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PRE-SERVICE CHEMISTRY TEACHERS' ATTITUDE OF SOCIO-SCIENTIFIC ISSUES AND CHARACTERS AS CITIZENS

L. Anwar[1], M. Alimin[2]*, J. Copriady[3], R.U. Rery[4], Syofni[5]

[1,3,4,5]Faculty of science and Teacher Training, Universitas Riau, Indonesia
[2]Science Education Department, Ewha Womans University, South Korea

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ABSTRACT

This study investigates the character, and value as a citizen and attitude of socio-scientific issues (SSI) among pre-service chemistry teachers in Riau, Indonesia. SSI learning was conducted in the classroom, and designed to cultivate the characteristics and attitudes of SSI. The integration of SSI with the learning process involved instruction that inquiry analyzing based on environmental issues. A total seventy-six of chemistry education majors participated in the study, including eleven male and sixty-five female students. Data were collected through a structured questionnaire that measured the participants' characteristics, civic value, and attitude of SSIs. The collected data were analyzed using SPSS 26 with, employing descriptive statistic and Mann-Whitney U analysis. The result revealed that male pre-service chemistry teacher group has a higher score in character, value as citizens, and attitude of SSI compared to their female counterparts. However, analysis showed no statistically significant difference (p>.05) between male and female pre-service chemistry teacher in the sub-factors of character and SSI attitudes. Despite the lack of significant gender differences, the findings suggest that the integration of SSI in chemistry education can enhance moral thinking and decision-making abilities and positive attitudes toward SSI. Teachers may consider both subject matter and instructional method when addressing these aspects in the classroom.

Keywords: attitude of SSI, character, chemistry education, SSI, teacher

INTRODUCTION

Various controversial issues related to science and technology has continually arisen, contentious to complex challenges at the intersection of science and societies and ill-structured are known as socio-scientific issues (SSI) (Zeidler, 2014). SSI represent issues without obvious solutions, presenting significant challenges to encounter these difficult topics in daily life (Sadler et al., 2016), such as the health risks, climate change and the detrimental effects of certain technologies (Cerulli et al.,2016; Zangori et al., 2017). Given the expanding importance of SSI, it is necessary to recognize that these issues often present challenges without clear solutions. There is an assertion that in science instruction, students should be provided with educational experiences that enable them to engage in responsible problem-solving and make logical judgments regarding scientific and social challenges that arise in numerous real-life situations. Therefore, an attitude toward the environment and character of a citizen who can put even a small action into practice is needed for cultivation. Socio-scientific issues in education are increasingly gaining attention to this necessity.

Based on these complexities, there is a consensus that science education must evolve to effectively address these multifaceted challenges. SSI education has been demonstrated to have a favorable impact on students' willingness to learn and

***Correspondence Address**
E-mail: nain_maza@yahoo.com

their attitudes towards science (Stuckey & Eilks, 2014) while also strengthening conceptual knowledge and increasing motivation to learn science (Sadler et al., 2016). Individuals who engage in SSI academic pursuits tend to perceive science as directly applicable to their lives (Martín-Páez et al., 2019) and often exhibit a heightened interest in acquiring scientific knowledge (Lederman et al., 2014). Studies have shown that SSI education can help students acquire positive attitudes (Topçu, 2010), a sense of responsibility (Hwang et al., 2023; Erna et al., 2023), moral reasoning (Fowler et al., 2009), character and value (Ko & Lee, 2017; Kim, Ko & Lee, 2020) and argumentation (Christensona & Rundgrenc, 2014). Students who engage with SSI can develop their ability to analyze and balance evidence, develop their decision making skills regarding controversial issues (Gresch et al., 2017).

However, restructuring science education to include SSIs can be difficult for teachers who must adapt to this evolving environment. Zeidler et al. (2011) emphasized the need for an 'in-depth restructuring' of science classes to effectively teach SSI. This requires a profound transformation, including shifts in students' beliefs about science, relationships with students and teachers, and classroom norms. Modern science classes require significant changes, and teachers face many challenges in addressing these (Nida et al., 2020). Teachers may encounter difficulties implementing SSI education, as it needs specific resources and the structuring of complex societal issues (Stolz et al., 2013). Despite these challenges, SSI-based classes are reported to be effective in fostering personality development through the enhancement of scientific communication skills and promoting collaboration (Hancock et al., 2019; Lee et al., 2013) and transforming science educational practice (Pitiporntapin et al., 2018). The growth of science, technology, and SSIs, which collectively address numbers of social and ethical challenges, does not have one correct answer in its nature, and has the characteristic of seeking the best solution by considering various perspectives on these unstructured issues.

To better understand the influence of SSI instruction, this study focuses on analyzing the character and value as citizens, as well as the attitude of SSI of pre-service chemistry teacher. Lee et al. (2013) categorized character and value into three dimensions: ecological worldview, social and moral compassion, and socio-scientific accountability. One of the components focuses on responsibility in addressing a socio-scientific issue (SSI), assessing how responsible citizens in resolving or causing issues. As a future teacher responsible for imparting chemistry knowledge, educating them on responsibility is essential, considering their dual role as educators and citizens. Furthermore, while previous research highlighted the potential SSI teaching to furnish the pre-service teacher for global challenges, but limited studies have explored how this approach shapes their character and value. Studies by Wahono et al., (2021) and Bozkurt et al., (2018) found that SSI based learning activities significantly impact students, equipping them to play pivotal role in preparing global world challenges. Additionally, the prospective of instructors on science, have a significant impact on their teaching practices and have personal interest into the teaching process (Hancock et al., 2019). However, limited research explores character and value in the context of SSI education. Topçu (2010) focusing on attitude of SSI cultivated into three element of SSI attitude (Anxiety about SSI, interest in and utility of SSI, and SSI likeability) one of the element addresses the degree of concern and apprehension regarding SSI. Encouraging a positive attitude toward SSI among pre-service chemistry teachers can help alleviate their apprehensions about teaching SSI.

In the context of science education in Indonesia, addressing the complexity of SSI is crucial for preparing future educators (Nida et al., 2021; Nida et al., 2020), particularly in the country's diverse cultural, environmental, and societal challenges. While the importance of SSIs in shaping responsible communities and fostering moral accountability is well recognized, there remains a gap in understanding how pre-service chemistry teachers perceive and approach these issues. Specifically, there is limited knowledge of how pre-service chemistry teachers' character, values, and attitude of SSI influence their readiness and effectiveness in addressing these challenge when they are in the classroom. The urgency of this challenge highlights the need for education systems that not only impart scientific knowledge but also foster responsible citizenship and moral accountability. The framework of character and values provided by Lee et al. (2013), and the attitude of SSI (Topçu, 2010) become pertinent framework in examine how pre-service chemistry teacher understand their role in addressing SSI in the class.

In light of this, the current study aims to assess the effectiveness of character and values of education within the context of science education were particular focus on the development of students' ethical reasoning abilities in the context

of SSIs. To investigate this, we conducted a seven-week experimental study with SSI intervention among the pre-service chemistry teacher in Riau. The primary objective was to assess the attitude of SSIs and development of character and value as citizens. Our exploration delved into the characteristics, value and attitude of SSI among pre-service chemistry teachers when confronted with SSIs, with a specific focus on gender differences. The guiding research questions are as follow, 1) what patterns emerge in the attitude of SSI and characteristic and value as citizens between genders? 2) Do the attitude of SSI and characteristic and value as citizens differ according to their genders?

METHODS

This study employed a quantitative method that allow numeric description of trends, attitude or opinions within a population by examining a sample of that population (Creswell, 2015) The population, which includes all of the individuals (components) that the research is concerned with, was basically the target that the researchers selected participant (Ary et al., 2014). The researchers kept the participant to a manageable size by considering several factors, including the statistical method used for data analysis, the study's framework or model, time constraints and the budget. At Riau University in Riau, Indonesia, seventy-six chemistry education majors took part in research, where eleven of them were male, and the other sixty-five were female. All respondent attended the subject of the class they had enrolled in. each participant received questionnaires, which they had 15–20 minutes to complete. All seventy-six students returned questionnaires. To address the research objectives, only questionnaires that were fully completed were examined.

This study employs a quantitative research approach. The SSI model was applied to students majoring in chemistry education to explore the efficacy of SSI based education. While the SSI model's effectiveness can be measured in various ways, this study focuses on changes in the pre-service chemistry teachers' perceptions of scientists. Although the teaching and learning of SSI has been discussed steadily (Friedrichsen et al., 2016; Sadler et al., 2017), there remains insufficient consensus on the character, value and attitude of SSI.

In the SSI based learning, we emphasized student initiated research experiences, encouraging students to generate their own ideas and select issues based on environmental and global concern. Additionally, students' analyses the textbook used in their chemistry instruction. This study is grounded in the SSI model proposed by Sadler et al. (2017) the SSI model, which follows several phases. Firstly the focal issue is introduced, raising awareness of social issues and potential effect of SSI. Next, students explore the relevant scientific concept in the textbook that related to issue and practice. Finally, the last phase involves activities that culminate the learning experience and motivate pre-service chemistry teachers to reflect on and integrate their insights.

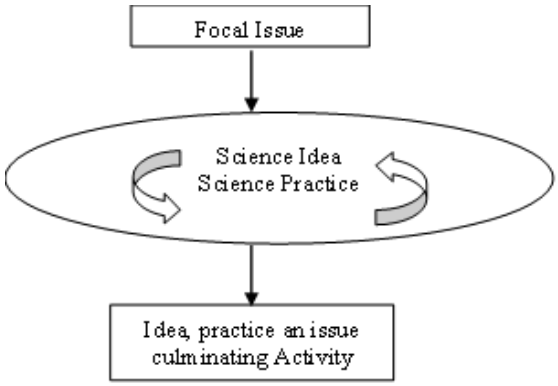

Figure 1. Instruction of SSI (Sadler et al., 2017)

We employed the character and values as global citizens' assessment (CVGCA), modified from Lee et al. (2013), and the attitude of SSI adapted from Topçu (2010), to explore the pre-service chemistry teachers' attitude and character of students based on SSI instruction. CVGCA consist of 20 items organized into three dimensions; while the attitude of SSI includes 12 items, also categorized into three dimensions (see Table 1). Both scale use a five-point Likert scale as follows (1) strongly disagree (2) disagree (3) neutral (4) agree (5) strongly agree. Original English version of CVGCA and attitude of SSI was translated into Indonesian. To ensure the clarity and accuracy, a science education lecturer proficient in both English and Indonesian reviewed and validated the translation. Gay and Airasian (2003) suggested conducting a questionnaire validity test. In this study, three experts involved confirmed that the instruments was appropriate for assessing variables.

CVGCA has reliability score of 0.805, while the attitude of SSI had reliability score 0.728. Overall, all reliability measures exceeded the minimum values of 0.7. Hair et al. (2010) suggested that a Cronbach's alpha value of 0.70 or higher is acceptable, indicating and reflecting that measuring items under component provide a reliable measure of internal consistency.

Table 1. Reliability of CVGCA and Attitude of SSI

Constructs	Sub Constructs	No of Items	Cronbach's Alpha	Total Cronbach's Alpha
Character and Values as Global Citizens' Assessment (CVGCA)	Ecological Worldview	3	.704	.805
		3		
	Social and moral compassion	2		
		2	.743	
		3		
	Socio Scientific accountability	3	.893	
		4		
Attitude of SSI	Interest and practicality of socio scientific issue.	5	.881	.728
	Liking of socio scientific issue	3	.714	
	Anxiety towards S socio scientific issue	4	.715	

Based on the groups of male and female participants, the participants assessed and responded to the character and values of SSI as global citizens. We performed descriptive statistics (means and standard deviation) using SPSS 26.0 software, based on male and female, to confirm to what extent the evaluation of character and values in the context of being global citizens and their attitude of socio scientific issues. To analyse the difference in character and values and attitude of SSI between female and male participants, we used a non–parametric Mann-Whitney U test.

RESULTS AND DISCUSSION

This study examines the attitude toward SSI and the character and value of pre-service chemistry teachers, as shaped by SSI learning activities. The findings related to the specific research questions addressed in this research are given below.

Table 2. Levels of CVGCA and attitude of SSI

Factors	Group	Pre-service teacher		U	*p*
		M	*SD*		
Interest and usefulness of SSI	Male	4.65	0.482	247.5	.093
	Female	4.39	0.491		
	Total	4.43	0.494		
Liking of SSI	Male	4.30	0.458	244.5	.085
	Female	4.02	0.478		
	Total	4.06	0.482		
Anxiety towards SSI	Male	3.29	0.621	305.0	.434
	Female	3.13	0.684		
	Total	3.15	0.674		
Attitude of SSI	Male	4.11	0.401	253.0	.121
	Female	3.88	0.391		
	Total	3.91	0.398		
Ecological worldview	Male	4.25	0.443	276.0	.217
	Female	4.03	0.381		
	Total	4.07	0.395		

Factors	Group	Pre-service teacher		U	*p*
		M	*SD*		
Social and moral compassion	Male	4.31	0.529	291.0	.311
	Female	4.07	0.336		
	Total	4.10	0.375		
Socio-scientific accountability	Male	4.32	0.394	241.5	.083
	Female	4.03	0.552		
	Total	4.08	0.539		
CVGCA	Male	4.30	0.418	252.0	.118
	Female	4.05	0.273		
	Total	4.09	0.308		

The descriptive analysis of CVGCA and attitude of SSI, as presented in tables 2, compares pre-service chemistry teachers according to gender, the results indicated that the male pre-service chemistry teacher scored higher on average compared to female students across all sub factors of SSI attitude. Notably, among the three sub-dimensions measured by attitude of SSI, students who were male and female groups scored higher in the two categories of like and interest in SSI as well as its usefulness. Additionally, a gender-based examination of Character and Values as Global Citizens Assessment (CVGCA) revealed that both the male and female groups scored higher in three variables: ecological perspective, Emotional and ethical empathy and Socio-scientific responsibility.

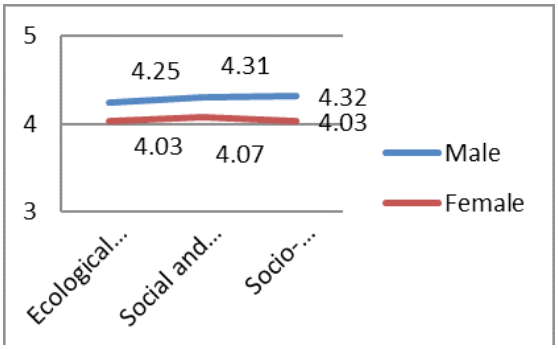

Figure 2. Mean of CVGCA

According to Mann-Whitney U test analysis, the statistical results presented character and values in the context of global citizens and attitude of SSI was statistically no significant difference between female and male participants. First, as shown in table 2, the mean scored for attitudes of SSI have different perspectives among female group and male group after participating in SSI learning, particularly across the three sub constructs, (1) the interest and usefulness of SSI, (2) the liking of SSI, (3) anxiety towards SSI. However, the overall mean scores toward attitude of SSI revealed no statistically significant differences between the groups (U= 247.5, p>.05). Similarly, the result regarding the CVGCA were comparable to those for attitude of SSI, with no significant difference between the perspectives of male and female group (u= 252.0, p> .05).

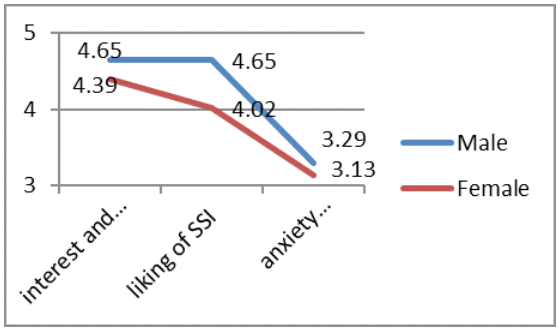

Figure 3. Mean of Attitude SSI

The groups consisting of male and female had the greatest mean scores on the SSI's utility and interest compared to its attitude. The male group unanimously agreed on prioritizing SSI as a means of enhancing their cognitive abilities (M=4.73). The score patterns between the female groups and the male groups' items were very comparable, with scores ranging from 4.28 to 4.54. Both groups firmly belief that the significance and benefit of SSI should lie in their comprehensibility.

The term "liking of science" refers the enjoyment one derives from scientific-related pursuits. It implies that students ought to be aware of how their actions impact the environment and whether they contribute to sustainable development. According to table 4, three element items support the liking of SSI with male groups outperformed female groups in terms of scores. Inte-

Table 3. Descriptive analysis of interest and usefulness of SSI based on gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Interest and usefulness of SSI	I would like to know more specifics regarding SSI because it impacts daily life	4.64	0.505	4.43	0.499
	My ability to think is improved when I debate SSI.	4.73	0.467	4.34	0.668
	SSI gives me the chance to gain a thorough understanding of science.	4.64	0.505	4.28	0.761
	I am curious about how SSI affects society.	4.64	0.505	4.40	0.581
	SSI has to be highlighted more in the media.	4.64	0.505	4.54	0.502

restingly, female students' scores lower in item, "I greatly like SSI to scientific problems" (M=3.83). It suggests that they felt strongly about the need to protect the environment through action. However, there may be some debate on SSI rather than scientific issues. In contrast, the male group mostly agreed with all items related to the liking of SSI, with averages ranging from 4.09 to 4.45..

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Table 4. Descriptive analysis of liking of SSI based on Gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Liking of SSI	It's fun to do research about SSI.	4.36	0.674	4.06	0.609
	I greatly prefer SSI to traditional scientific problems.	4.09	0.539	3.83	0.601
	I enjoy using my SSI knowledge to understand the behaviors occurring around me.	4.45	0.522	4.17	0.601

Anxiety towards SSI (Table 5) indicates that feelings of worry and concern related to SSI, where students should be aware of how science and technology impact society. As shown in table 5, four items represent anxiety towards SSI and mean item scores for groups differed significantly. Both male and female groups were less likely to agree that advances in socio-scientific issues have more negative effects on society than positive ones (male M=2.55; female M= 2.63). However, the male group's mean scores varied between 2.55 and 3.82, while the female group's mean ranged from 2.63 to 3.51, indicating some variations in the responses

Table 5. Descriptive analysis of anxiety towards SSI based on gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Anxiety towards socio-scientific issues	I oppose the application of SSI in relation to religion.	3.09	0.701	3.11	0.937
	I'm concerned about developments in socio-scientific research from moral and ethical viewpoints,	3.82	0.751	3.28	0.839
	In my opinion, the implementations of SSI are misused for harmful purposes.	3.73	1.104	3.51	0.937
	Innovations in socio-scientific issues hurt society more than they benefit it.	2.55	0.934	2.63	0.894

The first factor on CVGCA is the ecological worldview (see table 6), which emphasizes interconnectedness and sustainable development. It implies that students, who are also citizens, should be aware of whether their actions are contributing environmental deterioration or advancing enduring growth. According to table 6, in an ecological worldview, there are six items. The high scores, with a mean of 4.45 for male, were observed in the item that stating "It is conceivable, in my opinion, to pursue development that benefits both nature and humans." For the female group, the highest score was recorded in item stating "If people try to control and alter nature (or life) for their own benefit, terrible things could happen (M= 4.20). Pre service chemistry teacher in both female and male group obtained low mean scores in item, "I think that advances in science and technology, such as genetic modification, have the potential to upset the natural order" (M = 4.00 male; M= 3.71 female).

Table 6. Descriptive analysis of the Ecological Worldview based on gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Interconnectedness	I would like to know more specifics regarding SSI because it impacts daily life	4.64	0.505	4.43	0.499
	I believe that advances in science and technology, such as genetic modification, have the potential to disrupt the natural order.	4.00	0.775	3.71	0.744
	I believe that, one day, the effects of genetic manipulation by humans on the environment will reverse.	4.27	0.647	4.05	0.598
Sustainable Development	The manipulation and alteration of nature (or life) by humans for personal gain could have disastrous consequences.	4.36	0.674	4.20	0.617
	In my opinion, genetic modification technology must be used responsibly to avoid interfering with the natural world (ecosystem).	4.27	0.647	4.14	0.556
	It is conceivable, in my opinion, to pursue development that benefits both nature and humans.	4.45	0.522	4.12	0.600

The second factor on CVGCA is the social and moral compassion (see table 7) which emphasizes moral and ethical sensitivity and Empathetic concerns. There are seven items in Social and moral compassion. The mean scores for the female group were lower than those for the male group. The male group's mean scores varied from 4.09 to 4.55. It suggests that the group of male agreed more when it came to the idea that people should be morally upright and have integrity in order to believe in social concerns. However, in the group of female, their view on social and moral were likely higher to accept It suggests that the group of men agreed more when it came to the idea that people should be morally upright and have integrity in order to believe in social concerns (M=4.32).

Table 7. Descriptive analysis of the Ecological Worldview based on gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Moral and ethical sensitivity	I believe that social issues such as the safety of GMO food, the cloning of embryos and dignity of human life, arising from development in life, science can lead to ethical dilemmas.	4.36	0.674	4.06	0.496
	I am able to foresee the potential social, moral, and ethical effects of advances in life science.	4.09	0.944	3.83	0.601
	I make an effort to consider various viewpoints and opinions when determining my stance on social issues such as stability of GMO food, embryo cloning and dignity of human life, caused by development in life science.	4.36	0.505	4.08	0.510

Factors	Items	Male		Female	
		M	S.D	M	S.D
Empathetic concerns	Before criticizing differing viewpoints on social issues, I make an effort to empathize with others and consider their perspective such as stability of GMO food, embryo cloning and dignity of human life that caused by development in life science.	4.18	0.405	4.15	0.441
	I feel compassion for people who are unable to benefit from advancements in life science while suffering (for example, from starvation or terminal illnesses).	4.55	0.522	4.32	0.471
	Seeing those who sufferings (e.g from starvation or terminal illnesses) without taking use of life, science advancements, I feel as though I am witnessing it myself.	4.36	0.674	3.91	0.897
	Without taking advantage of the advancements in life, science technologies, I think we must tend to people who are suffering (for example, from starvation or terminal illnesses).	4.27	0.647	4.15	0.565

The final factor on CVGCA (see table 8) is Socio-scientific accountability, which refers to how students feel responsible for SSI and how their willingness to act in daily life. This factor contains seven items. In both groups, there were differences in the mean scores across these items. The lowest mean scores for Item that stating "I believe cooperation and supports from members of community I live in are required to solve social issues related to life science (e.g. Stability of GMO food, embryo cloning and dignity of human life)." The mean score for this item was 4.00 for male, and 3.66 for female. While both groups believe that small action they take will be able to contribute to resolving social issues, they also argue that solving complex SSI related to life science necessitates cooperation and supports from members of the community.

Table 8. Descriptive analysis of Socio-scientific accountability based on Gender

Factors	Items	Male		Female	
		M	S.D	M	S.D
Feeling of responsibility	I believe that even a small action on my part will help to address social issues, surrounding genetic technology, such as the stability of genetically modified food, the cloning of embryos, and the value of human life.	4.64	0.505	4.32	0.615
	I sense accountability for contributing social issues that associated with genetic technology	4.27	0.647	3.88	0.910
	I am prepared to endure personal difficulty I may have to undergo in order to address the social challenges that I feel are produced by the development of genetic technology.	4.00	0.632	3.66	0.834
Willingness to act	I believe in order to resolve societal challenges pertaining to life science such as the stability of genetically modified food, embryonic cloning, and the dignity of human life, community members' involvement and support are necessary.	4.18	0.405	4.03	0.684
	I am of the belief that addressing social issues linked to life science, such as the stability of GMO food, embryo cloning, and the dignity of human life, requires global cooperation and support from diverse nations.	4.45	0.522	4.26	0.713
	I will strive to initiate community movements and engage in communicate with community members to address social issues related to life science.	4.36	0.505	4.03	0.585

Factors	Items	Male		Female	
		M	S.D	M	S.D
	I am committed to actively participating in supporting inter-country cooperation and international conventions aimed at resolving social issues related to life science.	4.36	0.505	4.09	0.579

The objective of this study is to clarify pre-chemistry teacher character and value as citizens and attitude of SSI, firstly we underlying premise that character and values constitute one of the most crucial attributes that in this 21st century global citizens should possess. We believed that socio-scientific issues instruction could serve as an effective pedagogical approach for nurturing these qualities. To structure our investigation, we adopted the outline of the conceptual framework for value and character (Lee et al., 2013). This encompasses aspect like an ecological worldview, social and moral compassion, and socio-scientific accountability. Subsequently, we implemented an SSI learning tailored for the pre-chemistry teacher, aiming to assess the extent of the character and values essential for global citizenship within educational context. Moreover the attitude of SSI were examined under tree factors included liking of SSI, interest and usefulness of SSI and anxiety toward SSI. This multifaceted examination allowed thorough understanding of perspective on SSI and encompassing their potential concerns or uncertainty they might hold.

The first finding of this study showed that male group has higher score in the attitude of SSI after getting SSI intervention, were observed that in the interest and usefulness of SSI, liking SSI and anxiety of SSI that male have the highest score in that three dimension than female, even though there is no significant difference between both group male and female on examining the attitude of SSI, Yerdelem et al., (2018) found that pre-service teacher who were involved in the study have the same resulted based on that three dimensions were the participant after the intervention of SSI have increased their attitude perception. Moreover, developing and using multiple models equip with the appropriate knowledge and skills needed to deal with complex issues (Ke et al., 2021) In this study, we point it that pre-service chemistry teacher overall that they have a good perception of the liking SSI and interest and usefulness of SSI it is indicated that after they joined the SSI class they have positive perception in the attitude even in the anxiety toward SSI, they have more less positive perception. In some previous studies (Ke et al., 2020; Ottander & Ekborg, 2012) found that after the SSI-based teaching and learning, students acknowledge that they found SSI learning interesting and have a positive effect on their attitude toward SSI. In order to acknowledge the SSI, Topçu (2015) suggest that teacher have to possess a robust command of subject matter, be aware of societal implication with SSI, skills and facilitated students' learning activities, A study by Lee and Yang (2019) suggested in learning activities involving SSI such as debate or discussion, it's important for teachers to provide a space to student in their discussion session to help mitigate negative emotions (Tomas et al., 2016). Teachers have responsible for educating their student as scientific literacy and taking benefit of SSI as vital role in scientific literacy (Kapici & Ilhan, 2016), SSI teaching could contributed to development of student understanding of the nature of science (Herman, 2018; Yacoubian & Khishfe, 2018). Moreover Topçu (2010) developing a favorable disposition towards SSI showing keen interest in these matters, actively engaging in reading and discussion and recognizing the SSI (Hancock et al., 2019), when it is handled appropriately, could be constructive impact on society.

The second finding of this study showed that both group male and female have high score in characteristic and value as citizen. Based on the three dimensions both male and female have positive view of character and value as citizens. The characteristics of pre-service teacher growth mindset appear when they believe that small action that they take will be able to contribute to resolving social issues in science and technology (Lee et al., 2013). Pre-service teacher also believe that social issues resulting from advancements in life science, ethical concern and conflict could manifest in diverse and creative ways. The attitude of pre-service teacher in experiencing mistakes and failures in life, they believe that the mistakes and failures they experience are a means to more care and have the attitude to learning more the socio scientific issue in their around. Choi et al. (2011) recognized character and values, specifically the necessity to act responsibly and exhibit compassion for others throughout the global scale, as a key aspect in fostering global citizenship. They underscored the significance of the remaining service learning for 21st century. Moreover, Kim, Ko & Lee (2020) through their implementation

of the SSI-COMM program, found that student have a positive change on the character, and value following the program's completion. Their result highlights the effectiveness after implementing the SSI-COMM program in fostering meaningful shifts in students' knowledge and information that enacted through interaction among various physical and human resources of community. A study by Siew & Rahman (2022) based on the implementation of SSI-FTM in teaching, found that students developed into critical thinker able to identifying future possibilities, discerning needs and informed decisions in the future. Additionally, the SSI-FTM intervention increase students' awareness of the importance of addressing need in all aspect of life.

In addressing the importance of active effort in promoting SSI learning (Gomey et al., 2019; Kilinc et al., 2014; Saka, 2023; Robles et al., 2021; Subiantoro et al., 2021), pre-service chemistry teacher believe that it can contribute to the development of their characteristics and values as responsible citizen. Additionally, most pre-service chemistry teacher believed that the critiques and recommendations received while researching SSI could enhance their understanding of SSI as well as their morality and worth as citizens. Cebesoy & Rundgren (2023) found that PTs have learned more science content and they understand that SSI teaching need to be use in their future science teaching, need for further support and resources (Lee, 2022; Monera et al., 2023). Balakrishnan et al., (2020) found that university students prioritize the development of ethical principles and professionalism conduct for their future careers. They also have the self-assurance to seek feedback and insights from others regarding the outcomes of their job in order to improve it.

CONCLUSION

The aim of this study was to examine the perspective of pre-service chemistry teacher regarding their character, values and attitude of SSI. The result indicates that science major alone is not necessarily a factor that could give a positive character, value as citizens and attitude of SSI perception toward SSI, there could a thing that caused the effect of positive attitude such as the nature of education, including the experiences in teaching and learning related to SSIs, it will be interestingly to see overall science teacher views about their perspective character, value as citizens and have an attitude toward socio scientific issue. In light of this, it is essential to provide SSI education to both practicing teacher and pre-service teacher to cultivate these important attribute (Topçu et al., 2014). Topçu (2010) the implication who have positive attitude toward SSI, the teacher could consider subject matter and choice the method of instruction. Moreover, we believe that character and values can improve students' moral thinking and decision-making abilities.

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