OmniaScience

Journal of Technology and Science Education

JOTSE, 2024 – 14(2): 363-375 – Online ISSN: 2013-6374 – Print ISSN: 2014-5349

https://doi.org/10.3926/jotse.1988

TEACHERS' IMPLEMENTATION OF SOCIO-SCIENTIFIC ISSUES-BASED APPROACH IN TEACHING SCIENCE: A NEEDS ASSESSMENT

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Received October 2023

Accepted November 2023

Abstract

This study made a preliminary attempt to conduct a needs assessment of teachers' utilization of the SSI-based approach in teaching Science by exploring Filipino teachers' awareness, perceived need, readiness, and willingness. It also aimed to determine which among the demographic profiles of the teachers had significant differences in their perceived need and readiness. A needs assessment using a quantitative survey research design was used in this study. The data-gathering procedure was done using a validated online survey questionnaire with a Cronbach alpha of 0.89. A total of 124 science teachers participated in this study throughout the two-week implementation. Descriptive and inferential statistics were used to analyze the data gathered from this study. Results revealed that more than fifty percent of the teachers were highly aware of the SSI-based approach and perceived the need for its implementation in science classes. Teachers were also willing to participate in an SSI training program to learn more about it and develop their own SSI-related materials. Furthermore, gender and specialization significantly differed in teachers' perceived needs, while specialization significantly differed in readiness. Results obtained from this study can be used as a basis for exploring teachers' perceptions and views of implementing the SSI-based approach.

Keywords – Socio-scientific issues, SSI-based teaching, Science education, Needs assessment.

To cite this article:

Badeo, J. M. O., Duque, D. A. G., & Arnaldo, R. L. (2024). Teachers' implementation of socio-scientific issues-based approach in teaching science: A needs assessment. *Journal of Technology and Science Education,* 14(2), 363-375. https://doi.org/10.3926/jotse.1988

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1. Introduction

Socio-Scientific Issue (SSI) is a non-exhaustive social dilemma with theoretical and/or procedural links to Science (Sadler, 2004). It concerns science, technology, and society which typically prompts dialogue because of the social, ethical, and environmental consequences of several scientific and technological innovations (Zeidler & Nichols, 2009). With the growing number of studies about SSI in different

fields, science educators took the step to examine how it can be integrated into science education and its possible effects (Barrett & Nieswandt, 2010). One of the significant findings revealed that SSI helps promote scientific literacy among students (Owen, Zeidler & Sadler, 2017). There are two visions for scientific literacy. These are (1) idea comprehension within a scientific context and (2) idea comprehension of other contexts that are scientific but are shaped by social, political, and ethical issues (Roberts & Bybee, 2014).

One of the targets of science education is grooming scientifically literate citizens. Considering that SSI supports the realization of such goals, educators study its attributes as well as identify appropriate science lessons that can be presented as SSI (Levinson, 2006). Zeidler (2014) characterized SSI as (1) a controversial and poorly constructed problem, (2) it warrants students to engage in debates, dialogues, and evidence-based arguments to make sound judgments, and (3) it is linked to science content and requires moral reasoning. Eastwood Sadler, Zeidler, Lewis, Amiri and Applebaum (2012) also pointed out that choosing a topic to be introduced as an SSI must be related to Science and significantly affect society.

Aside from the finding that SSIs are useful in promoting scientific literacy, many studies have shown that SSI use during science teaching was effective in improving motivation and interest in science and science learning (Parchmann, Gräsel, Baer, Nentwig, Demuth & Ralle, 2006; Albe, 2008), communication abilities (Chung, Yoo, Kim, Lee, & Zeidler, 2016), and students' content knowledge in science (Dawson & Venville, 2013), decision-making skills (Gutierez, 2015). Different studies also revealed how SSI influences science education's teaching and learning processes. According to Lee and Witz (2009), SSI helps encourage students to participate in decision-making activities by involving awareness of the science-technology-society relationships. SSI in classrooms increased students' awareness of the science-society relationships and assisted them in identifying the strengths and shortcomings of their reasoning (Marks & Eilks, 2009). Gutierez (2015) added that using SSI strengthens the relevance of science learning to students' lives as well as providing an additional avenue for student assessment.

Several research studies have been carried out in the Philippines investigating the effect of using SSI in teaching Science. For example, the study by Gutierez (2015) explored using a quasi-experimental design how SSI affects the decision-making skills of Grade 8 students. One group experienced SSI-based teaching, while the other underwent traditional teaching. The pretest and posttest were compared showing a significant difference in decision-making skills in favor of the SSI group. On the other hand, 220 Physical Science Department students of De La Salle University Lipa enrolled in business courses participated in the SSI research of Talens (2016). This was done through interviews aimed at collecting pieces of evidence on how well the students work with the SSIs in their topic "Sources of Energy" during their Physical Science class. Results showed that through SSI, the non-science major students obtained improved knowledge and were able to answer questions based on laid evidence. Moreover, Mandapat and Prudente (2018) examined the effect of the SSI-based modules in teaching Biodiversity. The study found that after the SSI-based module implementation, there was an increase in terms of the participating Grade 9 students' academic achievement and reasoning. Lastly, Bigcas, Prudente and Aguja (2022) determined the effects of their developed SSI-based learning module in Nanotechnology on Grade 11 students' understanding and reasoning.

Over the past 15 years, SSI literature has grown extensively not just focusing on its effect on the various aspects of student learning and teachers' views, perceptions, and practices on SSI use in science education (Sibic & Topcu, 2020). Lee, Abd-El-Khalick and Choi (2006) showed that Korean secondary science teachers had positive views about SSI use, although only a few implemented it in their classes. The unavailability of teaching materials and lack of time were the reasons they mentioned that hindered them from teaching Science using the SSI-based approach. Bosser, Lundin, Lindahl and Linder (2015) also accomplished a longitudinal study of teacher perspectives on implementing SSI teaching for one year. Results showed that teachers generally embraced SSI use in science education and saw its potential in making Science learning more contextualized to students. However, they also identified numerous

constraints for successful science learning using this approach, similar to Lee et al. (2006). Eilks, Nida and Pratiwi (2020) piloted a survey study investigating Indonesian teachers' experience and insight toward SSI-based science education. Results reflected the varying degree of awareness among the participating teachers. Moreover, teachers perceived that students' content knowledge and achievement could be improved through the application of SSI.

Looking at the results of the studies presented above, it can be established that SSI-based teaching is a possible instructional approach to science education. Thus, there is a need to assess the Filipino science teachers' perception of SSI as a teaching approach. Although there were research studies in the Philippines about SSI implementation in science education, they only focused on determining students' learning outcomes effects, i.e., achievement, reasoning, and decision-making. For this reason, preliminary studies are essential to evaluate Filipino teachers' implementation of the SSI approach in teaching Science through the exploration of Filipino teachers' awareness, perceived need, readiness, and willingness to the SSI approach.

1.1. Research Questions

This study is conducted to examine the perceptions of Filipino teachers towards implementing the SSI-based approach in teaching Science and how such perceptions differ according to their demographic profile. Specifically, this study aimed to attain answers to the following research questions:

1. What is the perception of science teachers towards the implementation of the SSI-based approach in terms of (a) awareness, (b) need, (c) readiness, and (d) willingness
2. Is there a significant difference in science teachers' perceived need and readiness according to (a) gender, (b) school type, (c) length of teaching experience, (d) specialization, (e) educational attainment, and (f) level of education handled?

2. Methodology

2.1. Research Design

With the growing research studies about SSI-based teaching, Filipino science teachers' views and perceptions about it should also be considered. Previous studies were conducted in the Philippines, but they were limited to investigating the effect of SSI-based teaching on students' learning outcomes. Thus, the present study was made. This study is a needs assessment employing a quantitative survey research design (Ponto, 2015). It was conducted to obtain data on 124 teachers in the Philippines about their perception of the SSI-based approach to teaching Science. The gathering of data using an online validated questionnaire lasted for two weeks. Descriptive and inferential statistics were used to analyze the data gathered from this study.

2.2. Participants

This study was based on a questionnaire in a Google Form format wherein 124 science teachers responded within two weeks of implementation. Teachers' participation in this study was voluntary, and the confidentiality of the data obtained was assured. A data collection technique called random sampling was utilized to collect responses from the Science teachers regardless of their sex, school type, years of teaching experience, specialization, educational attainment, and level of education handled. Details of the demographic profile of the teachers are given in Table 1.

From the 124 teachers who participated in this study, teachers who were teaching for 0-5 years (52%) dominated the sample size followed by teachers teaching for 6-10 years (31%). In addition, 48% of the teachers specialized in Physics, while an equal number of teachers (22%) specialized in Biology and General Science. A significant number of teachers handle secondary-level students (77%). Regarding the sex of the teachers, female teachers are higher compared with male teachers, with Bachelor's degrees and MS/MA units (36%) as the highest educational attainment.

Demographic Profile	Profile	Frequency	Percentage (%)
Sex	Male	54	43
	Female	70	57
Type of School Affiliation	Public	66	53
	Private	58	47
Length of Teaching Experience	0-5 years	64	52
	6-10 years	39	31
	11-15 years	13	11
	16-20 years	4	3
	More than 20 years	4	3
Field of Specialization/Major	Biology	27	22
	Chemistry	10	8
	General Science	27	22
	Physics	60	48
Highest Educational Attainment	with Bachelor's Degree	23	19
	with Bachelor's Degree and MS/MA Units	45	36
	with MA/MS Degree	15	12
	with MA/MS Degree and PhD Units	37	30
	with Doctorate Degree	4	3
Level of Education Handled	Elementary	7	6
	Secondary	96	77
	Tertiary	21	17

Table 1. Demographic Profile of the Participants

2.3. Instrument and Data-Gathering Procedure

The instrument, "Questionnaire on Teachers' Awareness, Need, Readiness and Willingness on the Implementation of SSI-based Approach" was a researcher-made questionnaire. It was an online questionnaire in a Google form format designed to obtain information about (a) the demographic profile of the teachers and (b) teachers' awareness, perceived need, readiness and willingness tailored from the study of Eilks et al. (2020). The questionnaire was subjected to face and content validation before it was disseminated online. Five science education experts who consisted of four doctoral students and one secondary-level teacher validated the questionnaire in terms of quality of statements, language used and overall presentation. Their comments and suggestions were integrated into the final form of the online questionnaire. The questionnaire was piloted with 15 teachers to ensure its comprehensibility and internal consistency. The final questionnaire consisted of the following: (a) four questions which consist of one yes/no question and three open-ended questions for the awareness, (b) Likert-type questions wherein responses range from strongly disagree=1, disagree=2, agree=3, strongly agree=4 for the perceived need and readiness and (c) five yes/no question for the willingness. Moreover, the survey tool obtained a Cronbach alpha value of 0.89 for the reliability test performed a week before the data-gathering procedure started.

The procedure employed in this study consisted of the following steps: (1) development, revision, and validation of the online survey questionnaire, (2) pilot testing of the survey questionnaire, (3) dissemination and implementation of the survey questionnaire via email for two weeks, (4) data analysis.

2.4. Data Analysis

The Google form used in this study was utilized to tabulate the data obtained from this study from the two-week implementation were considered part of the study. Various statistical methods were used to analyze the data. Frequencies, percentages, mean and standard deviation were used to describe teachers' demographic profile, awareness, perceived need, readiness and willingness to implement an SSI-based approach in teaching Science. Moreover, non-parametric tests such as Mann-Whitney U and Kruskal-Wallis H tests were used to draw inferences and to test the differences in teachers' demographic

profiles and perceived need and readiness. Version 23 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data collected from the participants.

3. Results and Findings

3.1 Teachers' Awareness of the SSI-Based Approach

To determine the science teachers' awareness of the SSI-based approach, they were asked the following questions: (1) Have they heard/known/read about the SSI-based approach in teaching Science aside from this survey? and (2) If you have heard/known/read about the SSI-based approach, from which source(s) of information is it?

Out of the 124 teachers asked if they have known/heard/read about the SSI-based approach in teaching Science aside from this survey, 76 (61%) answered "YES" while 48 (39%) answered "NO". The 76 teachers with previous knowledge about the SSI-based approach gathered information from different sources. Results showed that journal articles (f=45) and workshops and training (f=44) were the common sources. Other sources include colleagues (f=38), book/book chapters (f=25) and conference paper (f=24). Some teachers responded to others (f=12) which they specified to be social media applications, documentaries, google searches, and teacher's lectures.

In an open-ended question wherein teachers were asked if they think SSI should be incorporated into teaching Science, all the teachers acknowledged the need to include it. The common reasons they provided were (1) to provide awareness of various issues and their connection to Science and their social implications, (2) to make the learning of Science more contextualized and relevant, (3) to improve students' classroom interactions and their skills such as argumentation, critical-thinking, problem-solving, reasoning and decision making, (4) to give wider perspectives on how students can address issues and provide possible solutions. Moreover, 8% of the teachers added that although they had previously heard of the SSI-based approach, they had not implemented it in their classes. Meanwhile, 3% of the teachers realized that they unconsciously incorporated SSI in explaining various science topics in their class while answering the survey.

Branch of Science	Code	Frequency
Biology	Biodiversity	17
	Genetically modified organisms	17
	Cells	11
	Biotechnology	9
	Viruses	6
	Endangered Species	4
Chemistry	Chemical Reactions	15
	Acids and Bases	9
	Medicines and Vaccines	9
	Chemical Bonding	3
	Acid Rain	3
Environmental Science	Climate Change	21
	Global Warming	18
	Waste Management	15
	Disaster Readiness	12
	Pollution	7
Physics	Energy	24
	Electricity	18
	Nuclear Power Plant	15
	Newton's Laws of Motion	7

Table 2. Possible topics for SSI teaching

Teachers also provided potential science topics that can be introduced as SSI. The teachers' responses were grouped according to the different branches of Science. Table 2 shows the issues that can be presented as SSI as mentioned in frequencies by the teachers.

3.2. Teachers' Perceived Need and Readiness to Implement the SSI-Based Approach

In determining the science teachers' perceived need and readiness to use the SSI-based approach in teaching Science, mean (M) and standard deviation (SD) were used (Table 3 and 4). The obtained mean values were interpreted according to the corresponding interpretations Strongly Disagree for values 0.0-1.0=; Disagree for 1.1-2.0; Agree for 2.1-3.0; and Strongly Agree for 3.1-4.0 (Lapada, Miguel, Robledo & Alam, 2020).

Teachers strongly agreed that using SSI in science classes is necessary because it will increase students' interest in issues (M=3.64; SD=.769), promote students' awareness (M=3.66; SD=.774), promote students' critical thinking skills (M=3.63; SD=.781), promote students' understanding of science concepts (M=3.59; SD=.776) and improve students' judgment (M=3.65; SD=.735).

When it comes to readiness, teachers' responses were a mix of agreeing and disagreeing with several statements. Teachers agreed that if they use the SSI-based approach in teaching Science, they believe they can use various teaching and learning strategies (M=2.87; SD=.797) and use different technological tools (M=3.00; SD=.830). Meanwhile, teachers disagree that they have sufficient knowledge about it (M=1.94; SD=.834), they can choose appropriate SSI to teach Science concepts (M=1.56; SD=.830), they have sufficient knowledge about the teaching and learning theories related it (M=1.17; SD=.853), and they have sufficient knowledge necessary to effectively implement it (M=1.12; SD=.848).

	Mean	SD	Verbal Interpretation
Using SSI in science classes is necessary because it will			
1. increase students' interest in issues	3.64	.769	Strongly Agree
2. promote students' awareness	3.66	.774	Strongly Agree
3. promote students' critical thinking skills	3.63	.781	Strongly Agree
4. promote students' understanding of science concepts	3.59	.776	Strongly Agree
5. improve students' judgment	3.65	.735	Strongly Agree

Table 3. Perceived need to implement the SSI-based approach

	Mean	SD	Verbal Interpretation
If I use SSI-based approach, I believe I have/can			
1. sufficient knowledge about it	1.94	.834	Disagree
2. use various teaching and learning strategies	2.87	.797	Agree
3. choose appropriate SSI to teach Science concepts	1.56	.830	Disagree
4. use different technological tools	3.00	.830	Agree
5. sufficient knowledge about the teaching and learning theories related it	1.17	.853	Disagree
6. sufficient knowledge necessary to effectively implement it	1.12	.848	Disagree

Table 4. Readiness to use the SSI-based approach

3.3. Teachers' Willingness to Implement the SSI-Based Approach

Table 5 shows teachers' willingness to implement an SSI-based approach in their own teaching. Despite all the possible challenges, teachers were willing to be trained in an SSI training program (n=118, 95.2%), to adapt SSI-based teaching approach in their class (n=112, 98.4%), to adapt SSI materials in their class

(n=121, 97.6%), to develop and design their own SSI materials (n=108, 87.1%), and to be guided in conducting their own SSI-related research (n=115, 92.7%).

	Yes (%)	NO (%)
Despite all the possible challenges, I am willing to		
1. to be trained in an SSI training program	118 (95.2%)	6 (4.8%)
2. to adapt SSI-based teaching approach in my class	122 (98.4%)	2 (1.6%)
3. to adapt SSI materials in my class	121 (97.6%)	3 (2.4%)
4. to develop and design my own SSI materials	108 (87.1%)	16 (12.9%)
5. to be guided in conducting my own SSI-related research	115 (92.7%)	9 (7.3%)

Table 5. Willingness to use SSI-based approach (%=teachers mentioning)

3.4. Testing Differences Between Teachers' Demographic Profile and Teachers' Perceived Need and Readiness to Use The SSI-Based Approach in Teaching Science

In testing differences among the dependent variables, i.e., perceived need and readiness, inferential statistics was used. A normality test was conducted to determine the appropriate statistical tests to use. Normality tests showed that the data obtained from this study were not normally distributed and had unequal variances. Hence, in drawing inferences, the nonparametric test was used. As such for testing the difference between two independent variables, the Mann-Whitney U test was used while in testing the difference for three or more independent variables, the Kruskal Wallis test was used.

Tables 6 and 7 showed the difference between teachers' demographic profile and perceived need and readiness to use the SSI-based approach in teaching Science.

Category		Teachers' perceived need to use SSI-based approach
Mann-Whitney U Test		
Sex Male/Female	Mann-Whitney U	2564.000
	Z	-1.922
	Asymp. Sig. (2-tailed)	.035
School Type Public/Private	Mann-Whitney U	1810.500
	Z	-.606
	Asymp. Sig. (2-tailed)	.544
Kruskal-Wallis H Test		
Length of Teaching Experience	Chi-Square	0.632
	df	4
	Asymp. Sig. (2-tailed)	.959
Teachers' Specialization	Chi-Square	11.034
	df	3
	Asymp. Sig. (2-tailed)	0.004
Teachers' Educational Attainment	Chi-Square	1.412
	df	4
	Asymp. Sig. (2-tailed)	.842
Teachers' Level of Education Handled	Chi-Square	3.820
	df	2
	Asymp. Sig. (2-tailed)	.094

Table 6. Testing differences between teachers' demographic profile and perceived need

Mann-Whitney U test and Kruskal-Wallis H test were utilized to explore the difference between teachers' demographic profile and perceived need to use the SSI-based approach in teaching Science. A significant difference in the perceived need between male and female teachers (U=2564.000, ϱ=.035) while a non-significant difference in the perceived need between teachers in public and private school (U=1810.500, ϱ=.544) was revealed using the Mann-Whitney U test.

The Kruskal-Wallis H test was performed to explore which among the teachers' demographic profiles had a significant difference with perceived need. Among the teachers' demographic profiles, only their specialization ($\chi 2(3)=11.034$, ϱ=.004) with a mean rank score of 82.67 for Biology, 44.40 for Chemistry, 57.96 for General Science and 62.89 for Physics showed a significant difference with their perceived need to use the SSI-based approach in teaching Science. Meanwhile, a non-significant difference was found between perceived need and length of teaching experience ($\chi 2(4)=0.632$, ϱ=.959, educational attainment ($\chi 2(4)=4.486$, ϱ=.344) and level of education handled ($\chi 2(2)=3.820$, ϱ=.094).

Category		**Teachers' readiness to use the SSI-based approach**
Mann-Whitney U Test		
Sex Male/Female	Mann-Whitney U	1885.000
	Z	-.026
	Asymp. Sig. (2-tailed)	.480
School Type Public/Private	Mann-Whitney U	1795.500
	Z	-.601
	Asymp. Sig. (2-tailed)	.548
Kruskal-Wallis H Test		
Length of Teaching Experience	Chi-Square	.083
	df	4
	Asymp. Sig. (2-tailed)	.999
Teachers' Specialization	Chi-Square	10.454
	df	3
	Asymp. Sig. (2-tailed)	.008
Teachers' Educational Attainment	Chi-Square	4.486
	df	4
	Asymp. Sig. (2-tailed)	.344
Teachers' Level of Education Handled	Chi-Square	2.456
	df	2
	Asymp. Sig. (2-tailed)	.496

Table 7. Testing differences between teachers' demographic profile and readiness

Mann-Whitney U test and Kruskal-Wallis H test were performed to explore the difference between teachers' demographic profile and readiness to use the SSI-based approach in teaching science.

The Mann-Whitney U test showed both a non-significant difference in the readiness between male and female teachers (U=1885.000, ϱ=.480) and readiness between teachers in the public and private school (U=1795.500, ϱ=.548).

The Kruskal-Wallis H test was performed to explore which among the teachers' demographic profiles had a significant difference with readiness. Among the teachers' demographic profiles, only their specialization ($\chi 2(3)=10.454$, ϱ=.008) with a mean rank score of 86.07 for Biology, 54.85 for Chemistry, 65.54 for General Science and 56.30 for Physics. On the other hand, a non-significant difference was revealed between readiness and length of teaching experience ($\chi 2(4)=.632$, ϱ=.959), educational attainment ($\chi 2(4)=1.412$, ϱ=.842) and level of education handled ($\chi 2(2)= 2.456$, ϱ=.496).

4. Discussion

This study aimed to examine the perceptions of Filipino teachers towards implementing the SSI-based approach in teaching science and how such perceptions differ according to their demographic profile. Their perceptions were examined in terms of awareness, need, readiness and willingness. Quantitative survey research was employed where data was gathered using an online validated questionnaire.

More than half of the Filipino teachers were aware of the SSI-based approach in teaching science and journal articles were their common sources of information. Although teachers had previously heard of the approach, some had not actually implemented it in their class and some realized that they unconsciously implemented it. In research conducted by Yilmaz (2012), 76% of the teachers were aware and believed that SSIs should be implemented in biology classrooms. The same result was concluded in the study of Sibic and Topcu (2020) where more than 50% of the participants were aware of the SSIs before they conducted their investigation. In contrast, some studies revealed that the number of teachers who had never read or heard about SSI-based teaching exceeded those who had previous knowledge about it (Öztürk & Erabdan, 2019; Eilks et al., 2020). Meanwhile, Sadler, Amirshokoohi, Kazempour and Allspaw (2006) mentioned that for effective SSI teaching to happen in classrooms, it is necessary that science teachers are not just aware of it but also know what SSI is and how it contributes to the aims of science education.

Teachers strongly agree that there is a need to use SSI in science classes for several reasons. It increases students' interest in issues, promotes awareness, and improves judgment. Participants in the study conducted by Subiantoro (2017) realized after participating in an SSI professional development program that teaching and learning processes in science should include the use of SSIs. While several researchers explained the premise that SSI could be a useful approach to science learning, designing and delivering SSI-based education is a challenging endeavor by its nature (Sadler, 2011). For this reason, SSI curriculum unit design in teacher professional development programs must be considered (Zeidler & Kahn, 2014).

When it comes to readiness, the result of this revealed that teachers disagreed with the statements that they have sufficient knowledge about SSI-based teaching, they can choose appropriate SSI to teach science concepts, they have sufficient knowledge about the teaching and learning theories related it and they have adequate knowledge necessary to implement it effectively. While the researchers were not able to ask why teachers disagreed with these statements, there were results of past investigations that can be considered. In the study of Levinson and Turner (2001), they found that teachers did not want to use SSI in their class because they lacked pedagogical and content knowledge and limited understanding of the SSI framework. Pedretti, Bencze, Hewitt, Romkey and Jivraj (2007) mentioned that a lot of teachers were found to be optismistic in teaching controversial issues related to science but they lack confidence in their ability to engage students in argumentation. Hancock, Friedrichsen, Kinslow and Sadler (2019) enumerated numerous constraints for successful SSI teaching, including time constraints for planning and classroom execution, lack of SSI-related materials, and limited support from administrators and the community. For these reasons, Sadler (2011) and Mamlok-Naaman, Eilks, Bodner and Hofstein (2018) suggested that teachers should be given enough resources and support to implement SSI-based learning successfully.

Despite teachers disagreeing with statements about their readiness, they showed a willingness to be trained in an SSI training program, adapt SSI-based teaching in their class, develop and design their own SSI materials and conduct SSI-related research. This agrees with a few case studies that revealed some exemplary science teachers who participated in addressing SSIs in a teacher development program out of their own initiative (Lee et al., 2006; Friedrichsen & Barnett, 2018). Numerous cases were also documented wherein teachers successfully utilized SSI-based teaching regardless of the predicaments (Lee & Witz, 2009; Saunders & Rennie 2013; Simon & Amos 2011). Yilmaz (2012) added that biology teachers believed that they should learn about SSI and participate in training programs that would help them teach SSI in science classrooms. Sibic and Topcu (2020) concluded that offering courses in universities and teaching opportunities should be considered to practice the SSI-based approach.

Mann-Whitney U and Kruskal-Wallis H tests were performed to explore the difference between teachers' demographic profile and perceived need and readiness to use the SSI-based approach in teaching science. Among the demographic profile of the teachers, only their gender and specialization had significant differences with their perceived need, while only teachers' specialization was found to have significant differences with readiness. This study showed that female teachers had a higher perceived need to implement an SSI-based approach than male teachers. This is in agreement with several studies that concluded that female teachers generally possess positive perceptions and views of socio-scientific issues (Butler, Parker, Rennie & Riley, 1993; Hughes, 2000; Stolz, Witteck, Marks & Eilks, 2013). On the other hand, Yilmaz (2012) revealed that differences concerning gender were not significant in perceptions and implementations of SSIs.

5. Conclusion

More than half of the participants of this study were aware of the SSI-based approach and journal articles were their common source of information. Although some of them had previous knowledge about it, they had not implemented it in their class. The teacher mentioned several topics that can be introduced as SSIs, such as climate change, global warming, energy, electricity, biodiversity, chemical reactions, etc. Despite having insufficient information about the SSI-based approach, teachers believed that there is a need to implement it in science classrooms. Given that they strongly agreed that SSI is a promising approach, they were willing to participate in an SSI training program, make their own SSI-related materials and conduct research. Teachers' demographic profile such as gender and specialization significantly differed from their perceived need and readiness to implement the SSI-based approach in teaching science. In contrast, teachers' school type, length of teaching experience, educational attainment and level of education handled had no significant difference in their perceived need and readiness.

Results showed that teachers held positive perceptions in terms of their awareness, need, readiness, and willingness to implement the SSI-based approach in teaching science. Several studies mentioned in this paper revealed that SSIs effectively improve students' learning outcomes. However, it is important that teachers who implement this must have adequate knowledge of the SSI-based framework and how it contributes to the aims of science education. Different teacher-related studies on the implementation of SSI enumerated constraints in implementing it. Therefore, it is recommended that the school and the community give teachers enough resources and thorough support. In addition, for teachers to overcome obstacles and predicaments with this approach, science education should invest and commit to continuous professional development and training programs/opportunities concerning its implementation in science classes.

Acknowledgment

The authors would like to acknowledge the Natividad Galang-Fajardo Foundation and the Department of Science and Technology – Science Education Institute (DOST-SEI) for their support of this research through Capacity Building Program in Science and Mathematics (CBPSME). Also, they extend their most profound gratitude to the experts who validated the survey questionnaire and to the teachers who participated in this study. Their valuable assistance has helped the researchers succeed in this study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

Albe, V. (2008). Students' positions and considerations of scientific evidence about a controversial socioscientific issue. *Science and Education*, 17(8), 805-827. https://doi.org/10.1007/s11191-007-9086-6

Barrett, S.E., & Nieswandt, M. (2010). Teaching about ethics through socio-scientific issues in physics and chemistry: Teacher candidates' beliefs. *Journal of Research in Science Teaching*, 47(4), 380-401. https://doi.org/10.1002/tea.20343

Bigcas, B.R., Prudente, M., & Aguja, S., (2022). Improving Health Science Students' Performance in Nanotechnology Using Socio-Scientific Issues-based Module. In *13th International Conference on E-Education, E-Business, E-Management, and E-Learning (IC4E)*. Tokyo, Japan. https://doi.org/10.1145/3514262.3514265

Bossér, U., Lundin, M., Lindahl, M., & Linder, C. (2015). Challenges faced by teachers implementing socioscientific issues as core elements in their classroom practices. *European Journal of Science and Mathematics Education*, 3(2), 159-176. https://doi.org/10.30935/scimath/9429

Butler, K.J., Parker, L., Rennie, L., & Riley, D. (1993). Gender differences in science education: Building a model. *Educational Psychologist,* 28(4), 379-404. https://doi.org/10.1207/s15326985ep2804_6

Chung, Y., Yoo, J., Kim, S., Lee, H., & Zeidler, D. (2016). Enhancing students' communications skills in the science classroom through socioscientific issues. *International Journal of Science and Mathematics Education,* 14(1), 1-27. https://doi.org/10.1007/s10763-014-9557-6

Dawson, V., & Venville, G., (2013) Introducing high school Biology students to argumentation about socioscientific issues. *Canadian Journal of Science, Mathematics and Technology Education*, 13(4), 356-372. https://doi.org/10.1080/14926156.2013.845322

Eastwood, J.L., Sadler, T.D., Zeidler, D.L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing nature of science instruction in socio-scientific issues. *International Journal of Science Education,* 34(15), 2289-2315. https://doi.org/10.1080/09500693.2012.667582

Eilks, I., Nida, S., & Pratiwi, N. (2020). A case study on the use of contexts and socio-scientific issues-based science education by pre-service junior high school science teachers in Indonesia during their final year teaching internship. *Front. Educ.* 5, 1-8. https://doi.org/10.3389/feduc.2020.592870

Friedrichsen, P., & Barnett, E. (2018). Negotiating the meaning of next generation science standards in a secondary biology teacher professional learning community. *Journal of Research in Science Teaching,* 55(7), 999-1025. https://doi.org/10.1002/tea.21472

Gutierez, S.B. (2015). Integrating socio-scientific issues to enhance the bioethical decision-making skills of high school students. *International Education Studies,* 8(1), 142-151. https://doi.org/10.5539/ies.v8n1p142

Hancock, T., Friedrichsen, P., Kinslow, A., & Sadler, T. (2019). Selecting socio-scientific issues for teaching: A grounded theory study of how science teachers collaboratively design SSI-based curricula. *Science & Education*, 28(4), 639-667. https://doi.org/10.1007/s11191-019-00065-x

Hughes, G. (2000). Marginalization of socioscientific material in science–technology–society science curricula: Some implications for gender inclusivity and curriculum reform. *Journal of Research in Science Teaching,* 37(5), 426-440. https://doi.org/10.1002/(SICI)1098-2736(200005)37:5%3C426::AID-TEA3%3E3.0.CO;2-U

Lapada, A.A., Miguel, F.F., Robledo, D.R., & Alam, Z.F. (2020). Teachers' Covid-19 awareness, distance learning education experiences and perceptions towards institutional readiness and challenges. *International Journal of Learning, Teaching and Educational Research,* 19(6), 127-144. https://doi.org/10.26803/ijlter.19.6.8

Lee, H., Abd-El-Khalick, F., & Choi, K. (2006). Korean science teachers' perceptions of the introduction of socioscientific issues into the science curriculum. *Canadian Journal of Science, Mathematics and Technology Education*, 6(2), 97-117. https://doi.org/10.1080/14926150609556691

Lee, H., & Witz, K.G. (2009). Science teachers' inspiration for teaching socio-scientific issues: Disconnection with reform efforts. *International Journal of Science Education,* 31(7), 931-960. https://doi.org/10.1080/09500690801898903

Levinson, R. (2006). Towards a theoretical framework for teaching controversial socio-scientific issues. *International Journal of Science Education*, 28(10), 1201-1224. https://doi.org/10.1080/09500690600560753

Levinson, R., & Turner, S. (2001). *Valuable lessons: Engaging with the social context of science in schools*. London: The Wellcome Trust.

Mamlok-Naaman, R., Eilks, I., Bodner, G., & Hofstein, A. (2018). *Professional Development of Chemistry Teachers: Theory and Practice.* Croydon, UK: RSC Publishing.

Mandapat, C., & Prudente, M. (2018). *Use of socio-scientific issues-based module in teaching biodiversity.* Master's Thesis. De La Salle University, Manila, Philippines.

Marks, R., & Eilks, I. (2009). Promoting scientific literacy using a socio-critical and problem-oriented approach to chemistry teaching: Concept, examples, experiences. *International Journal of Environmental & Science Education*, 4(3), 231-245. Available at: https://www.ijese.net/makale/1396

Öztürk, N., & Erabdan H. (2019). The perception of science teachers on socio-scientific issues and teaching them. *International Online Journal of Education and Teaching*, 6(4), 960-982. Available at: http://iojet.org/index.php/IOJET/article/view/706

Owen, D., Zeidler, D., & Sadler, T. (2017). Controversial issues in the science classroom. *Phi Delta Kappan*, 99(4), 45-49. https://doi.org/10.1177/0031721717745544

Parchmann, I., Gräsel, C., Baer, A., Nentwig, P., Demuth, R., & Ralle, B. (2006). "Chemie im Kontext": A symbiotic implementation of a context-based teaching and learning approach. *International Journal of Science Education*, 28(9), 1041-1062. https://doi.org/10.1080/09500690600702512

Pedretti, E.G., Bencze, L., Hewitt, J., Romkey, L., & Jivraj, A. (2007). Promoting issues based STSE perspectives in science teacher education: Problems of identity and ideology. *Science & Education*, 17(8), 941-960. https://doi.org/10.1007/s11191-006-9060-8

Ponto, J. (2015). Understanding and evaluating survey research. *Journal of the Advanced Practitioner in Oncology*, 6(2), 168-171. https://doi.org/10.6004/JADPRO.2015.6.2.9

Roberts, D.A., & Bybee, R.W. (2014). Scientific literacy, science literacy, and science education. In Lederman, N.G., & Abell, S.K. (Eds.), *Handbook of research on science education* (2nd ed.) (545-558). New York: Routledge.

Sadler, T.D. (2004). Informal reasoning regarding socio-scientific issues: A critical review of research. *Journal of Research in Science Teaching,* 41(5), 513-536. https://doi.org/10.1002/tea.20009

Sadler, T.D. (2011). *Socio-scientific issues-based education: What we know about science education in the context of SSI.* In book: Socio-scientific Issues in the Classroom (355-369) https://doi.org/10.1007/978-94-007-1159-4_20

Sadler, T.D., Amirshokoohi, A., Kazempour, M., & Allspaw, K.M. (2006). Socioscience and ethics in science classrooms: Teacher perspectives and strategies. *Journal of Research in Science Teaching*, 43(4), 353-376. https://doi.org/10.1002/tea.20142

Saunders, K.J., & Rennie, L. (2013). A pedagogical model for ethical inquiry into socioscientific issues in science. *Research in Science Education*, 43(1), 1-22. https://doi.org/10.1007/s11165-011-9248-z

Sibic, O., & Topcu, M.S. (2020). Pre-service science teachers' views towards socio-scientific issues and socio-scientific issue-based instruction. *Journal of Education in Science, Environment and Health*, 6(4), 268-281. https://doi.org/10.21891/jeseh.749847

Simon, S., & Amos, R. (2011). Decision making and use of evidence in a socio-scientific problem on air quality. In Sadler, T.D. (Ed.), *Socio-scientific issues in the classroom* (39, 167-192). New York: Springer. https://doi.org/10.1007/978-94-007-1159-4_10

Stolz, M., Witteck, T., Marks, R., & Eilks, I. (2013). Reflecting socio-scientific issues for science education coming from the case of curriculum development on doping in chemistry education. *Eurasian Journal of Mathematics, Science and Technology Education*, 9(4), 361-370. https://doi.org/10.12973/eurasia.2014.947a

Subiantoro, A.W. (2017). P*romoting Socio-Scientific Issues-Based Learning in Biology: Indonesian Students' and Teacher's Perceptions and Students' Informal Reasoning.* Doctoral dissertation, Curtin University, Bentley, Australia.

Talens, J. (2016). Teaching with socio-scientific issues in Physical Science: Teacher and students' experiences. *International Journal of Evaluation and Research in Education.* 5(4), 271-283. https://doi.org/10.11591/ijere.v5i4.5954

Yilmaz, K. (2012) Pre-service biology teachers' perceptions on the instruction of socio-scientific issues in the curriculum. *European Journal of Teacher Education*, 35(1), 111-129, https://doi.org/10.1080/02619768.2011.633999

Zeidler, D.L. (2014). Socio-scientific issues as a curriculum emphasis: Theory, research and practice. In Abell, S.K., & Lederman, N.G. (Eds.), *Handbook of research on science education* (697-726). New York: Routledge.

Zeidler, D.L., & Nichols, B.H. (2009). Socio-scientific issues: Theory and practice. *Journal of Elementary Science Education*, 21(2), 49-58. https://doi.org/10.1007/BF03173684

Zeidler, D.L., & Kahn, S. (2014). *It's debatable!: Using socioscientific issues to develop scientific literacy K-12*. Arlington: NSTA Press.

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