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Article

The Attitude of Chemistry Education Students to Socio-Scientific Issues (SSI) In Chemistry Learning

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ABSTRACT

The social-scientific problem (socio-scientific Issues) is a controversial social problem that has a link to the concept or procedural of science. Learning about socio-scientific issues can promote scientific literacy by linking science to everyday life and society. This study aimed to explore and analyze students' attitudes toward Socio-scientific Issues after being given basic chemistry using the SOIE Learning model (Strengthening, Orientation, Investigation and Evaluation) in SSI's context, and Conventional models. This research conducted during one semester of a basic chemistry course in the chemistry education department in Universitas Negeri Makassar, Indonesia, with sixty-eight chemistry students. We carried data collections out using survey questionnaires and semi-structured interviews. Data analyzed using SPSS's Independent t-test programs version 22 and tested with interview data. The results showed that there was a difference in attitudes towards significant socio-scientific issues between students taught using SSI's contextualized SOIE model and conventional models. More than 70% of students taught using SSI's contextualized SOIE model showed a more positive attitude toward SSI when compared to students taught with conventional models. The results showed that the SOIE learning model in SSI's context could be used to develop a student's attitude to socio-scientific issues in chemistry learning. Through the implementation of the SOIE learning model with SSI context, expected besides improving chemical literacy, students are also more concerned about environmental issues because of the impact of scientific-social phenomena.

INTRODUCTION

Compulsory courses must program by a chemistry student, one of which is the Basic Chemistry. The aim of the course is that students can understand the basic concepts of chemistry and its application in life. Besides mastery of cognitive aspects, affective aspects or attitudes are also crucial in achieving a learning objective. Many studies then researched more about the aspect of attitudes, especially attitudes towards science (Kristiani et al., 2015; Kayumova & Tippins, 2016; Hasanah et al., 2020). The definition of attitudes towards science, according to Osborne et al. (2004), the feelings, beliefs, and judgments about objects or findings of science. Also, the impact of science in society and the environment. Different from

the attitude towards science, a person's attitude that explicitly sees the impact of scientific findings or innovation in the environment and the community that known as attitudes towards issues or socio-scientific issues (Nida et al., 2020; Çalık & Karataş, 2019). Examining facts, phenomena, or occurrences in society that have a scientific connection is known as the socio-scientific method. Building learning around compelling issues, presenting problems first, offering scaffolding for advanced practice (such as argumentation, reasoning, and decision making), and giving students high-level experiences are all crucial components of socioscientific-based learning. Examining facts, phenomena, or occurrences in society that have a scientific connection is known as the socio-scientific method. Building learning around compelling issues, presenting problems first, offering scaffolding for advanced practice (such as argumentation, reasoning, and decision making), and giving students high-level experiences are all crucial components of socioscientific-based learning (Hayawati & Faizah, 2023). That students' scientific attitudes toward learning—such as curiosity, objectivity and honesty, critical resonance, cooperation and open-mindedness, and responsibility—are strengthened by the scientific method (Chheun & Kong, 2023).

The social-scientific problem (socio-scientific Issues) is a controversial social problem that has a link to the concept or procedural of science. Learning about socio-scientific issues can promote scientific literacy by linking science to everyday life and society (Sadler, 2009; Sadler et al., 2007). Social-scientific issues are an open issue with a sensible and clear answer. Answers or solutions can explain using valid scientific principles, theories, and data. The specific examples of SSI include global warming, air pollution by pollutant gases, greenhouse gas effects, acid rain, and the depletion of the ozone layer (Guarnieri & Balmes, 2014; Kabatas-Memis & Cevik, 2017). SSI's related research suggests that the context of SSI has many solution perspectives from a variety of areas, including science, technology, economics, politics, religion, and health so that they can debate it. The ability to criticize, discuss, and make informed decisions on socio-scientific issues is an essential characteristic of science literacy. Science literacy today has become the goal of science education in the world to prepare communities to face the rapid development of science and technology (Fives et al., 2014; Lederman, 2014; Yerdelen et al., 2018). Through SSI, besides enhancing the cognitive and intellectual capabilities of students can also exercise the development of emotional/affective and social aspects (Topcu, 2010). A summary of SSI's related literature (Sadler, 2009; Sadler et al., 2007; Sadler, 2011), concludes four main themes of SSI-related research: knowledge of science content, the concept of science (Nature of Science), skills of argument, and affective domain. The first three themes are closely related to intellectual or cognitive aspects, while the fourth theme is related to attitudes or affective aspects.

According to Bloom (1972), the affective domain is an educational objective that emphasizes interest, attitudes, and values in the Affective realm (Taber, 2015). Science Teachers using SSI to address problems in a learning process then argued the use of socio-scientific issues gave positive results to student's affective. Some researchers (Erman, 2022; Hewitt et al., 2019; Nida et al., 2020) reports that students are more interested in science after using SSI in learning. The attitude towards SSI is further researched by Topcu et al. (2010) which then explores the categories of attitudes that best affect SSI's decision making and student attitudes and find the four categories of primary attitudes that can measure (1) interest in SSI; (2) concerns about SSI; (3) fondness of SSI; and (4) SSI's usability.

Learning science involves more than just mastering concepts; it also involves applying those concepts to real-world situations (Al Mustafid et al., 2024). Interest in science refers to a feeling of great curiosity about science. Interest in SSI can define as a positive attitude towards the science associated with the scientific-social context (Topcu, 2010). The other interest in SSI related studies Sinatra (2012) found the relationship between the student's interest and SSI decision-making. For example, Sinatra (2012) found that students will take action to reduce the impact of climate change issues that show a positive attitude toward SSI. Concerns about SSI

are feelings of anxiety or worry about science. Topcu (2010) found that concerns about SSI are a category of attitudes that most influence student decision making on social issues related to science. For example, the response related to human cloning issues, most students worried about the rapid development of technology in gene engineering, and it associated with an essential moral value in society.

The fondness with science refers to the feeling of enjoyment of science learning experience. Hassan (2008) suggests that studies in laboratories and field studies have a positive influence on enhancing student's fondness for science. In this study, researchers not only explored learning experiences related to their fondness for science but also social life and experience outside of school. In this case, the fondness is more specific and relevant to social science issues in the Community (Topcu, 2010). SSI's usability refers to the student's feelings of values and beliefs in science applications that benefit them and society (Hassan, 2008). More specifically, this study looks at student views on how socio-scientific issues (SSI) are essential and useful to society and for themselves. One of the learning models researches later developed is the SOIE learning model with SSI context. We developed the SOIE learning model through the analysis of the strengths and weakness of learning models that commonly used to improve science literacy skills, but also the development of this model through a thorough study of the theory of learning. Then generates the syntax of the SOIE learning model. The SOIE learning model developed and designed to improve chemical literacy skills and student attitudes towards SSI.

The SOIE learning model with SSI context comprises of four phases: (1) Strengthening of prior knowledge, this phase aims to strengthen student's initial knowledge through question-answer methods and advance organizer to help students relate it to the new concepts and context of SSI. According to Piaget (1954), knowledge is not static, but it continues to evolve and change because learners face new experiences that force them to build and modify previous knowledge (Arends, 2012). (2) Orientation at SSI, this phase is adapting issues of contemporary social scientific issues (SSI) to students. Improve scientific literacy of student can do through a design of learning that includes discussions on social issues related to science and applications of science and technology in large or potential industries (Stohlmann et al., 2012; Fives et al., 2014). (3) The investigation, in this phase, students conduct investigations through a scientific method related to SSI's context and contribute ideas and arguments in discussion regarding SSI's issues associated with the chemical concepts. (4) Evaluation, in this phase, evaluated on the learning process. The evaluation gives in the form of feedback regarding the chemical concepts taught. The goal is to see the extent to which students understand the concepts.

Through the implementation of the SOIE learning model with SSI context, expected besides improving chemical literacy, students are also more concerned about environmental issues because of the impact of scientific-social phenomena. Therefore, researchers want to review student attitudes towards SSI by measuring four dimensions of SSI related attitudes. The study aims to test whether there are differences in attitudes towards SSI students who taught using SOIE learning model with SSI context, and conventional learning and further digging through in-depth interviews on dimensions of SSI attitude.

METHODS

This research is a quasi-experimental research with a post-test only control group design. The Data in this study collected from 68 students of the second semester 2018/2019 of the Chemistry Education Department, Faculty of Mathematics and Natural Science, Universitas Negeri Makassar, Indonesia comprising two classes. Both classes first tested for initial ability through tests, and its test scores analyzed through an independent t-test with SPSS to see if there was an average difference in their initial ability. From the test, a p-value of 0.11 indicates that both classes have no fundamental ability difference. Both classes then randomly selected

for the determination of the experimental class (34 students) and the control class (34 students). Experimental classes taught using SOIE model with SSI contexts. The control class taught using methods commonly used by lecturers (conventional models). Research design show in the following table.

Table 1. Research Desain

Class	Treatment	Post-test
Experiment	X	O
Control	-	O

(Adapted from Creswell, 2012)

Note:
O: Post-test
X: SOIE Learning model with SSI context

In the class of experimental treatment used of the SOIE model learning with SSI context, that aims to improve student attitudes related to social scientific issues (socio-scientific issues). The SOIE learning model developed through the analysis of learning models commonly used to improve science literacy skills, also the theory of learning. Then generates the syntax of the SOIE model. Details of SSI-based SOIE model stages show in the table below.

Table 2. Learning Activities through the SOIE Learning Model with SSI Context

Phase	Stage	Activity
Phase I: *Strengthening Prior Knowledge*	*Identification and reinforcement of prerequisite concepts*	Dig and recall the initial knowledge that students have related to new concepts through question-answer methods.
Phase II: *Orientation at SSI*	*Problem analysis*	Studying the context of SSI then create a list of variables that are problematic from the context of SSI to the resulting formulation of problems that focus the discussion.
	Planning investigation	Determine what data to look for in SSI's context. Then compile the investigation steps.
Phase III: *Investigation*	*Collecting Data*	Study references that are relevant to the context have acquired, classify some data, and interpret the data.
	Elaboration with SSI context (online)	Conduct open discussions online related to the progress of the investigation and clarify and confirm the results of the discussion.
	Communication	Students were presenting investigative results and discussion results in front of the class.
Phase IV: *Evaluation*	*Feedback*	Do a question-answer about the things that have discussed. Then conclude the important things of what has been discussed and addressed.

SSI's context raised in the study focused on global warming phenomena, and other scientific phenomena that accompany the phenomenon of global warming include (1) NO_x pollutant Gas at the atmosphere. In this context discussed exhaust gas such as NO_x gas. The chemical reaction of the gas in the atmosphere discussed, including its impact on the global warming phenomenon. Through this context, we expected students to analyze and criticize the causes, impacts, and provide solutions to minimize the impacts caused; (2) Greenhouse effect in Indonesia. In this context, discussing the cause of greenhouse effect, the gases belonging to the greenhouse gases such as CO_2, N_2O, CH_4, and CFC, further also discussed the source of greenhouse gases and the impact caused which eventually led to the phenomenon Global warming; (3) Ocean acidification. The context discusses one impacts caused by the phenomenon of global warming. Where gas-concentrated CO_2 pollutants are increasing in the air resulting in CO2 dissolved in the oceans, is also increasing. The absorption of CO_2 resulted in declining seawater pH that leads to changes in chemical compounds in the ocean, then continued on the destruction of ecosystems in the ocean.

Of the three contexts raised in the learning process, students expected to associate these three contexts, which ultimately lead to a global phenomenon of global warming. Students

expected to have more concern in the environment after understanding science concepts. Also, social phenomena that are occurring in the community. Before conducting the research, researchers first filed a written research permit to the Rector and Dean of the University research site. At the recommendation of the Rector and the Dean, researchers then contacted and met with the Head of Chemistry Department and a lecturer of basic chemistry courses to ask for a willingness to involved in the lecture process to implement the research.

The instrument for data collection uses a student attitude questionnaire on Socio-scientific Issues (SSI) with a Likert scale consisting of four dimensions: (1) interest in SSI; (2) anxiety over SSI; (3) fondness for SSI; and (4) SSI usability. We adapted the questionnaire from the instrument 'Attitudes Towards Socio-scientific Issues (ATSIS)' developed by (Topcu et al., 2010). Of these four dimensions, then developed into 36 numbers where 9 item statements represent each dimension. Two professors and four lecturers in the field of Chemical Education Department have tested the validity of the contents and the construct of the instruments made. We test the next step of the instrument to see item's validity and reliability. From the test carried out, obtained the validity percentage of the questionnaire instrument by 94%, the result indicates that the instrument is valid for further research. The instrument has the reliability of the Cronbach Alpha of 0.89, which is relatively high and reliable.

Besides the questionnaire, researchers used a semi-deep structured interview to explore the student attitudes towards SSI further. The interview is a semi-structured interview to gain qualitative data to deepen the understanding of quantitative data. Twelve students voluntarily took part in the interview. Six students came from the experimental class, while six other students came from the control class. Students interviewed intensely after completing the course. The interview comprises four parts. The first part of an interest in SSI is investigating the extent of student interest in the context of SSI (Socio-scientific issues). The second section on concerns about SSI is investigating the extent to which students concerned about the scientific phenomena occurring in nature and the impacts caused by the phenomenon. The third part of a fondness for SSI is investigating the extent to which students offered discussion in the context of SSI. The fourth section on the usability of SSI is to investigate how far students are aware of the benefits of SSI's context. Interviews recorded and transcribed for further analysis.

We conducted this study in 15 times meetings. Researchers act as lecturers and conduct learning to use the SOIE model with SSI context, which then conducts tests, collects data and analyzes the data obtained. The student attitude towards SSI questionnaire data was analyzed descriptively to determine whether the influence of the SOIE model with SSI context is related to SSI's student attitudes.

RESULTS AND DISCUSSION

The results of a poll that measures the attitude towards SSI then subsequently tabulated and analyzed manner descriptively to determine the percentage of student attitudes toward SSI. Results of a percentage of attitudes on classes using the SOIE model with SSI contexts (experimental Class) for the four dimensions of the measured attitude are an interest in SSI (76.5%); concerns about SSI (84.5%); fondness for SSI (73.7%); and the usability of SSI (80.1%). While the percentage of attitudes on the control class to use conventional methods (control classes) for the fourth dimension of attitude is: interest in SSI (53.3%); concerns about SSI (60.8%); fondness for SSI (59.7%); and SSI's usability (75.3%).

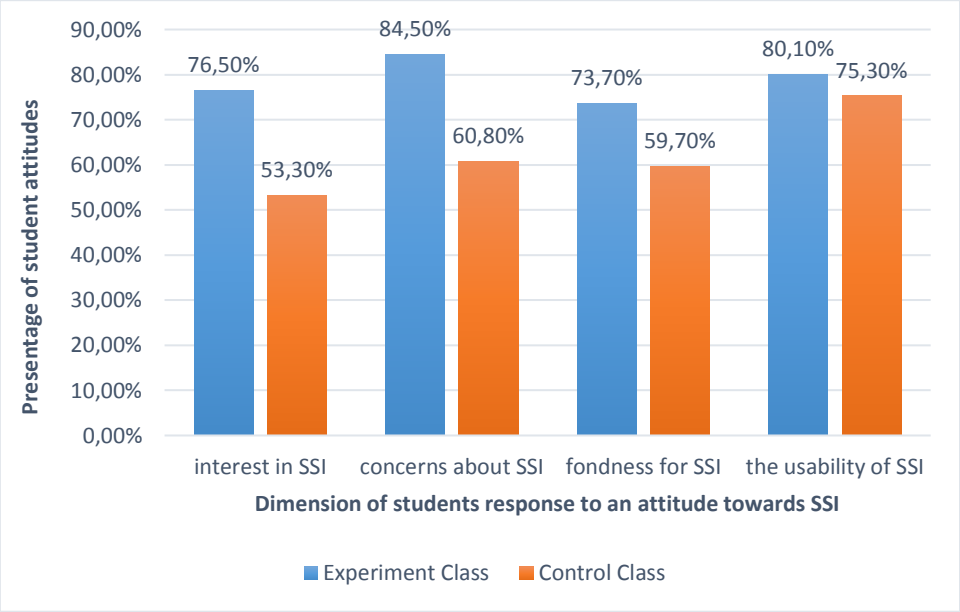

Figure 1. Percentage of Student Response to an Attitude towards SSI

Based on the percentage results and the above graph, there is a percentage difference for each attitude dimension in the experiment class and the control class. Students in experimental classes have an interest and preference for higher SSI. Besides, they have more concerns about the scientific phenomena that occur in nature, along with the impact caused by the phenomenon. Students in experimental classes mostly consider that by associating chemical concepts with the context of SSI are very useful for them. The significant influence of implementing the SOIE model to the student's attitudes, further analysis is conducted with the independent t-test, before we carry it out the prerequisite analysis test of data normality.

Stance data on SSI class experiments and control classes normally tested with the Kolmogorov-Smirnov test with a confidence level of 95% (α value = 0.05) using the SPSS program's version 22. The test result normality of the experimental class shows that the data has distributed normally (n = 34, p = 0200) and has a homogenous variance (n = 34, p = 0719). Similarly, the control class whose data has been distributed is normal (n = 34, p = 0189) and has a homogeneous variance (n = 34, p = 0719). Since the data has fulfilled the prerequisite test, it can follow by a hypothesized test using the independent t-test that also uses the SPSS version 22 programs, which will show in the following table 3.

Table 3. Independent T-Test Result Data of Student Attitude towards SSI

Class	**Model**	**Mean difference**	**Std. Error**	**Sig (2-tailed)**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Experiment	SOIE with SSI context	73.74	1.785	0.022	-7.739	-0.614
Control	Conventional	69.56	1.785	0.022	-7.740	-0.613

Based on table 3, the value of Sig (2-tailed) is 0.022, which is less than 0.05, can be concluded there is an average difference in student attitudes towards SSI between SOIE model with SSI context and conventional model. In cases where experimental investigations do not provide sufficient descriptions of data, researchers may use qualitative follow-up procedures to help understand the data further (Creswell, 2012). In this study, the type of qualitative data used to strengthen quantitative data was the student interview data from the experimental class and the control class. Interview Data is then collected and analyzed so that the description obtained for each dimension of attitude.

The SOIE (Strengthening, Orientation, Investigation, and Evaluation) approach with SSI (Socio-Scientific Issues) has a positive impact on the following four phases or dimensions due to its student-centered nature and the relevance of the topics raised. Here is the explanation.

1) Interest in SSIhis approach stimulates students' curiosity by presenting topics that are relevant to everyday life, such as environmental, health or social issues. Interest increases as students feel that the topic has a direct impact on their lives.
2) Anxiety about SSI: SOIE focuses on strengthening understanding and orientation, which helps reduce anxiety. Through systematic investigation and clear evaluation, students feel more prepared and confident in discussing or resolving complex issues. This lowers their level of anxiety towards SSI.
3) Enjoyment of SSI: Using the SOIE approach, students are actively involved in the investigation and evaluation of social and scientific issues. This creates an interesting and enjoyable learning experience, thus increasing students' liking for the topic.
4) Uses of SSI: This approach emphasizes practical connections between theory and real-world applications, so students better understand the usefulness of science in their lives. They more easily see the relevance of SSI and how the solutions or knowledge gained can be applied in real situations.

Overall, SOIE with SSI promotes relevant, immersive, and contextualized learning experiences, which increase motivation, reduce anxiety, foster liking, and clarify the benefits of the topic for students.

From some of the data presented above, it found that the positive attitude towards SSI students in the classes taught with the SOIE model with the SSI context is higher than that of classes to use conventional models. This is due to several factors. First, the learning steps in the SOIE model make students directly learn to understand the phenomenon of SSI through chemical concepts. The context of SSI focuses on how students understand a problem and make decisions regarding socio-scientific issues such as global warming, environmental pollution, etc (Rahayu, 2019).

Through the SOIE model in the context of SSI, students are actively discussing and arguing about issues regarding global warming. Some researchers suggest that the process of issuing an expression of thought in this discussion could help students to build their thoughts more carefully (Vonderwell, 2003), and also hone in on high-level learning skills such as analysis, synthesis, and evaluation (Newman et al., 1995). Second, SSI's raised context is relevant to the phenomenon occurring in student life, making chemistry learning more meaningful and more rewarding for students as it can change their way of viewing the environment and make them care more about the environment. Real-world contextual and tangible problems need to include in every chemical study to develop a variety of thinking skills and the development of the affective dimension (Rahayu, 2019). SSI's context provides students with a meaningful and relevant context for scientific learning. Socio-scientific issues such as global warming open up students' insight into the impacts and causes of other phenomena that accompany global warming phenomena such as the depletion of the ozone layer, the melting of polar ice, acidification of the ocean, and the greenhouse effect.

1) Interest in SSI

   The dimensions of interest-related attitudes towards SSI from Figure 1 appear to be 76.5% of students interested and keen to discuss the context of SSI in this context related to global warming. From the interviews known further that their interest, dominant because of the many prints and electronic media discussing the phenomenon of global warming that is the world's attention today. Experimental class students are very interested and curious about the phenomenon of socio-scientific issues (SSI), such as global warming because it is widely discussed on social media and is certainly attracting the world's attention at the moment. Apart from being able to master the concept, students also indirectly become more familiar with SSI phenomena such as global warming, its impacts, causes and solutions.

Experimental class students look for the cause or impact of this phenomenon but not in too much detail. Usually look for information on the internet on the IPCC website, BMKG, and on TV such as the National Geographic Channel. Meanwhile, control class students were less interested in discussions about global warming, even though many appeared on TV and the internet, this was because students were not interested in watching or reading articles about global warming. Meanwhile, control class students did not find out the causes or impacts of this phenomenon.

Achieving the aim of science literacy supported by the mass media that always spread the scientific discoveries and pros cons of innovations in Science (Howell & Brossard, 2021). Their interest has become more and more increasing because through the model of the context of the SOIE SSI lecturer then provides and facilitates further, so they are interested in seeking to know and explore further information related to global warming. Context-based learning has proven to have a positive impact on student interests (Bennett et al., 2007). In the control class, most students also have a high interest in SSI (69.56%), but lecturers do not facilitate the students' interest, from some students interviewed about interest in SSI gave a negative response. This is because the chemical learning process is less motivating students. Donnelly (2001) reveals the same thing that science learning lacks interest and motivation, but teachers restrict student ideas, and learning is dogmatic, and only give a little space for student creativity.

2) Concerns about SSI

The corresponding dimension of concern with SSI on the experimental class of Figure 1 shows that 84.5% of students concerned with the global warming phenomenon. From interviews, we know that their concerns triggered after seeing negative impacts in the environment resulting from science innovations products such as Air Conditioner (AC). There are some students who are very worried, and some are not worried at all about the rapid innovation and progress of science, for example Science and Technology Product Innovation. One of them is Air Conditioner or AC (Air Conditioner). Questions were asked to students from the experimental class and the control class. Students from the experimental class said I like studying chemistry related to natural phenomena because their knowledge becomes broader and they know the negative impacts of these phenomena. The benefits that students gain from studying chemistry are increasingly evident. Apart from that, the chemistry concepts studied will be useful and will enable me to remember them for a long time. Meanwhile, control class students do not like discussing or debating phenomena related to SSI because students do not really like differences of opinion. Both students from the control class and the experimental class experienced difficulties when carrying out investigations and discussions/debates regarding social science phenomena. Experimental class students have difficulty finding sources and scientific evidence because many articles and information are not based on facts. Meanwhile, the control class students were because they had never investigated the SSI phenomenon, so the control class students did not know whether there were difficulties in linking these two things.

In the beginning, researchers hoped that student worries could diminish after further understanding of SSI's related concerns. However, their worries become larger after know through discussion and debate why science products such as air conditioning can worsen the phenomenon of global warming. A study related to SSI's concern by Yerdelen et al. (2018) also found that there was an increased anxiety score against SSI from the prospective science teachers after learning by involving SSI's context. Students who do not have concerns about SSI's phenomenon are because of their incomprehension regarding global warming and other phenomena that trigger an increase in global warming.

3) Fondness for SSI

The dimension of preference for SSI from Figure 1 shows that 73.7% of students like learning by using the SSI context. From the interview, we know that students prefer to learn

chemistry by being attributed to the context of SSI more because of their curiosity regarding the phenomenon of global warming, they feel the knowledge becomes broader and more realized the importance of understanding a chemical concept to understand more detail of the phenomenon occurring around them. Students in the experimental class said they liked studying chemistry related to natural phenomena. Because my knowledge has become broader and I know the negative impacts of this phenomenon. The benefits I get from studying chemistry are becoming increasingly apparent. Apart from that, the chemistry concepts studied will be useful and enable students to remember them for a long time. Meanwhile, students from the control class do not like discussing or debating phenomena related to SSI because they do not really like differences of opinion.

When conducting investigations and discussions/debates regarding social science phenomena, students from the control class and the experimental class both experienced difficulties. Students from the experimental class have difficulty finding sources and scientific evidence because many articles and information are not based on facts. Students from the control class experienced difficulties because they had never investigated the SSI phenomenon, so they did not know whether there were difficulties in linking the two things. Some students dislike learning by involving SSI's context because they do not like discussions and debates involving students' differences of opinion. They prefer to learn the concepts and theories of chemistry without being associated with anything else.

4) SSI Usability

The dimension of the attitude related to SSI's usage of the chart shows that there are 80.1% of students stating that understanding SSI's context brings benefits to them. From the results of the interview, we know that the perceived benefit of most students from studying the chemistry associated with the context of SSI is that they become more concerned with the conditions surrounding the environment. The sense of concern encourages them to help to minimize the causes and impacts of the global warming phenomenon. Researchers asked questions to students from the experimental class and control class. Experimental class students find scientific and social phenomena useful, because students become more concerned about the environment and increasingly understand the causes and impacts of phenomena such as global warming. I care more about the environment to help minimize the impact of this phenomenon. Control class students said that scientific and social phenomena were not very useful because control class students assumed that it was more important to understand chemical concepts.

The study conducted by Cordero et al. (2008) provided consistent results, students showed a relatively high level of awareness about global warming, with 80% of them stating that the issue was an environmental problem Important and needed to get more attention. SSI's contextualized SOIE learning Model proved to make students accustomed to associating chemical concepts and understanding scientific information by associating a real-world context. The abundance of scientific information gained will make students understand how nature works and understand the nature of Science.

CONCLUSION

Based on a discussion of the results of the study, it can conclude that there is a significant difference in student attitudes toward SSI between students taught using SOIE model with SSI contexts and conventional models. Stages in the SOIE Learning model help students associate basic chemistry concepts with solving problems in the context of SSI. Criticizing and finding solutions to context problems make students understand how scientists work through scientific measures such as formulating problems, establishing hypotheses, setting investigative measures, analyzing data up to obtain a correct conclusion. More than 70% of the total number of students showed a positive attitude towards SSI. This indicates that the student is interested and likes to associate the context of SSI in understanding chemical concepts. Understanding

the social phenomena of science such as global warming makes students understand the dangers of CFC compounds for the ozone layer, the high concentration of CO_2 in the atmosphere that can threaten the lives of humans and Earth where humans live. Besides other definite highlights of understanding SSI's context, they are increasingly aware of the importance of safeguarding the Earth and its environment.

These results bring up some important things that could take up for further discussion. For example, further analysis compares the four-dimensional attitudes towards SSI with different levels of science literacy capabilities. Furthermore, studies related to SOIE models in the context of SSI can perform on different science materials with the selection of SSI context adapted to the science materials used.

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