

## Science teachers and students' perspectives on SSI-based instruction: basis on the development of SSI-based curricular resources

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### Abstract

**Keywords:**

Argumentation;  
Evidence;  
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Despite the most studies empirically reveal the advantages of teaching Socioscientific Issues (SSIs) in catering the evolution of scientific knowledge and pedagogy in teaching science concepts better to meet the required competencies and students' needs to develop appropriate skills and capabilities, the teaching of SSI-based is still obscure and new to the country due to science teachers find it difficult and unable to integrate in their classroom due to lack of curricular resources, unfamiliarity, infrequent integration, and teaching trust issues which results to learning gap among students; inability to argument and less motivated to learning SSIs. A semi-detailed questionnaire was used to collect information such as teacher-student background knowledge on SSIs and SSI-based pedagogy, perception on the pedagogy and the need to develop SSI-based curricular resources. Interviews were done to selected teachers and students to highlight relevant and significant opinions. Furthermore, results revealed that science teachers and students are not acquainted with SSIs. Most teachers don't know SSIs and don't employ SSI-based lessons in their teaching resulting to zero experience among students to SSIs. Nevertheless, both teachers and student respondents asserted that the development of SSI-based curricular resources may improve teaching and learning processes in science areas which may positively affect to students deeper understanding, science practices and argumentation.

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### Introduction

In the early 1980s, Science Education emphasized much importance on the Science, Technology, and Society (STS) approach making science matter to society; applying scientific knowledge to real issues and problems. Experts in Science Education had found something that is lacking. This is where STS is primarily concerned with the impact of science and technology decisions on society and forgetting the importance of ethical aspects and issues in the environment (STSE). SSI-based in contrast to STS focuses on moral aspects of science-based issues that are societally important compared with the Science, Technology, Society, and Environment (STSE) approach, both have similar characteristics teaching with moral dimensions and socioscientific problems (Petretti, 2003). In addition, the Science Education community has been promoting and strengthening the sense of scientific literacy as part of the SSI mission and vision. To attain scientific literacy, teaching must anchor to understanding

scientific processes, practices, and basic principles within a strictly scientific context. This can also be attained by integrating "real-life" situations that are scientific in nature and can influence by other factors, such as social, political and ethical issues (Robert, 2007). The latter idea of scientific literacy is consistent with the Next Generation Science Standards (NGSS) particularly in scientific practices such as analyzing and interpreting data, using evidence to participate in argumentation, and collecting, evaluating, and communicating information (NRC, 2012). Thus, Teaching of Socio Scientific Issues (SSIs) in science guarantees quality teaching. Teachers can ensure class discussion as collaborative and respectful as students entertain different perspectives and opinions, resulting in higher participation and productive instruction (Sadler, 2011).

On the other hand, The National Assessment Test (NAT) results revealed that most Philippine students have mastered less than 50% of what they ought to learn in the Kto12 Curriculum (DepEd, 2019). The data is consistent when the results have been officially released to the public by the PISA in 2019 on December 3, where the Philippines ranked second-lowest during the 2018 Programmed for International Student Assessment (PISA), where the country got 353 points out from the OECD average points of 489) in Mathematics and 357 points in Science out from OECD average of 483 (Philippine Star, 2019), compared the OECD coverage index of 88%, the Philippines was above level 2 as 32% coverage of proficiency in science were only attained and one (1) out of 20 students performed below level 1b which means that students could only perform tasks that were required low-cognitive demand and learners in these levels were considered low achievers in science (OECD, 2019). Results from PISA indicated the quality and equity of learning outcomes attained around the world and that gave ideas to policy-making bodies including educators to enhance further education systems and practices in the country.

*“With the PISA results also reflecting the learners’ performance in the National Achievement Test, DepEd recognized the urgency of addressing issues and gaps in attaining the quality of basic education in the Philippines,”* – Education Secretary Leonor Briones.

In response to the PISA results, the Department of Education committed and vowed to strengthen quality education in the country by launching the "Sulong EduKalidad" Program. The program emphasized the four critical areas as foci that need to be addressed which are abbreviated as KITE; (1) **K** for Review and Update K to 12, (2) **I** for Improving learning facilities, (3) **T** Upskilling and Reskilling of both Teachers and school heads through transformative professional development programs, and (4) **E** for Engagement of all stakeholders for support and collaboration (DepEd, 2019). This alarming result has driven stakeholders of the country's Department of Education (DepEd) to improve the quality of education.

As one of the stakeholders, the Philippine Normal University, National Center in Teaching Education (NCTE), initiated to conduct the study about the PISA performance by examining the alignment of the K-12 Curriculum competencies and that of the PISA. Experts noted some significant findings that explore the alignment of the PISA framework in three major literacy areas (reading, mathematics, and science) and in four innovative areas (global competence, creative thinking, financial literacy, and collaborative problem solving) with identified appropriate subject areas in the Kto12 Curriculum. Results found to be that literacy behaviors in digital and non-digital environments were not explicitly reflected in the curriculum

and although there was a high degree of alignment of the Kto12 Science Curriculum with the 2018 PISA. There was still a lack of explicit inclusions of some topics and the learning competencies were not proportionately and appropriately distributed across grade levels (Mangali, 2021). Furthermore, the study highlights the needed competencies such as performing investigation with a focus on the problems encountered in the community. Seminars, training, and workshops both pedagogy and research must be provided for science teachers to leverage their skills in demonstrating students' scientific literacy (Pg.133-134).

Teaching SSIs requires the advancement of scientific thinking for students to higher-order science practices (Topcu et al., 2008) such as argumentation (Dawson & Venville, 2013), reasoning (Zeidler et al., 2009), and decision-making (Presley et al., 2013). Pitiporntapin et al. (2016) found out some of the challenges of Pre-service science teachers in using socioscientific issues in practicum include a lack of knowledge about SSI-based teaching and no teaching materials and SSI-based related resources that may supplement their instruction. In addition, teachers do not dare to employ the teaching method because of their "inability" to argumentation (Newton et al., 1999) because of a lack of support to discuss SSI in the classroom or the limitation of time in teaching (Lee et al., 2006).

In SSI, students shared their experiences and perspective on the learning environment and may bridge the concept of science with societal issues during the discussion. Students' real-life experiences were valued and counted as important requisites. Students tended to accommodate knowledge by trying to connect their prior knowledge and lead to the construction of new understanding (Branstord et al., 1991). Social interaction with others was deemed helpful to the learner in giving meaning to information which then believe on Constructivism, that knowledge was constructed through personal experiences and interactions with the outside world. Thus, the learners took an active role in the construction of knowledge, and teachers facilitated this endeavour (Agakar, 2019). With the use of argumentation and reasoning along with social interaction, students were then allowed to position themselves while being challenged to explore their values and attitudes and those of others. As transformative teaching in nature, the approach allowed students to have self-evaluation and reflections upon issues and develop their ideas, beliefs, and attitudes. Making students more skeptical and mindful in evaluating information, understanding more of their critical thinking and inquiry ability to enable students to debate and make appropriate decision-making. This upheld and was anchored on the theory of reconstructionists which believed that education should then be directed toward arousing interest in public activism, favored students getting out as much as possible into society, understanding political processes, analyzing issues, making the reasoning, judgments, and decisions (Ozmon, 2012).

However, SSI-based faced many difficulties in implementation. Sadler (2009) and Ziedler et al. (2011) as cited in the study of Bosser et al. (2015) enumerated points that need to improve and address, this may include teachers' proficiency in both pedagogy and pedagogical content skills (PCK), learning media resources, assessments, and classroom set-up.

Another observation, government teachers were religiously following the mandates of the Department of Education. They were following the required competencies to be discussed at a given time and regulations being set. Teachers working with SSI experience a tension between educational arguments for devoting time to developing students' understanding of scientific processes and classroom reality. They often find it more important to reproduce

scientific facts than to develop the idea that scientific knowledge had a degree of tentativeness associated with it (Bartholomew et al., 2004). Some chose to stick with that of being a traditional teacher and refused to explore new methods and strategies, integrating old principles and beliefs that he/she believed to be true and effective. Moore et al. (2002) reported that teachers tended to incorporate new policies into a largely unaltered practice due to belief systems that were more important than the new curriculum. Nevertheless, the efficient integration of SSI-based instruction can be one of the best solutions to address the deteriorating Philippines PISA results in 2018 and to enhance the country's quality primary education and National Assessment Test (NAT) students' performances.

SSI can be an effective tool in transforming science teaching knowledge-content based. As argumentative, teachers can ensure that students are more critical and problem solvers. They were responsible to one's learning. Most importantly, they could stand opinion, debate with valid bases that were further validated through utmost, and even consider other aspects aside from science. Engaging students in SSIs in the classroom offers potential help to develop students understanding of both the concept of science and social significance of the issue, activating their skills in argumentation while strengthening their moral and ethical perspectives.

## **Method**

### *Research Design*

A qualitative research approach was utilized to analyze the samples' responses to investigate teachers' teaching of SSI experiences and Students' learning of SSIs. Semi-structured questionnaire and interview was used in gathering the data to support the study.

### *Participants*

Ten (10) Science teachers handling science classes in Junior High School Department and Fifty-one (51) 9<sup>th</sup> graders were involved during the survey study.

### *Data Collection*

A secured consent formal letter to the respondents and parents has been presented for the research ethics before the proper endorsement to the school principal for the conduct of the study. The school head's endorsement letter was forwarded to the Ministry of Basic, Higher and Technical Education- Basilan Schools Division for the proper endorsement and approval to conduct the study. The researcher gathered respondents for Needs Assessments which preliminarily surveyed ten (10) Science teachers (4 males and 6 Females) where a majority (70%) were majoring in General Science and half of the samples (50%) rendered 1-5 years in a teaching position and 51 student respondents (9 males and 42 females) participated the face-to-face survey. Teachers and student respondents were equally given ample time to answer the questionnaire. The teachers' audio interview was transcribed to highlight important details and for data clarification purposes which after then analyzed via content analysis. To maintain data confidentiality, coding procedure (e.g TR01 means Teacher respondent no. 1, NASR01 means Needs Assessment Student respondent no.1) was strictly observed after finally collating all the possible codes and themes to protect the personal information and to identify potential patterns and themes that were relevant in the study.

### *Data Analysis*

Content analysis was used to analyze the qualitative data such as from the questionnaires and audio-recorded interviews. Audio recordings were used to clarify and highlight unstressed

answers from the answered questionnaire; to stress the important details which may be relevant to the study. Transcribed recorded data was subjected to initial and careful sorting, and classified through familiarization and possible code groups and themes to avoid redundancy and misconstrue. Initial themes were reviewed to check proper alignment to the question and quotes if it makes accountability and sense for all coded extracted data. Finally, themes were labeled based on the researcher’s understanding and from the available findings of some related literature.

## Results and Discussion

### Teachers and Students to SSI-based Teaching and Learning Experience

Teacher's survey results reflected that only 3 (30%) out of 10 science teacher respondents indicated having experience of SSI-based instruction. They taught and incorporated SSI in their science instructions. On contrary, 7 out of 10 teachers do not teach SSIs in their science instruction and could not give examples of SSIs. This was also congruent to all student respondents who individually indicated "No Experience" with SSI-based teaching and cannot give examples related to SSI. Pitiporntapin (2019) cited that some teachers were not familiar with it and found it hard to incorporate SSI in their teaching due to a lack of knowledge and confidence. This data revealed that the most science teachers did not teach SSI-based lessons and gave examples of the SSI teaching topics.

When teachers were asked what is/ are SSI(s) for them, only 3 science teachers can describe the term. Below were extracted data from the question *what is/are SSI(s)?* Science teachers described SSI as the method, issues, and multidisciplinary approach in science teaching.

**Table 1.** Emerging themes on Teachers’ definition of Socioscientific Issues (SSIs)

Quotes	Codes	Theme
TR02 [“An instruction used by a teacher...”] TR06 [“Teaching science concepts...”]	Method In Teaching	<b>An interdisciplinary approach where students’ real- life problems</b>
TRO6 [“SSIs are controversial social issues.”]	Controversial Issues	
TR02 [“lessons that are based on a real-life situation.”] TR03 [“SSIs is a real-world problem.”]	Real-life Issues World Problem	
TR03 [“The problem that is informed by science.”] TR06 [“Issues that relate to science.”]	Science- informed	
TR02 [“Application of integrative lessons.”]	Multidiscipline	<b>Multifaceted</b>

Codes like method in teaching, controversial issues, real-life issues, science-informed and multidisciplinary were used to describe data extracted from the teachers’ answer to the question what is/are SSI(s). Generally, socioscientific issues defined as ill-structured, multifaceted, with uncertain and complex solutions (Kuhn, 1991; Zohar & Nemet, 2002). It integrated two main elements : (1) connections to science content, and (2) social significance, motivating students’ interest by generating their arguments and positions on SSI making them

freely express ideas that were not only scientifically knowledge-based but also considered other aspects like social, economic, ethical, and moral aspects of the problem (Sadler, 2009). The method in teaching where students were engaged in a process of debate and structured discussion on such disputable issues (Dawson & Venville, 2013).

The data suggested that SSI-based lessons must include the above-stated elements and characteristics of SSI-based instruction. It must have a connection to scientific concepts and social importance which can be done by integrating social issues that are controversial, and multifaceted. It may also consider other aspects and disciplines including moral and ethical background to the resolved problem.

During the interview, the researcher asked Science teachers to define SSI on the way they understood the term and they defined SSI as follows:

*"It (SSI) is a socially relevant issue or real-world issue that is well-informed by science."*  
[TR06]

*"This is a sort of a process of the method of teaching wherein you are going to use the scientific way in answering those what happening around us (flood, that causes several trashes and garbage(s) that are being thrown in our community causing pollution)."*[TR02]

*"SSI... is a Socioeconomic issue. Global warming and the pandemic that we are facing today."*  
[TR03]

The first definition describes the features of SSI. "Socially relevant", "World-issue" "Science-informed" were just a few of the described words to SSI. This was true since SSI was an issue-based pedagogy that related ethics and social problem to science. These were issues that were morally and ethically important issues, usually open-ended, controversial issues with no clear-cut solutions (Pedretti, 2003, Sadler, 2004, Eastwood, et al., 2012 & Pitiporntapin, 2019). Second, the respondent described SSI as pedagogy and associated it with the words "process" and "method". SSI was more of those social dilemmas (Sadler, 2004) rather than that of a "Method". Issues that focused across the different fields like Genetic engineering (Sadler & Doneelly, 2006; Sadler & Zeidler, 2005) which were controversially connect society and science. But, when this issue (SSI) was being collaborated to teaching, it aimed not only strengthening one's conceptual understanding but to address controversial conflicts (Presley et al., 2015) along with developing argumentation skills morally and ethically. As such, SSI may then be described as a pedagogy and process of teaching. The third teacher defined SSI as Socioeconomic issues. The answer was quite confusing as SSI described it as Socio-economic issues instead of socioscientific issues as how it was being abbreviated. TR03 also described that social sciences were commonly associated with the economic aspect and how it was influenced and affected when teaching SSI. But, she made it clear by giving examples of SSI describing the pandemic and the global warming that we were facing today which affected the country's economy and businesses. In addition, teachers who indicated their experience in SSI were also asked to give examples of SSI since 70 percent indicated "No experience" to SSI-based teaching. Only those who said yes could provide some topics or examples of SSIs. Below are the extracted data from their answers, this is question number 2 of the second part of the needs assessment.

**Table 2.** Summary of Socioscientific Issues Based Topics Brought in the Classroom

Quotes	Codes	Theme
TR02 [“Yes, Pollution, Global warming, weather changes.”] TR04 [“Yes. Global Warming.”] TR06 [“...Climate Change and Fish Farming.”]	Increase of temperature Ecological disturbance	<b>Environmental Issues</b>
TR02 [“Yes like Cloning.”] TR04 [“Animal Cloning.”] TR06:...Cloning	Cell & DNA	<b>Genetic engineering</b>
TR04 [“Atomic Bomb.”]	Nuclear fusion and fission	<b>Safety and Security Issues</b>
TR03[“Yes like Sexually Transmitted Diseases (HIV and AIDS).”] TR04 [“The pandemic that we are facing today.”]	Talk about viruses	<b>Health Issues</b>

As to these data, the analysis reflected that some teachers indeed lack the knowledge of SSIs and how to bring SSIs to their respective classrooms based on the provided answer. In contrast, others answered YES and could give examples as reflected on the questionnaires gathered.

Teacher respondents mentioned common topics like global warming and weather-related problem. This coded for an increase in temperature as a teacher illustrated how CO<sub>2</sub> accumulated in the atmosphere and trapped heat caused a sudden increase in the temperature, commonly known as global warming. Pollution, climate change, and fish farming were some topics that science teachers would commonly bring to the class. These topics were grouped as one theme since they tackled environmental-related problems like rising temperatures, and contaminated air, and water, leading to ecological disturbances. Second, animal cloning which codes for Cells and DNA. This can be categorized as Biological Issue where the topic focuses on how DNA behaved and replicates. This was also a good topic that was under Genetic Engineering. Next, the teacher listed the atomic bomb as an example of SSI, the researcher categorized the answer on nuclear fission and fusion where the teacher must have a proper background in chemistry and physics. This topic may cause students to debate whether inventing more atomic bombs may secure the country's security and safety or may have bad connotations and unethical implications for students. Lastly, teachers cited STDs and the pandemic as the common denominator was "virus." These examples vividly showed the health issues and aspects in the socio-scientific Issues. This was also timely since our country faced great diseases and problems related to the virus.

Meanwhile, Socio-scientific issues (SSI) were open-ended social problems with substantive connections to science such as climate change (Sadler & Zeidler, 2004), gene therapy (Lewis & Leach, 2006), and nuclear power topics of Wu and Tsai (2007). These issues were controversial (Sadler, 2004; Oulton et al., 2004) to science and had social significance (Eastwood et al., 2012). These were diverse to every individual that shall challenge one's scientific literacy. These solutions can be informed by scientific principles, theories, and data,

but the solutions cannot be fully determined by scientific considerations (Sadler, 2011). Overall, teachers cited 8 examples of topics in SSIs which can be grouped into 4 themes; 1.) Environmental Issues, 2) Genetic Engineering, 3) Safety and Security Issues, and 4) Health Issues. Researchers also wanted to know how these teachers brought SSI to their classrooms and what were the reasons why they (some teachers) cannot teach and bring SSI to science discussions. Below were the extracted data on question number 3 from the teacher's assessment answer about the question on how they brought SSIs into their lessons and what the reasons behind by not integrating SSI in teaching science.

**Table 3.** Summary of Teachers' SSI Teaching Approaches

Quotes	Coded for	Theme
TR02[“Through the utilization of an inquiry sheet project, reflection logs, and investigatory projects.”]	learning activities	<b>Teachers’ SSI teaching approaches</b>
TR03[“I introduce SSIs in my lessons most of the time especially if our lessons can be linked/connected to real-life scenarios and problems. For example, biodiversity, so I bring issue about global warming, if the topic is on the digestive system then the issues I may bring about is a healthy diet and eating what is good for our health.”]	Integrative teaching	
TR06 [ ... By integrating the content of Socio-scientific Issues into the lesson.’]		

Codes like learning activities and integrative teaching were gathered from the extracted data on teachers' frank answers. Utilization of the inquiry sheet project, reflection logs, and investigatory projects was used in SSI-based instruction. The researcher coded it as learning activities to emphasize the term "activity". TR02 described SSI instruction during the interview according to her it was a method and a process of applying the scientific concept in solving community issues. The teacher also highlighted the investigatory project as an activity in SSI and financial problems as one of the challenges in teaching SSI. Based on the observation, teacher 02 only brought SSI as a concept and problem during the discussion and asked students about some projects/ tangible projects (e.g recycling plastics to a product) out of the available materials in the surroundings. TR02 described project-based teaching rather than SSI-based and data revealed that Science teachers who brought SSIs lessons in their respective classes were just actually emphasizing traditional teaching methods but might be related to issues that could be anchored on SSIs. The SSI-based approach followed some key aspects in engaging learners in higher-order practices and opportunities to explore the issues on scientific and social dimensions. According to Topcu et al., (2018), as cited by Presley et al., (2013), who developed SSI based framework, the key aspects of SSI-based instruction included the following: 1.) Organizing instruction around a compelling issue (Prepping SSI-based activities); 2.) Featuring the compelling issue at the beginning of instruction (Utilization of Video clips, pictures, data, and audio to arouse problem analysis); 3.) Focusing on students’ science content learning (bringing science concepts to social issues); engaging students in scientific practices such as argumentation (brainstorming and group discussion); 4.) Providing opportunities for students



to use media to collect and analyze information about the issue (Utilization of media resources such as the internet, books, magazines, articles, etc.); and 5.) Support student negotiation of the issue's social aspect (mediate and scaffold students argumentation activity).

Additionally, teaching approaches were categorized into three (3) as cited in Topcu et al. (2018) first is the promotion of students' conceptual scientific understanding (Klosterman & Sadler, 2010; Topcu & Genel, 2014). Second, the advancement of students' scientific thinking through engagement in higher-order science practices such as argumentation, reasoning, and decision-making. This was a central consideration in SSI-based learning classrooms (Walker & Zeidler, 2007; Zeidler & Nichols, 2009) and building strong understanding and negotiating social aspects of the issue.

Since SSI-based pedagogy enhanced student's scientific literacy, teaching must anchor to understanding scientific processes, practices, and basic principles within a strictly scientific context. It must also be integrated with "real-life" situations that were scientific in nature and that were influenced by other factors, such as social, political and ethical issues (Robert, 2007). It must also train and develop students' high-order cognitive practices such as argumentation, reasoning and decision-making (Preslet et al., 2013) through analyzing and interpreting data, using evidence to participate in argumentation, collecting, evaluating and communicating information (NRC, 2012). SSI promoted a student-centered approach in teaching that held the idea that every student was a constructor and active learner in the teaching and learning processes. Hence, Lee, and Branch (2018) suggested that faculty "should" follow three principles and assumptions to design student-centered learning environments: "(i) students as active constructors of meaning; (ii) knowledge constructed in authentic contexts; and, (iii) teachers' guidance and support for students' learning."

During SSI-based instruction, as cited by Topcu et al. (2018), Klosterman and Sadler (2010) suggested that teachers may employ pedagogical strategies such as group discussion, presentation, and argumentation, combined with a collaborative and interactive atmosphere. Moreover, teachers should contribute to the ideas and knowledge in the classroom while maintaining neutrality and simultaneously, avoiding positioning themselves as sole knowledge persons (Dolan et al., 2009). Maintaining healthy discussion by supporting the ethical and moral development of the student (Sadler & Zeidler, 2005) judgment ability of the student (Gutierrez, 2015), reasoning (Mat Saad et al., 2017), and students' motivation (Reis, 2009; Zeidler et al., 2009). In case of disagreement along the way in settling the issue, teachers must take steps to manage disputes that will inevitably arise over the SSI-based instruction, creating open, interactive, and cooperative classrooms by which students can freely express their thoughts and opinions about the issues (Topcu et al., 2018).

Based on the extracted data and literature provided in the context, Science teachers seemed only to bring up scientific and social issues during a discussion in their class. Still, they did not follow the SSI-based Model in teaching.

**Table 4.** Summary of the Difficulty in Teaching SSI

Quotes	Coded for	Theme	
TR01 ["First time to read/know about SSI."] TR01 ["I used the traditional teaching frequently."]	Lack of Understanding No professional Development	<b>Teachers' content and Pedagogical Content Skills</b>	
TR04 ["No, because of the limited time allocated to each subject area to teach."] TR04 ["No materials and ready-made resources to incorporate.] TR02 ["Resources like books."]	Time limitation Lack of teaching supplementary materials		
TR02 ["Equipment & Connectivity.."] TR03 ["Lack of Gadgets."] TR04 ["Current and Electricity.."]	Lack of accessibilities		<b>Learning Media Resources</b>
TR02 ["Learner preferences in terms of learning capacity."] TR02 ["Learner's readiness..."] TR03["Students are less motivated when it comes to social issues."]	Students' ability to learn new things Students' engagement		<b>Assessment and Classroom Set-up</b>

Knouse (2001) highlighted the usefulness and the unique advantages of internet accessibility compared to the traditional way of teaching. Internet and electricity enabled teachers and students to access boundless information; explore features, platforms, and programs that may facilitate the teaching and learning process. Like students, teachers also needed to obtain information from mass media that included articles, newspapers, and books (Dawson & Soames, Osborne et al., 2004). Like Chinese students, Philippines students like to be passive and lack of motivation and initiative to explore knowledge on themselves (Phuong-Mai et al., 2006). Meanwhile, SSI-based faced many difficulties in implementation. Sadler (2009) and Ziedler et al. (2011) as cited in the study of Bossler et al. (2015) enumerated points that needed to improve and address. This may include; 1.) Teachers' proficiency in both pedagogy and pedagogical content skills (PCK); 2.) Learning media resources; 3.) Assessments and classroom set-up. Pitiporntapin (2016) also noted the challenges of future teachers (PSTs') in teaching and integrating SSIs in the classroom. Among those were lack of knowledge about SSI-based teaching and no teaching materials and SSI-based related resources that may supplement teaching. Also, teachers do not dare to employ the teaching method because of their "inability" to argumentation (Newton et al., 1999). The lack of the support to discuss SSI in the classroom due to limitation of time in teaching (Lee et al., 2006).

Hancock et al. (2019) cited several constraints that hindered teachers from employing SSI. These were teachers' perceptions of limited time for both planning and classroom enactment, lack of SSI-oriented curricular materials and little support from local administrators. Some struggles included teacher discomfort with controversial conversations in their

classrooms (Bryce & Gray, 2004), limited assessment practices (Tidemand & Nielsen, 2017), and a tendency to focus exclusively on scientific ideas at the expense of contextualized understandings of the issue (Ratcliffe & Millar 2009). According to Friedrichsen, Sadler, Graham and Brown (2016), most researchers claimed that SSI-based instruction was scarcely applied in science classrooms for two major reasons as cited by Atabay and Topcu (2017). First, instructional materials for the instruction were not plentiful and second, teachers did not receive sufficient support for implementing such an instruction (Hofstein et al.,2011).

**Table 5.** Summary of the Students’ Difficulty in Learning Socio-Scientific Issues (SSIs)

Quotes	Coded for	Theme		
NASR02 [“No. My science teacher didn’t topic this lesson.”]				
NASR39 [“No. The teacher didn't teach SSI.”]				
NASR45 [“No. because the teachers don’t teach us about SSI.”]				
NASR05 [“Hindi, dahil di pa kame natuturuan.”]				
NASR09 [“Hindi pa kami natuturuan ng SSI.”]	Teachers didn’t teach SSIs	<b>Teacher Factors</b>		
NASR13 [“Hindi poh kami naturuan ng SSI lessons noong last year.”]				
NASR16 [“Hindi pa ito dinidiscus sa amin. kaya hindi naming poh to alam.”]				
NASR21 [“Hindi pa poh kami naturuan.”]				
NASR26 [“No, because no learned the SSI because no topics on SSI being discussed.”]				
NASR43 [“Because I haven't been taught about the SSI.”]				
NASR14 [“No, dahil hindi ko pa ito nalaman.”]				
NASR36 [“We never learn SSI.”]				
NASR10: Hindi pa po ser. Ngayon ko lang poh yan narinig sa grade –9.			First time hearing the term SSI.	
NASR11 [“Ngayon ko lang narinig ang tungkol sa SSI.”]				
NASR42 [“Teachers are too busy and running out of time to do it.”]	Too busy and Lack of Time			
NASR04 [“Hindi (dahil) pa kami naturuan dahil ang mga natuturo saamin ay mga digestive system.”]				
NASR07[“No, because respiratory and others; part of the circulatory system lang ang naituturo saamin ng teachers.”]	Teachers only teach Science concepts.			
NASR08 [“No, I don't know why because my teacher in science teaches us only in science (concept).”]				
NASR15 [“Hindi po sir, kasi yong mga tinuturo saamin ay mga science lang po yung mga madali lang.”]				
NASR17 [“ No, hindi pa kami naturuan ng SSI noon, dahil ang tinuturo lang sa amin ay about Science lang.”]				

Quotes	Coded for	Theme
NASR18 [“Hindi Pa Poh sa pagkat and tinuturo lang poh sa amin ay science lang.”]		
NASR19 [“No. They (teachers only) taught science in elementary to grade-8 the example of the circulatory system, cigarette smoking, which is harmful to our health.”]		
NASR38 [“Because the teacher only taught us what is only in the book.”]	Teachers only teach what is in the book.	
NASR02 [“No face-to-face.”]	Limited physical contacts/	<b>Environmental Factor</b>
NASR03 [“Hindi, dahil sa grade 8 po wlang face-to face.”]	Classes are canceled	
NASR20 [“I think because of No face to face.”]		
NASR31[“Because of NO face to face.”]		
NASR37[“Because no face to face.”]		
NASR40 [“No sir. Because no face to face.”]		
NASR42 [“No because NO face to face yet.”]		
NASR43 [“There was No face to face classes.”]		
NASR24 [“Because face to face is canceled.”]		

Some teachers were not confident in facilitating and teach Socio –scientific issues based on topics (Pitiporntapin et al., 2016; Loughran, 2007), because they were ashamed for not being familiar with SSI (Pitiporntapin et al., 2016; Forbes & David, 2008). They also lack of understanding and resources of the SSI-based pedagogy and cannot link science content with SSIs (Pitiporntapin et al., 2016; Seomsul et al., 2015).

The abovementioned studies were supplied reasons as to why teachers mostly failed to incorporate SSI which in turn influenced the poor performance of students in science subjects and how pandemic hindered students learning to SSI. Teacher and environmental factors affected students' conceptual understanding and performance to argumentation inside the classroom, COVID pandemic continuously limited the physical contact among students and teacher resulting in limitation of teaching in a modular learning modality.

### 3.2 Teachers-Students perception on the needs to develop contextualized SSI lessons

**Table 6.** Summary on the Needs to Develop SSI-based Lessons

Quotes	Coded for	Theme
TR01 [“yes, because as its purpose itself, it allows students to study a topic more in-depth.”] NASR02 [“Yes, Para malaman kung ano-ano ang mga leksyon nito.”]	Conceptual Understanding	
NASR04 [“Yes, para matutunan naming kung ano ba itong SSI.”] NASR07 [“Yes, dahil para malaman ang SSI at matutunan ang mga parts nito.”] NASR03 [“Yes. Para mas maintindihan (and SSI) ng mabuti.”] NASR21 [“Yes. Para malaman ang tungkol sa SSI.”] NASR25 [“Yes, Yes.para poh malaman (SSI).”] NASR26 [“ Kailangan malesson ang SSI to understand.”] NASR24 [“For understanding ng mga students kung ba tla ang SSI.”] NASR36 [“Yes. To know what is SSI.”] NASR39 [“Yes para matutunan naming ang SSI.”] NASR40 [“To learn more (about) SSI.”] NASR42 [“...so that, we can learn about socio-scientific issues.”] NASR44 [“To learn more about SSI lessons.”] NASR45 [“Yes. To know what is SSI all about.”] NASR13 [“Yes, kasi poh para maintindhan naming kung ano talaga ang SSI at para rin malaman.”] NASR17 [“Yes, Para maintindhan naming kung ano ba tla ang Ibig sabhin ng SSI.”] NASR07 [“Matutunan ang mga part nito.”] NASR10 [“Yes! Para poh malaman naming kung ano poh and SSI.”]	To understand parts and features of SSI. To know what is/are SSIs.	<b>To enhance students' knowledge of SSI</b>
NASR11 [“ <b>Yes in order for us</b> to learn an SSI lesson.”] NASR32 [“Yes. for it allows us to experience SSI-based lessons.”] NASR43 [“Yes to know the issues of the topics discussed.”] NASR09 [“Opo. Para kami maturuan ng SSI lesson.”]	To experience SSI-based Teaching	
TR01 [“Conduct relatable activities which will further prepare them for life.”] TR01[“Gives a context to what they are learning about	Engage to a meaningful learning	

Quotes	Coded for	Theme
NASR07 [“Yes, para matutunan ang halaga ng SSI.”] NASR05 [“Yes, para malaman naming kung paano ito gawin.”] NASR22 [“Yes. para alam naming what ba talaga ang SSI.”]	To know the importance of SSI	

Students who participated in SSI-based learning experiences demonstrated a better understanding of science ideas (Sadler et al., 2011a). SSI-based education has been found to be beneficial from the implementation to evaluation and from merely developmental of instructional material to the enhancement of student's ethical, social and conceptual understanding and toward argumentation and decision making (Guitierrez, 2015; Forbes & Davis, 2008; Dolan et al., 2009; Eilks, 2010; Evagorou et al., 2014; Pitiporntapin et al., (2016) (2019), Sadler & Zeidler, 2005 and Presley et al., 2013). SSI promotion of students' conceptual scientific understanding (Klosterman & Sadler, 2010; Topcu & Genel, 2014).

SSI instruction allowed students to explore the concept of science and social issues related to themselves. Students mostly engaged in group discussion and presentation of ideas perceived them as active constructors of knowledge rather than passive learners. Students were given the chance to express their ideas and personal notes to the issue which may others find substantially important and that were morally and ethically appropriate, resulting to a more meaningful and life-changing experience in the learning process.

**Table 6. (Cont'd)**

Quotes	Coded for	Theme
NASR07 [“ Mapamahagi sa ibang tao at kamag-aral.”]	Share knowledge with others	<b>To develop a sense of confidence in learning and teaching SSI</b>
NASR40 [“Yes. Makakatulong ito sa mga wala pang alam tungkol sa SSI.”] NASR10 [“Para naman kung may mga tanong poh saakin , alam ko poh ang maisasagot ko sir.”]	Answer other queries efficiently	
TR02 [“Contextualized SSI lessons and activities may provide teacher-ready-made resources.”]	Ready-made teaching resources	
TR05 [“Yes, because it will serve as a template/pattern in making SSI lessons and activities are readily use by teachers.”] TR02 [“To facilitate SSI more efficiently in the classroom and during discussions.”]	Teach Science topics efficiently	

Moreover, Pitiporntapin (2019) cited Hanagean et al. (2007) research that the inclusion of scientific content with moral and ethical perspectives about SSI in the curriculum or a lesson can enhance confidence in students' learning, participation, and understanding of SSIs. Also,

many researchers reported that students who learned through SSI-based teaching developed a comprehensive understanding of the subject matter (Sadler, 2011a; Zeidler et al., 2011). And, that development of SSI-based lessons can help teachers and future teachers improve pedagogy and confidence to teach SSIs. Currently, SSIs-based teaching is considered a powerful strategy for the development of scientific literacy (Presley et al., 2013).

**Table 6.** (Cont'd)

Quotes	Coded for	Theme
NASR36 ["Yes. To enhance our Ideas in the argumentation.]	Sharpens one's ideas	<b>To improve students' argumentation skills</b>
NASR50 ["Students need SSI for us to know to argue issues."]		
NASR41 ["Yes, because it can help students with an argument about social science issues (SSI)."]	Engages in reasoning and argumentation	
NASR42 ["Yes. We can develop our argumentative skills."]		
NASR43 ["Yes we need to enhance our argumentative skills."]		
NASR46 ["Yes. It helps the argumentative skills of the students."]		
NASR49 ["Yes, we need SSI for our argumentative skills to be enhanced."]		

Zohar and Nemet (2002) reported on a case study of year 9 (15 years old) students from two schools in Israel who were taught a 12-h unit on genetics that integrated explicit argumentation skills. The unit aimed to develop students' understanding of genetic topics (e.g., genetic counseling, inheritance, gene therapy, and genetic cloning) and develop argumentation skills (e.g., developing and justifying arguments and counter-arguments). The experimental group of 99 students was taught argumentation skills, bioethical principles and practiced using these skills while debating ten moral dilemmas. When they were compared to a comparison group of 87 students who were taught a traditional genetics topic, the experimental students were more likely to use their biological knowledge to improve the quality of their arguments about bioethical dilemmas. They scored statistically significantly higher scores in a genetic test of 20 multiple-choice questions. The authors conclude that teaching explicit argumentation skills enhanced conceptual understanding and argumentation performance. Hence, Students' participation in SSI was found to have improved students' argumentation (Venville & Dawson, 2010). reasoning skills (Kolstø et al., 2006; Sadler & Zeidler, 2005; Zeidler, Applebaum, & Sadler, 2011); and moral, ethical, and character development (Lee et al., 2006).

**Table 6. (Cont'd)**

Quotes	Coded for	Theme
TR02 ["Yes, because it is essential."] TR03 ["Yes! Because science nowadays is upgrading."] NASR12 ["SSI taught us the connection of lessons to our health, community, politics, at the home of course, and other issues."] NASR19 ["Because just like I said, these (SSI-based lessons) are very useful to our health."]	Allows integrative teaching and learning	<b>Motivate learning and teaching of SSI</b>
TR05 ["Can be a big help to teachers and students."] TR10 ["It will be a great help to both teachers and students."] NASR37["To help teachers and students in the educative process."]	Benefit teacher and students	
NASR15["Yes sir, because SSI is good to help a lesson."] NASR16 ["Yes, kasi SSI is needed. To keep a lesson and discussion enjoyable."]	Motivate students	

Extracted data significantly discussed the importance and advantages of the need for contextualized SSIs lesson plans. Teaching-learning materials could positively impact teachers and students alike while enjoying the benefits of being educated in Science classrooms empahsizing real-life scenarios and life-long learnings in this evolving society.

The methods of involving controversial issues in formal science education guarantee an ideal approach to promoting scientific literacy (Presley et al., 2013). A vision and mission of SSI based instruction consistent with the Next Generation Science Standards (NGSS) particularly in terms of scientific practices such as analyzing and interpreting data, using evidence to participate in argumentation, and collecting, evaluating and communicating information were considered (NRC, 2012). The teaching of SSI was believed to have improved students' both conceptual and argumentative skills (Presley et al., 2013; Zeidler, 2014).

As the NAT and PISA results suggested the need for country's improving quality of science education and curriculum (PISA 2019: OECD 2019). In the pursuant act, it was further stated in section 10.2 The Standards and Principle of the Basic Education Curriculum Development (a-h) where it described the characteristics of the Philippine education curriculum. These made as bases in crafting the SSI-based lessons were the idea that 1.) The curriculum should be learner-centered, inclusive and developmentally appropriate;(2) This shall be relevant, responsive, and research-based, (3) The curriculum shall be contextualized and global;(4) The curriculum shall use pedagogical approaches that are constructivist, inquiry-based, reflective, collaborative and integrative; (5) The curriculum shall be flexible enough to enable and allow schools to localize, indigenize and enhance the same based on their respective educational and social contexts. Consequently, according to Sec. 10.2, the SSI-based approach was student-centered (Subiantoro, 2012). Relevant and research-based in nature according to



the study of Hanley and Ratcliffe (2007). These were contextualized, localized, constructivist, inquiry-based, reflective, collaborative, and integrative as lessons based on Zeidler et al. (2019).

Teachers must be knowledgeable on both scientific and social aspects of the issue but must confess that they might not have boundless knowledge of the issue (Presley et al., 2013). The teacher should be willing to share his authority with students and the in-class atmosphere should be marked with cooperation, interaction, and mutual respect between teacher and students (Sadler, 2011).

### 3.3 Teachers and Students' Perception on the Teaching of SSI lessons

**Table 7.** Summary of Themes on the advantages in Teaching SSI-based Lessons to Students

Quotes	Coded for	Theme
TR04 [“(Advantageous)Especially to young ones who are already using (indulging) to smoking cigars for it takes time to educate them and to get recover from smoking.”]	Allows students to self-responsibility	<b>Self- Informed about the Issues</b>
TR05 [“Having SSIs known to students they would take precautions on activities that may harm them.”]	Talk about precautionary measures	
NASR03 [“para malaman natin ang mga dapat gawin.”]		
NASR04 [“Yes, dahil para malaman namin ang mga bagay na kailangan gawin.”]		
NASR28 [“Yes. because dito naming malalaman ang mga bawal sa kalusugan.”]		
NASR31 [“Yes, because SSIs in my opinion will help us to know what we need, for instance, helping our body to have great development, avoiding what is bad.”]	To know the advantages of SSI on one's health	
NASR49 [“Yes, these topics in SSI will let us know about the issues.”]		

SSI is brought to the classroom for the students to be informed about the concepts of science and its social aspects and relevance to students' experiences. And, through the integration of their experiences from the community, students will be involved in solving a social problem and enlightened by their understanding. They will learn to value themselves while appreciating the issues around them.

**Table 7. (Cont'd)**

Quotes	Coded for	Theme
NASR01 [“Yes, nakakatulong ito para hikayatin ang mga tao tungkol sa kahalagahan ng issues at sa kanilang buhay.”]	To Encourage people on the importance of the issue	
NASR07 [“Yes, para taong hindi marunong uminti sa tamang salita o mga taong mahirap paliwanagan.”] NASR12 [“Yes, (you) can convince someone to stop doing something that may cause harm to our health...”]	Provide clear clarification and explanation;	<b>Encourages Communication Skills</b>
NASR20 [“Yes. Because we will be trained how to convince people.”] NASR08 [“Yes, para gumaling kami sa pagsasalita.”] NASR18 [“para matuto kaming magsalita sa isa’t isa.”]	Talk about the importance of public speaking	
NASR20 [“Talk about how to resolve issues altogether.”] TR01 [“allows to communicate with their peers”] TR05 [“It engages students in dialogue and discussions.”]	Discuss issues with peers	
NASR01 [“Yes, sabihan ang mga tao tungkol sa kahalagahan ng issues at sa kanilang buhay.”] NASR19 [“Yes. To let them (people) know on what is the harmful of those things that they do.”] NASR12: [“Yes, you can (teach) that guy to do something beneficial or good to himself (health)”] NASR34 [“Allow (yourself) to give them (people) advice”]	Teach other people the importance/ greatness of the Issue	

Students in SSI-based teaching had trained students to construct valid scientific arguments and then integrated those thinking skills with knowledge about specific socio-scientific issues (SSIs). They were better able to justify their positions on the issues and were ultimately better prepared to debate on controversial matters (Lin & Mintez, 2010). SSI teaching also helped students communicate conceptually based on the opinion and reasoning that other students may be present.

**Table 7. (Cont'd)**

Quotes	Coded for	Theme
<p>TR09 [“Students will be trained to search support their claims and warrants during the activity.”]</p> <p>TR09 [“Enhance students' ability to research and look for strong supportive evidence to every rose argument.”]</p> <p>TR01 [“Enhances individuals' Critical thinking and discovers evidence that supports or refutes their position.”]</p>	<p>Enhance students' ability to search</p>	
<p>TR01 [“Have a better judgment on what approach to take regarding a sensitive topic such as Gays in donating blood.”]</p> <p>TR02 [“They will learn to a right decision; what is the right food to eat, for instance, the effect of “bad” foods on our body system, and how to take care of our body.”]</p>	<p>Enhance students' moral and ethical values</p>	<p><b>Involves Reasoning &amp; Decision making</b></p>
<p>NASR02 [“sabihan ang mga tao kung ano ang totoo at mali base sa SSI na naituro”]</p> <p>NASR03 [“Yes, para malaman and bawal at hindi bawal.”]</p> <p>NASR04 [“Para malaman kung ito (desisyon) ba ay tama o mali.”]</p> <p>NASR34 [“You can argue to the people who don't agree to the right decision and you can explain to them what the right decision is.”]</p> <p>NASR35 [“Yes. Because you can argue with the people who don't want to listen and choose the right decision.”]</p>	<p>Weigh right and wrong decisions</p>	
<p>NASR43 [“Students to know issues of the topic and argue about it.”]</p> <p>NASR44 [“Yes, it involves scientific topics that require us to engage in discussion and debate.”]</p> <p>NASR46 [“Yes (there is an advantage). To argue about the issue if a person does not agree with what you are agreeing.”]</p>	<p>Discuss and argue on the right thing</p>	

Quotes	Coded for	Theme
NASR45 ["Yes. Because SSIs are controversial that involve scientific debate."]	Allows students to make claims and warrant and debate	
TR02 ["May also help learners develop/her way of learning, through giving and sharing his/her insights in a constructive and essentially explained and supported with pieces of evidence."]		
TR01 ["Allow students to develop a position on controversial, real-world issues, discover evidence that supports or refutes their position."]		
NASR12 ["These lessons encourage our argumentation skills and be developed."]		

SSI engaged learners in higher-order practices and opportunities to explore both scientific and social dimensions of the issues, promoting to enhance not only conceptual understanding but also argumentation skills (Klosterman & Sadler, 2010; Topcu & Genel, 2014). It also engaged students in processes of data analysis, reasoning, argumentation, and decision-making ensuring class discussion was collaborative and respectful. They also expected that students' participation was high, productive (Sadler, 2011) and motivated (Reis, 2009; Zeidler et al., 2009). As students would engage with scientific ideas and practices related to the issue (Tal & Kedmi, 2006) they would learn how to negotiate the social aspect of the issue, balancing issues and decisions by relating and considering their moral and ethical perspectives (Zeidler, 2014).

The concepts of Tal and Kedmi (2006) and Zeidler (2014) noted that when students were engaged with scientific ideas and practices related to the issue they would learn how to negotiate the social aspect of the issue. They were balancing issues by relating and considering their moral and ethical perspectives (Zeidler, 2014). The aim of SSI-based instruction was not only to teach students how to argue on specific social issues that may affect their lives, but also the sense consider other perspectives and opinions by weighing others' ideas based on the degree of ethical and moral aspects.

Presley et al. (2013) suggested that students may consider high-level implications of the focal issue after collecting and analyzing the data to understand the issue during the instruction. They were nurturing students to be equipped by scientific information and the social aspect of the subject. Since, SSI is an interdisciplinary approach where teaching must not only devote to the understanding of scientific processes, practices, and basic principles within a strictly scientific context but also integrating "real-life" situations that were scientific in nature and that were influenced by other factors, such as social, political, and ethical issues (Robert, 2007). This allowed the student to explore issues by engaging, integrating other aspects in solving

problems and dilemmas, both scientifically significant and socially and morally (Pedretti, 2003; Sadler, 2004; Eastwood et al., 2012).

SSIs as an approach developed students' argumentative skills by strengthening their reasoning and logical abilities as they made their stands on raised issues. Students' opinions eventually do not matter content-wise but rather improve their critical thinking by being influential thinkers thereby developing their higher-order thinking skills.

Teaching students the argumentation skills enabled them to learn to construct valid scientific arguments and then integrate those thinking skills with knowledge about specific socio-scientific issues (SSIs). They were better able to justify their positions on the issues and were ultimately better prepared to engage in debate on controversial matters (Lin & Mintez, 2010). Osborne (2010) explained that the elements of an argument that supported the claim may be subject to rebuttal or counter argumentation and that by itself required the ability to compare, contrast, and distinguish different lines of reasoning. Through the cognitive process of comparison and contrast (Osborne, 2010), argumentation would help students develop new understandings produced by the interaction between the old ideas they hold and the new ones they encounter. Thus, giving students a chance to justify their claims and generate counterarguments and rebuttals. These would help them construct and reconstruct their knowledge (Berland & McNeill, 2010) and test new meanings.

**Table 7. (Cont'd)**

Quotes	Coded for	Theme
TR06 [“SSI increases students' interest in the lesson. It also increases their motivation because real-life issues or topics are the central focus.”]	Motivate students to real-life issues	<b>Future-oriented</b>
TR01[“Serve them both in future academic studies and the workplace/force”]	Prepare them for future	

A study by Feierabend and Eilks (2020) found that the lesson plans developed for the topic of climate change were very feasible and motivating, mimicking societal debates, provoking self-reflection on the handling of socio-scientific issues within society. He recognized that learners' perception of the relevance of science teaching rose in the students' estimation for all four subjects (Biology, Chemistry, Physics, and Politics). Showing that the socio-critical, problem-oriented approach to teaching allowed for innovation in science classrooms and led to higher levels of motivation and a greater perception of the relevance of science for everyday life.

SSIs can develop students' argumentative skills by strengthening their reasoning and logical abilities as they make their stands on raised issues. Students' opinions eventually did not matter on content-wise but rather improved their critical thinker by being influential thinkers thereby developing their higher-order thinking skills. On the teacher side, the developed SSI-based lessons can help them improve their pedagogical and pedagogical content skills. Below

were some comments and suggestions from teachers and students in developing SSI-based lessons such as Digestive, Respiratory and Circulatory System.

**Students:**

*“Yes, we need to develop SSI-based lessons! Because not all lung cancer is caused by cigarettes, not all allow gays to donate blood or eating of insects. Lung cancer can be caused by air pollution, a family history of lung cancer, and asbestos.”*[NASR47]

*“Yes, if weren't thought about this until we grew up, we will never know the issues regarding these topics and we will never know how to argue with the issues.”*[NASR50]

*“Para matigil na ang lahat ng bisyo (to Stop (people) from Addiction).”*[NASR07]

*“Opo, makakatulong sa amin ang argumentative in SSI kasi po ditto natin malalaman na pwede tayo mgkakasakit kung hindi natin pagbabawalan ang mga taong nainigarilyo kasi po kahit hindi po tayo naninigarilyo pwede rin tayo mapektuhan kasi poh ng dahil sa usok at iba pa.(Yes, this will help to improve our argumentation skills on SSI, because through this we'll be informed of the possibility of getting sick if we don't know how to ban people from smoking, (because) even if we are not smoking we can still get sick and affected due to its smoke and others.)”* [NAS13]

**Teachers:**

*Based on my opinion, teachers need talaga ma to enhance para they can able to adopt learned ways, other methods to enhance learning in science ...so perhaps the teacher should attend training seminars on the enhancement of this kind of methodology or methods that we have, you have introduced to us.(Based on my opinion, the teacher should be enhanced for them to be able to adopt learned ways (like these SSI-based lessons), other methods to enhance (students') learning in science. .. so perhaps the teacher should attend training seminars on the enhancement of this kind of methodology or method that we have, (that) you (the researcher) have introduced to us.)”* [TR02]

*Yes. I think ..teaching SSI in science helps students make a... use of science for application in real-world problems. ... they will become aware of the socio-scientific issues once they have understood what is, what are issues and if those issues affect them... research and training, Those are the things that they (Teachers) need so that they can integrate.”* [TR06]

Teachers and students seemed to believe in the positive results of this endeavor that the development of the SSI-based lesson can help students enhance understanding, improve argumentation and the pedagogical ability of teachers. NASR47 and NASR13 expressed the importance of two topics (Circulatory and Respiratory systems) on the ethical aspect and one's understanding. NASR50 expressed the necessity to learn SSI and NASR07 strong belief that the developed lessons could stop addiction. Much more to students, the teacher also strongly agreed that SSI-based lessons can enhance students' performance in science, their communication skills as interpersonal intelligence along with higher order practices such as reasoning, decision making and argumentation; making them aware of the real-life issues that they are facing and enabling them to generate potential solutions to the problem that are seemingly relevant to their learning and experiences. Moreover, teachers still recommended

that teachers should indulge themselves in a training seminar to capacitate their ability and to be able to teach SSI confidently and effectively.

### Conclusion

Results revealed that most science teachers do not teach SSIs inside their classroom which affects students' engagement and learning to SSIs. All grade 9 students could not provide examples of SSIs and have difficulty in learning due to teacher's inability to teach. The Infrequent and failure of teachers to integrate SSIs in the classroom can be categorized in two related aspects; 1) Teachers' proficiency in SSI-based pedagogy and Pedagogical content skills (PCK) such as relating social issues to science concepts, 2) Teaching accessibilities and ready-made learning assessment which is unavailable. Hence, with the identified needs and challenges from this study, it further suggested that there is a need for the development of contextualized ready-made curricular resources such as a unit plans of SSIs lessons following SSI-based instruction model to address teachers' and students' concerns and to bridge the gap in the related literature.

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### Credit Authorship Contribution Statement

**Anwar I. Kolong:** Conceptualization, Writing- original draft, review and editing, implementation, data collection, initial data analyzation. **Monera Salic-Hairulla:** Research adviser, Supervision, Writing- review and Editing. **Amelia T. Buan:** Conceptualization, Methodology, formal analysis. **Sasitaph Pitiporntapin:** Conceptualization, Methodology, Review and editing, Visualization and Formal analysis.

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