three aspects are described as important indicators for understanding individual interest and its development. The instrument included 11 items from students' positive feelings towards biology, 9 items from the perceived personal value of biology, and 13 items from independent and voluntary reengagement in biology-related content and activities. Because this instrument is intended for use with a population that likely has an existing interest in biology, a 6-point Likert-type scale is used. Strongly disagree (SD)= 1, Moderately disagree (MD)= 2, Slightly agree (SLA)= 3, Moderately agree (MDA) = 4, Mostly agree (MSA)= 5, and Strongly agree (STA)= 6, which has more positive response options than negative to rate the feelings- and value-related items. With anticipation that the reengagement items would be equally as easy to endorse as the feeling and value items, a balanced 6-point Likert-type scale for these items. Strongly disagree (STD)=1, Disagree (D)= 2, Slightly disagree (SLD)= 3, Slightly agree (SLA)= 4, Agree (A)= 5, and Strongly Agree (STA)= 6 were chosen.

The validity evidence of this instrument was investigated applying exploratory factor analysis (EFA) followed by a confirmatory factor analysis (CFA) (n = 222) to confirm the result gained. EFA was run using the R package psych. CFA and measurement invariance were run using the R package lavaan and Multiple fit indices were checked to evaluate model fit. Above 0.5 were the questionnaire associations which considered as high values. The CFI > 0.95, SRMR < 0.08, and RMSEA < 0.06. were used to evaluate the adequacy of the models. Coefficient ω with a value of > 0.70 which considered acceptable was computed based on the model results and was used to assess reliability.

To confirm the factor structure suggested by the EFAs, two CFA models were specified. The specified two-factor CFA and three-factor model demonstrated model fit that was close to a chosen guideline. The questionnaire had nine or more items on each subscale, and most items correlations were above 0.5 which both can be considered high values. The correlation between the feelings factor and value factor was high (0.88).

Furthermore, the students' interest level was interpreted as very low, low, medium, high and very high interest. It is anchored from the study of Pratiwi, et al. (2018). In the Likert scale of interest, the students' interest is calculated at the scale of 1 to 10. This connotes that the higher the number, the higher the interest is. Students interest will be calculated and be converted into percentage score to which it will be categorized. The percentage score of 0%-20% is categorized as no interest or very low interest, 21% - 40% is categorized as low interest, 41% - 60% is categorized as medium interest, 61% - 80% is categorized as high interest and 81% - 100% is considered as very high interest.

Table 2. Categorization of Students' Interest Level

Percentage Interest Score	Interest Level
81- 100	Very High
61- 80	High
41- 60	Medium
21- 40	Low
0- 20	Very Low

Note. Scale adopted from Pratiwi, et al. (2018)

The instruments used in this study were the CUT, BIQ, Interview Guide, Students' Journal, and Field Notes. These instruments were used to determine the students' conceptual understanding and interest in biology. The quantitative data, including mean scores, mean gain scores, and the relationship between conceptual understanding and biology interest, were processed and analyzed using Statistical Package for Social Sciences (SPSS) Software for MS Windows. While, descriptive approach was utilized to present, analyze, and interpret this data, with thematic analysis employed to identify recurring themes.

As suggested in the ethical clearance, this study adhered to the highest standards of research conduct, ensuring the rights, respect, and dignity of all participants were upheld. Thus, pseudonyms were used to maintain the confidentiality of the participants.

4. Results and Discussion

This presents and discusses the analysis and the interpretation based on the gathered data. The statement of the problem mentioned earlier follows the sequence of the presentation.

Experimental and Control Group of Students' Levels of Conceptual Understanding Before and After Intervention

Table 3. Number and Percentage Distribution of Control and Experimental Groups of Students' Levels of Conceptual Understanding in Science before and after Intervention

Levels of Conceptual Understanding	Before Intervention		After Intervention	
	Control	Experimental	Control	Experimental
Low	28 (100%)	28 (100%)	16 (21.0%)	0 (0%)
Moderate	0 (0%)	0 (0%)	13 (46.0%)	9 (32.0%)
High	0 (0%)	0 (0%)	9 (32.0%)	19 (68.0%)
Total	28 (100%)	28 (100%)	28 (100%)	28 (100%)

Note. Raw score: 0-210 = low, 211-291 = moderate, 292-420 = high

The experimental group on Table 3 demonstrated significantly higher levels of conceptual understanding after the intervention compared to the control group. In contrast, a segment of the control group remained at a low level. These findings align with the research of Hancock et al. (2019), who emphasized that SSI enhance students' conceptual understanding by developing their critical thinking abilities and also fosters more effective and autonomous learning in science. Furthermore, the collaborative environment within an SSI setting, where students interact with their classmates, likely facilitated learning. This collaborative dynamic significantly contributes to improved conceptual understanding.

Comparison Between the Experimental and Control Group of Students' Conceptual Understanding Test Mean Scores before and after Intervention and Mean Gain Scores

Moreover, the experimental groups in Table 4 manifested higher mean score than control group. The result revealed that there is significant difference. Also, the mean gain scores are significantly different in favor of the experimental group. The result disclosed that there is significant difference. This implies that when students are introduced with SSIBI in the experimental group, it resulted to a noticeable increase in their conceptual understanding. Students became more assimilated with the topic hence, improves student's retention and help them to learn the concept more quickly.

Table 4. T-test and Significance (p) Values on the Comparison of the Experimental and Control Group of Students' Conceptual Understanding Mean Score before and after Intervention and Mean Gain Scores

Period	Group (n=28)	Mean score	Mean Gain Score	SD	t- value	p-value
Before Intervention	Control	44.75		10.31	-1.52	.14 (ns)
	Experimental	50.36		16.60		
After intervention	Control	240.32		50.75	-5.9	.00 (s)
	Experimental	314.82		41.82		
	Control		195.57	49.80	-6.04	.00 (s)
	Experimental		264.46	34.11		

Note. s = significant, ns = not significant at 0.05 level

Experimental and Control Group of Students' Interest Level Before and After Intervention

Students' interest in terms of positive feelings, perceived personal values and independent and voluntary reengagement were compared before and after intervention. The proceeding tables illustrate the interest and the interpretation on both control and experimental group.

Using Pratiwi's et al. (2018) study, the students' interest in the Likert scale were measured from 0 – 5, which means that the higher the number, the higher interest the student has. In this study, the interest score of each student was summed up, calculated, and categorized into very low, low, medium, very high and high interest. Students with percentage of 0%-20% were categorized with no interest or very low interest, 21% - 40% were labeled as low interest, 41% - 60% are categorized as medium interest, 61% - 80% as high interest and 81% - 100% is considered as very high interest.

Positive Feelings

Table 5. Number and Percentage Distribution of Control and Experimental Groups of Students' Levels in terms of Positive Feelings towards Biology before and after Intervention

Levels of Interest	Before Intervention		After Intervention	
	Control)	Experimental	Control)	Experimental
Very Low	0 (0%)	2 (7.0%)	0 (0%)	0 (0%)
Low	5 (18.0%)	14 (50.0%)	0 (0%)	0 (0%)
Medium	22 (78.0%)	12 (43.0%)	10 (36.0%)	0 (0%)
High	1 (4.0%)	0 (0%)	16 (57.0%)	23 (82.0%)
Very High	0 (0%)	0 (0%)	2 (7.0%)	5 (18.0%)
Total	28 (100%)	28 (100%)	28 (100%)	28 (100%)

Note. Percentage score: 0-20 = very low, 21-40 = low, 41-60 = medium, 61-80 = high and 81-100 = very high

As illustrated in the previous table, before the intervention, none (0%) of the students in the control group showed very low interest, whereas 2 (7.0%) of the experimental group students did. This suggests that control group students were somewhat more interested in learning biology initially. This might be because these students preferred conventional instruction or had pre-existing interests or career goals that drew them to biology. For instance, some students might naturally enjoy biology because it primarily deals with the human body, a common area of fascination, or other human-related topics.

This aligns with Tsabari et al. (2020) study, which suggests biology as a popular science subject among students and adults. Adults, for example, often show more interest due to concerns about health issues. Furthermore, interest is an intrinsic quality, implying that students engage in activities because they genuinely enjoy them. Knekta et al. (2020) highlighted that people's daily lives in industrialized nations might be partly governed by their interests. For instance, pre-medical students are often driven by a desire to help others, not solely by an interest in scientific learning.

After the intervention, students' interest levels in terms of positive feelings showed greater progress in the experimental group compared to the control group.

Students became more attracted to learning biology and more appreciative of acquiring new information, suggesting they now perceive biology as an exciting subject. This indicates increased enthusiasm for learning, eagerness to work on biology topics, and a desire to return to their biology class after breaks. Consequently, after the intervention, experimental group students developed positive attitudes and became more interested in studying biology.

This positive outcome is likely due to the students' exposure to motivating activities that allowed them to resolve captivating issues. This is further supported by insights from the students' journals, which convey their excitement and motivation during the activities, observations that were consistently noted in the researcher's field notes.

Comparing the positive feelings of students in the experimental group, it's clear they became more absorbed and captivated after receiving SSI-based instruction. These findings are supported by Nwafor et al. (2018) study, which suggests that incorporating interest-based activities into biology can significantly trigger student interest. When students are allowed to pursue their own interests, they participate more, remain engaged for longer periods, and demonstrate more creative performance in science (Tsabari et al., 2010). Similarly, as Sadler (2011) pointed out, students become more competent academic science students when they begin to talk, think, and believe like scientists. Rowland et al. (2019) also noted that initial interest generated by the learning environment can develop into a more profound and enduring form of interest, known as individual interest.

Perceived Personal Values

Table 6. Number and Percentage Distribution of Control and Experimental Groups of Students' Levels of Interest in terms of Perceived Personal Values towards Biology

Levels of Interest	before and after Intervention			
	Before Intervention		After Intervention	
	Control	Experimental	Control	Experimental
Very Low	0 (0%)	4 (14%)	0 (0%)	0 (0%)
Low	9 (32%)	8 (29%)	0 (0%)	0 (0%)
Medium	18 (64%)	14 (50%)	13 (46%)	0 (0%)
High	1 (4%)	2 (7%)	12 (43%)	26 (93%)
Very High	0 (0%)	0 (0%)	3 (11%)	2 (7%)
Total	28 (100%)	28 (100%)	28 (100%)	28 (100%)

Note. Percentage score: 0-20 = very low, 21-40 = low, 41-60 = medium, 61-80 = high and 81-100 = very high

Table 6 shows that most students in both the control and experimental groups had a medium level of interest in terms of perceived personal values in biology before the intervention.

This suggests that, prior to the intervention, students in both groups likely prioritized their hobbies over studying biology. For them, biology might not have seemed an important subject, possibly because they didn't see its influence on their future careers.

As Gamage et al. (2021) emphasized, values significantly influence an individual's role within their learning community and ultimately affect their academic achievement. This shows that when an individual is inclined towards something, they will remain motivated. Personal values act as a guiding principle for individual choices (Nkaizirwa et al., 2022). Thus, personal values control an individual's behavior, choices, and attitudes toward life even without external influence. Furthermore, the experimental group, based on their post-intervention responses, demonstrated high interest, with none in the low interest categories.

This proves that their exposure to SSI-based instruction made them more aware of their community, leading them to value the topics covered in class. This perhaps confirms that students became more interested in learning and acquiring new knowledge and believed that being educated in biology held personal significance in their lives. Through this teaching and learning strategy, they demonstrated high interest because they were inspired by the topics and found them relevant to their lives and society. Consequently, they realized that learning biology is valuable and priceless. This is evident from the written journal entries of the experimental group students.

This highlights that SSI-based instruction made him self-driven in his study and exploration of biological concepts, principles, and activities. This likely means students in the experimental group discovered a sense of value in the lessons learned. Gamage et al. (2021) stated that personal values significantly influence all aspects of one's life and shape behavior, building connections towards learning. How students value a subject often determines their success in learning it.

Independent and Voluntary Re-engagement

Table 7. Number and Percentage Distribution of Control and Experimental Groups of Students' Levels of Interest in terms of Independent and Voluntary towards Biology before and after Intervention

Levels of Interest	Before Intervention		After Intervention	
	Control	Experimental	Control	Experimental
Very Low	1 (4.0%)	1 (4.0%)	1 (4.0%)	0 (0%)
Low	8 (28.0%)	19 (68.0%)	1 (4.0%)	0 (0%)
Medium	19 (68.0%)	8 (28.0%)	20 (71.0%)	8 (29.0%)
High	0 (0%)	0 (0%)	6 (21.0%)	20 (71.0%)
Very High	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	28 (100%)	28 (100%)	28 (100%)	28 (100%)

Note. Percentage score: 0-20 = very low, 21-40 = low, 41-60 = medium, 61-80 = high and 81-100 = very high

As Table 7 indicates, before the intervention, students in the control group showed a higher level of interest in independent and voluntary re-engagement compared to the experimental group. This low engagement likely indicates that they do not frequently visit exhibits, zoos, museums, or participate in other related activities unless obligated. For many students, especially teenagers, their hobbies are likely a central focus, overshadowing voluntary biology-related pursuits. This also infers that they do not engage with biology outside of classroom requirements and rarely spend time in nature. These observations are further supported by student responses.

As Rowland et al. (2019) stressed, interest is often triggered by the environment and can be prompted by specific situations. Re-engaging with content signifies a degree of engagement that manifests as repeatedly choosing to participate in activities related to a specific area of satisfaction. An individual with growing personal interest is likely to re-engage with enthusiasm. This is because individual interest is a psychological state that creates a lasting inclination to re-engage with a particular type of content over an extended period (Renninger et al., 2016).

Conversely, after the intervention, students' interest in terms of independent and voluntary re-engagement in the control group showed little change, while it intensified in the experimental group.

Re-engagement largely depends on availability and opportunity. For example, experimental group students might want to visit zoos or attend seminars but lack the chance to do so. They express a willingness to engage in seminars or presentations about biology topics and are likely interested in joining science clubs, but the school's unavailability of such clubs prevents them. This aligns with Knekta et al. (2020) study, which notes that students who want to engage but lack the opportunity do not experience the positive reinforcement that further supports interest. Students might independently and willingly engage in various biology-related activities but might not have the chance due to limited opportunities within the school premises, such as science clubs or access to zoos. While the use of SSI-based instruction significantly impacts students' preferences when given an opportunity, their experience with SSI-based activities motivated them to discuss what they learned in biology outside of class. Therefore, incorporating interest-based activities, such as those found in SSI-based instruction, can genuinely generate student interest.

Comparison Between the Experimental and Control Group Student's Interest before and after Intervention

Table 8 presents the control and experimental group's interest before and after intervention. Mann Whitney U test was employed to identify if there were significant difference between the control and experimental group's interest before and after intervention.

Table 8. Mann Whitney U and Significant (p) Value on the Comparison of Control and Experimental Group of Students' Interests before and after Intervention

Period	Interest	Group (n=28)	Mann-Whitney U	p-value
Before Intervention	Positive Feelings	Control	304.0	0.089 (ns)
		Experimental		
	Perceived Personal Values	Control	322.0	0.19 (ns)
		Experimental		
	Independent and Voluntary Reengagement	Control	268.5	0.022 (s)
		Experimental		
After Intervention	Positive Feelings	Control	295.0	0.086 (ns)
		Experimental		
	Perceived Personal Values	Control	279.5	0.039 (s)
		Experimental		
	Independent and Voluntary Reengagement	Control	206.5	0.00 (s)
		Experimental		

Note. ns= not significant, s=significant at 0.05 level

This illustrates that before the intervention, students' interest in terms of positive feelings and perceived personal values toward biology was not statistically significant ($U = 304.0$ and $U = 322.0$, $p > 0.05$). Therefore, the null hypothesis for these aspects is

accepted. However, students' interest in terms of independent and voluntary re-engagement in biology-related activities showed a significant difference, with a p-value of 0.022, which is less than the 0.05 significance level.

After the intervention, students' interest in terms of positive feelings was not statistically significant ($U = 295.0$, $p > 0.05$), leading to the acceptance of the null hypothesis for this area. Nevertheless, students' interest in terms of perceived personal values and independent and voluntary re-engagement in biology-related content and activities was significant ($U = 279.5$ and $U = 206.5$, $p < 0.05$), and therefore, the null hypothesis for these aspects is rejected.

This indicates that the two groups were initially comparable in their interest regarding positive feelings and perceived personal values toward biology. This similarity can be attributed to both groups receiving the same instructional methods and learning conditions prior to the intervention. However, they differed initially in their interest in terms of independent and voluntary re-engagement in biology, primarily because the control group students had a higher innate interest than the experimental group.

As the data before the intervention shows, students' initial interest in terms of positive feelings and perceived personal values toward biology was at a low level in both groups, which explains why they did not differ significantly. The difference in students' interest regarding independent and voluntary re-engagement, however, can be accounted for by the control group students having a pre-existing interest in biology that was greater than the experimental group's. This also suggests that control group students already had an interest in discussing biology and participating in biology-related activities like science clubs, seminars, and other biology exhibits.

It is crucial to note that interests are intrinsic in nature (Knekta et al., 2020), denoting an innate inclination that arises from within. Studying biology provides a satisfying challenge, and the feelings associated with it are not based on the relationships of that object to other objects or areas. For example, for a birder, identifying a new bird species would be a treasured accomplishment. Correspondingly, students develop an emerging individual interest and tend to repeatedly choose to engage in activities that provide satisfaction. Wegner et al. (2020) stated that there is an improvement in interest among older students. Adults tend to like biology because it deals with the human body. As shown in the study by Wai et al. (2020), biology, in contrast to other subjects, is expected to achieve much better results because its topics touch upon life and life processes, making it inherently interesting and motivating for learners. This can be further reiterated from the student's response.

Relationship between Students' Conceptual Understanding and Interest in Biology of the Experimental and Control Group

To investigate the relationship between the experimental and control group's conceptual understanding and interest in biology, nonparametric correlation spearman rho was employed. Table 9 presents the correlation between the students of control and experimental groups' conceptual understanding and interest in biology-related activities

Evidently, the relationship between conceptual understanding and student interest in the control group was not significant, with a p-value of 0.773 (which is greater than 0.05). Therefore, the null hypothesis is accepted, implying that there is no significant correlation between conceptual understanding and student interest in this group.

Table 9. Coefficient correlation (r) and p- value of Students' Conceptual Understanding and Interest (Feelings, Values & Reengagement) in Biology of the Control and

Experimental Groups			
Group	Variable	p-value	Significant result
Control	Conceptual Understanding	0.773	Not significant
	Interest		
Experimental	Conceptual Understanding	0.012	Significant
	Interest		

Note: ns = not significant, s = significant at 0.05 level

This indicates that the conceptual understanding of students in the control group does not correlate with their interest in science. This suggests that control group students might be more pragmatic; they may perceive that simply passing the biology course is necessary for advancing to the next grade level, even without deep conceptual understanding. Accordingly, these students initially had a low level of conceptual understanding but still showed some interest before the intervention.

It is important to note that while interest plays a crucial role in boosting enthusiasm and engagement in the learning process, it might not be the sole factor in building conceptual understanding. Various other elements can impact the relationship between conceptual understanding and student interest. Research shows that factors such as the type of teaching approach, the difficulty of the subject matter, students' prior knowledge, and the availability of learning materials also affect both conceptual understanding and interest. This can be seen in students' responses from interviews.

This aligns with Wai et al. (2020) study, which found that, according to teachers, one of the most significant causes of student difficulties in learning biology was a lack of adequate instructional materials. Evidently, on the experimental group there is significant relationship ($p = .012$) between the students' conceptual understanding and students' interest. This strongly indicates that students' conceptual understanding is associated with their interest. It suggests that students who clearly understand concepts are more likely to be interested and engaged in their studies. This is because understanding concepts makes the learning process more meaningful and enjoyable, also making it easier for students to apply what they have learned to new situations, which can further boost their interest and motivation. This was demonstrated in the students' journals, as displayed below, and supported by the teacher's field notes.

As supported by Höft et al. (2018), interest plays a critical role in influencing student development and achievement through knowledge progression and sustained learning outcomes. Interest has also been shown to promote attention and recall, further improving conceptual understanding (Renninger et al., 2016). This is confirmed by Turner et al. (2020) study on the enhancement of conceptual understanding and biology interest through SSI, which reveals how student engagement in debates improves both understanding and passion.

Also, as Kurt's (2021) study revealed that students are generally more interested in learning subjects related to their real lives and tend to value these concepts more. Also, Nieswandt (2007) emphasized that students' interest and perceptions play a crucial role in developing a deep understanding of scientific concepts.

Furthermore, Howard et al. (2014) discovered that developing students' conceptual understanding through social interaction is highly effective. Student friendships can facilitate conceptual understanding through discussion, explanation, and application to "real-life" contemporary issues. This again demonstrates how improved student interest can lead to better conceptual understanding. Similarly, Cooper et al. (2019) investigated the benefits of collaborative learning through SSI as an approach that establishes conceptual understanding and interest in biology. Their study considered how group work,

such as peer discussions and cooperative problem-solving tasks, influences students' knowledge and engagement in biology.

Experimental Group's Perceptions on Socio-Scientific Issues as a Method of Instruction

Students from the experimental group articulated their perceptions on the use of SSI-based instruction through one-on-one interviews, supported by their daily journals. The following themes emerged from these interviews: (1) Promoting positive social interaction, (2) Enhancing critical thinking skills, (3) Fostering active participation for continuous and meaningful learning experience, (4) Developing decision-making skills, and (5) Addressing limitations.

5. Conclusion

The Socio- Scientific Issues- Based Instruction as method of teaching was found to be effective in enhancing the conceptual understanding of the students than the conventional instruction as manifested in the increase of conceptual understanding levels and test mean score of the experimental group. In addition, students' interest can be improved through SSIBI as reflected on the students' highly interested level and the significant increase in their interest. Meanwhile, students can be engaged in biology related work if given an opportunity. Also, results of BCUT and BIQ revealed that increased students' interest further augment their conceptual understanding in science.

Accordingly, students from the experimental group perceived that using SSIBI students fosters active participation for continuous and meaningful learning experiences such as excitement and challenges in learning and acquisition of new knowledge. Using Socio-Scientific Issues-Based Instruction improved students critical thinking in dealing with complex issues which enhances social interaction. Thus, students become responsible in decision making. Meanwhile, some problems encountered by the students with the use of Socio- Scientific Issues- Based Instruction include disagreements, misunderstanding, and a lack of clarity in communication. But generally, students had positive enriching experience.

Based on the findings of the study, the following are recommended:

1. The result of this study may serve as baseline data for the teachers and other educators in developing instructional materials such as modules to foster clear understanding and effective learning of scientific issues concerning society for the conduct of the effectiveness of SSIBI.
2. Administrators and curriculum makers might formulate plans, guidelines and policies to improve teachers' competence and confidence in using socio-scientific issue- based instruction and integrate it in the curriculum.
3. More so, the result of the study can be a starting point of the Department of Science and Technology in partnership with Department of Education to implement programs in education in using SSI in the class which promote higher scientific literacy among people, thus contributing to the improvement of the standard of living that would eventually hasten economic growth.
4. Consequently, science teachers and other educators are ought to use SSIBI to develop and improve the students' critical thinking skills.
5. Furthermore, a parallel study must be directed on the effectiveness of the SSIBI on other grade level and learning areas such as grade 8 on mathematics, etc.; and
6. Coherent studies on this area using large samples in other grade levels are recommended to have greater effectual result.

Acknowledgement

The researcher's sincere and everlasting appreciation is also extended to the Department of Science and Technology (DOST), for providing financial support for the researcher's entire schooling and for funding the conduct of the study.

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