Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang. Vol. 13(1) pp 1-12 ISSN:2339-0786
DOI: https://doi.org/10.26714/jps.13.1.2025.1-12

The Effectiveness of Inquiry-Based Learning in the Context of Socioscientific Issues (SSI) in Improve Students' Critical Thinking Skills And Global Citizen Character

Irma Setianingsih [a,1], Riva Ismawati [b,2*], Eko Juliyanto [c,3]

[a,b,c] Science Education, Tidar University, Magelang, 56116, Indonesia

[1]irmasetianingsih@students.untidar.ac.id; [2]rivaismawati@untidar.ac.id; [3]ekojuliyanto@untidar.ac.id
*corresponding author

Article history
Submission : 2024-09-06
Revised : 2024-10-14
Accepted : 2024-11-16

Keyword
Inquiry-Based Learning
Socioscientific Issues
Critical Thinking
Global Citizen Character

Abstract

This research aims to analyze the effectiveness of the SSI inquiry-based learning model in improving students' critical thinking skills and global citizen character. Critical thinking skills and global citizen character must be possessed to face problems that arise. Based on previous research, students' ability to think critically is still in the low category, and their knowledge of global citizenship is still lacking. This study was conducted to determine whether there was an increase in students' critical thinking skills and global citizen character after the SSI-based inquiry learning model was implemented. This research is quantitative with a quasi-experimental type and a non-equivalent control group design. Based on the results of data analysis on the T-test <0.001 for critical thinking skills and 0.04 for global citizen character, there is a significant difference. There was a significant increase in critical thinking skills based on the average pretest score of 58.625 and a posttest score of 75.81. Global citizen character also significantly increased based on the average pretest score of 85.31 and a posttest score of 90.093. These results are supported by the average results of the N-Gain test of the experimental class, which showed a significant increase in critical thinking skills of 0.416 with a moderate category and global citizen character of 0.339 with a moderate category. This research concludes that the SSI inquiry model effectively improves students' critical thinking skills and global citizen character.

1. INTRODUCTION

Meaningful science learning in the learning process is when students can answer and solve a problem they face. Science learning development in 21st-century skills needs to be considered in order to deal with problems that arise. Critical thinking is a process of searching, analyzing, collecting, and conceptualizing information with personal awareness to improve the ability to face a problem (Norrizqa, 2021). When someone is faced with a social problem, so that to solve problem,

critical thinking skills are needed in producing a decision. Students with critical thinking skills can filter, determine, and consider carefully when faced with information (Wahyudi et al., 2020). Several studies show that the ability to think critically is still relatively low. This is evidenced by research conducted by Irawan et al. (2017), namely in students of SMP N 1 Jaten class VII-A, which showed that the average results of critical thinking skills were still below 50%, namely 44.87%. Research by Maslakhatunni'mah et al. (2019) also shows that the critical thinking skills of students at MTs Al Hidayah Karanggupito class VII are still low, especially in the explanation indicator, so it needs to be improved and trained through a learning model that can train students' critical thinking skills indicators.

Global citizen character needs to be developed in the 21st century. Global citizens play an important role in technological progress and the rapid flow of globalization to make social changes (Sumaryati, 2016). Global citizen character includes citizens' responsibilities, attitudes, and competencies when faced with local or global problems (Murdiono, 2018). One of the important goals of science learning in schools is to prepare students to face events in everyday life, so students need to be prepared to become responsible citizens (Xiao, 2018). Through the global citizen character, students are trained to solve problems from various perspectives and analyze the decisions to be taken so that students are involved in the scientific process using their knowledge and science skills (Hsu & Lin, 2017).

Walangadi et al. (2020) explained that students' knowledge about global citizenship is still lacking. Students' global citizen character is still relatively low. The results of observations conducted by Jeramat et al. (2019) explained that students' attitudes and responsibilities towards the environment are still low. This is indicated by students who still throw garbage in inappropriate places without considering the impact that will occur. The global citizen character that is possessed will have a sense of responsibility and anticipate problems by making decisions based on their critical thinking skills. Critical thinking skills become a character of global citizens that will be a provision for students facing global problems and challenges in the future (Nurjanah, 2020). Through the global citizen character, students will be interested in the problems in their environment so that they can use their critical thinking skills to collect various information and conduct evaluations before making effective decisions. Students will also consider the impact of decisions and actions in solving problems. Critical thinking and students' global citizen character need to be prepared in science learning to solve problems and act responsibly in making mature decisions. SocioscientificSocioscientificSocioscientific Issues (SSI) is a context of issues or problems interconnected between scientific and social aspects. Learning with SSI can provide authentic experiences for students to face and overcome science-related global issues. Integrating social construction and practice with scientific concepts and processes is needed in investigating socioscientificsocioscientificsocioscientific issues (Putra, 2022). Research conducted by Lee et al. (2013) states that learning with SSI increases students' sensitivity to moral and ethical aspects, knowledge, and technology. Students are also more responsible for solving problems related to socioscientificsocioscientificsocioscientific issues. The SSI context is a blend of learning because it can impact people's lives. The inquiry learning model supports SSI. Implementing SSI in science learning makes it easier to achieve inquiry learning objectives (Shoba et al., 2023). The inquiry learning model is a learning model with activities to search and investigate logically, systematically, analytically, and critically.

2. METHOD

This research uses quantitative research with a quasi-experimental type. The research design used is a non-equivalent control group design. The application of this research is an initial test (pretest) and a final test (posttest). The class used in this research, namely the experimental class, was treated with the SSI-based inquiry learning model, and the discovery learning model was used for the control class. The population used was all class VII students of SMP N 1 Mungkid. The sampling technique was obtained using purposive sampling and is based on consideration in sampling: the same number of students and the same teacher. This is because the sample used can be homogeneous, and the teaching method has no significant difference. The sample used was students of classes VII B and VII C. The control class consisted of 32 students from class VII C, and the experimental class consisted of 32 students from class VII B, consisting of males and females. The

data collection technique used was through a questionnaire used for tests given before and after the implementation of the SSI-based inquiry learning model. The test instrument was used to measure critical thinking skills, and the questionnaire was used to measure students' global citizen character. The instrument was tested for validity with valid and reasonably valid results. Reliability testing was also conducted on the test instrument and questionnaire, which were 0.576 and 0.444, indicating that the instrument was reliable. The data obtained were analyzed using the independent t-test and the N-Gain test. N-Gain is used to measure whether there is an increase in the variable being tested or no increase.

3. RESULTS AND DISCUSSION

Result

Critical Thinking Skills

The results of the independent sample t-test on the initial critical thinking ability test scores in the treatment and control classes produced a value of 0.116 (Sig.>0.05). Hence, the test results stated that H0 was accepted. These results indicate that the initial test between the two classes showed no difference in their initial abilities. The results of the independent sample t-test on the final critical thinking ability test scores between the treatment class and the control class produced a significance value of <0.001 (Sig. <0.05), so the test results stated that H1 was accepted. These results can be interpreted to mean that in the final test, there was a significant difference in mean between the two classes, indicating that the initial abilities between the two classes were the same—results of calculating pretest-posttest scores in measuring students' critical thinking abilities before and after learning activities. The average results of the pretest and posttest scores for the experimental and control classes are presented in Table 1.

Table 1. Result of Average Pretest and Posttest Scores for Students' Critical Thinking Skills

Class	Pretest average	Standard Deviation	Posttest Average	Standard Deviation
Experiment	58.625	1.270	75.81	11.043
Control	55.56	13.048	61.6	11.234

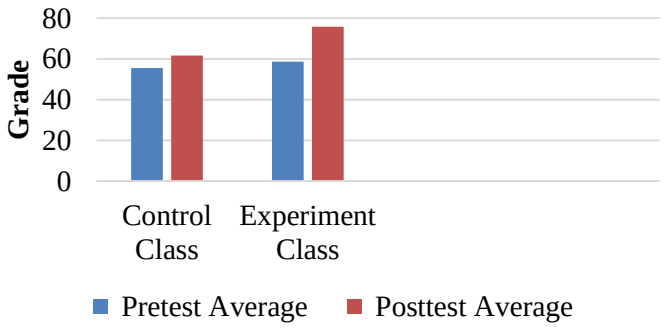

Figure 1. Average Pretest and Posttest Critical Thinking Skills

Table and Figure 1 show that the control class's average pre-post test scores were 55.56 and 61.6. Meanwhile, the average score for the experimental class in the initial test results was 58.625, and the average score for the final test was 75.81. These results indicate that there was an increase in both classes. There was a significant increase in the experimental class, so using the SSI-based inquiry model could improve students' critical thinking skills compared to the control class. The increase in students' critical thinking skills based on the results of the pre-final tests in the control and experimental classes can be seen through the average results of the N.Gain test. The results of the N-Gain mean score for students' critical thinking abilities can be seen in Table 2.Prior to doing hypothesis testing, two basic tests must be met: normality and homogeneity. The Kolmogorov-Smirnov Test was used to assess data distribution normality at a 5% significance level ($\alpha = 0.05$). The results of the normality test analysis are presented in Table 2.

Table 2. Average Result N-Gain of Students' Critical Thinking Skills

Class	N-Gain Average	Information
Experiment	0.339	Medium
Control	0.009	Low

The gain normality test (N-Gain) was conducted to determine how much the pretest and posttest results changed. The test was conducted to show whether or not there was an increase in students' critical thinking skills. The N-Gain test results have increased if they are in the high category with an N-Gain value > 0.7 and the medium category, 0.3 < g < 0.7. The average N-Gain results for students' critical thinking abilities were higher in the experimental class compared to the control class. The experimental class showed N-Gain results in the medium category of 0.416, and the control class showed the low category with a value of 0.111. Higher N-Gain results occurred in the experimental class compared to the control class, so critical thinking skills in the experimental class improved better than those in the control class. The results of the N-Gain values per indicator in the control and experimental classes can be seen in Table 3.

Table 3. N-Gain Results Indicator Students' Critical Thinking Skills

Indicator	Hasil N-Gain			
	Experiment Class	Category	Control Class	Category
Interpretation	0.447	Medium	0.028	Low
Analysis	0.247	Low	0.247	Low
Evaluation	0.661	Medium	0.218	Low
Inference	0.457	Medium	0.096	Low
Explanation	0.318	Medium	0.163	Low
Self-regulation	0.407	Medium	0.016	Low

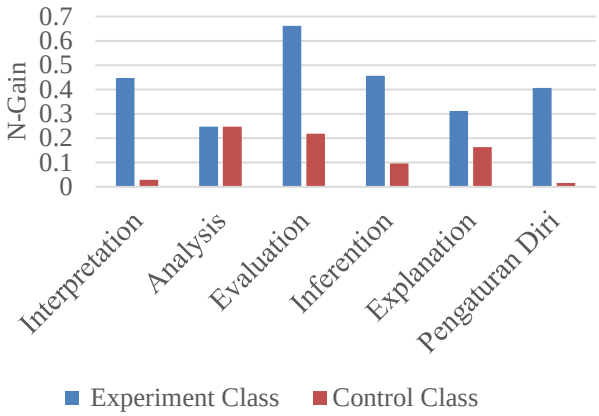

Figure 2. Comparison Chart of Average N-Gain for Each Critical Thinking Skills Indicator

The results of the N-Gain value per indicator in the experimental class show the medium category for interpretation, evaluation, inference, explanation, and self-regulation. In contrast, the analysis indicators show the low category (see Figure 2). Meanwhile, the N-Gain results per indicator of students' critical thinking abilities stated that they were in the low category for all indicators in the control class. These results showed a better improvement in the interpretation, evaluation, inference, explanation, and self-regulation indicators in the experimental class compared to the control class. Meanwhile, the analysis indicators do not show an increase.

Character Global Citizen

The results of the N-Gain value per indicator in the experimental class show the medium category for interpretation, evaluation, inference, explanation, and self-regulation. In contrast, the analysis indicators show the low category. Meanwhile, the N-Gain results per indicator of students' critical thinking abilities stated that they were in the low category for all indicators in the control

class. These results showed a better improvement in the interpretation, evaluation, inference, explanation, and self-regulation indicators in the experimental class compared to the control class. Meanwhile, the analysis indicators do not show an increase.

Table 4. Result in Average Score Pretest dan Posttest Students' Global Citizen Character

Class	Pretest Average	Standard Deviation	Posttest Average	Standard Deviation
Experiment	85.31	6.265	90.093	6.678
Control	84.47	6.021	85.78	4.598

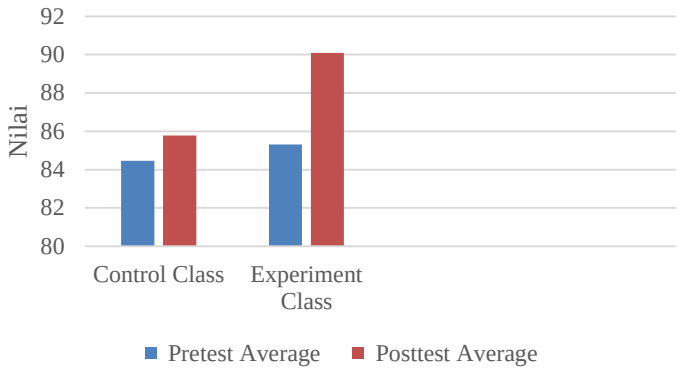

Figure 3. Average Pretest and Posttest Students' Global Citizen Character

Table 4 and Figure 3 show the mean pretest-posttest scores on the students' global citizen character questionnaire; in the control class, the pretest-posttest scores were 84.47 and 85.78. The average pretest-posttest scores for the experimental class were 85.31 and 90.093. The average value results indicate a significant increase in the experimental class compared to the control class. The increase in questionnaire results was analyzed using the N-Gain test based on the pretest-posttest results in both classes. The results of the average N-Gain value can be seen in Table 5.

Table 5. Result of Average N-Gain Students' Global Citizen Character

Class	N-Gain Average	Information
Experiment	0.339	Medium
Control	0.009	Low

The gain normality test (N-Gain) was conducted to determine how much the pretest and posttest results changed. The test was conducted to show whether or not there was an increase in students' global citizen character. The N-Gain test results have increased if they are in the high category with an N-Gain value > 0.7 and the medium category, $0.3 < g < 0.7$. The N-Gain results for the experimental class in the medium category were 0.339, different from the control class, which showed the low category, namely 0.009. The average N-Gain result of students' global citizen character is higher in the experimental class than in the control class, so it can be concluded that there has been an increase in global citizen character in the experimental class. The results of the N-Gain values per indicator in the treatment class and control class can be seen in Table 6.

Table 6. Result in N-Gain Indicator Students' Global Citizen Character

Indicator	Hasil N-Gain			
	Experiment Class	Category	Control Class	Category
Ecological Worldview	0.356	Medium	0.07	Low
Social and Moral Sensitivity	0.286	Low	0.09	Low
Sosioscientific Accountability	0.289	Low	0.08	Low

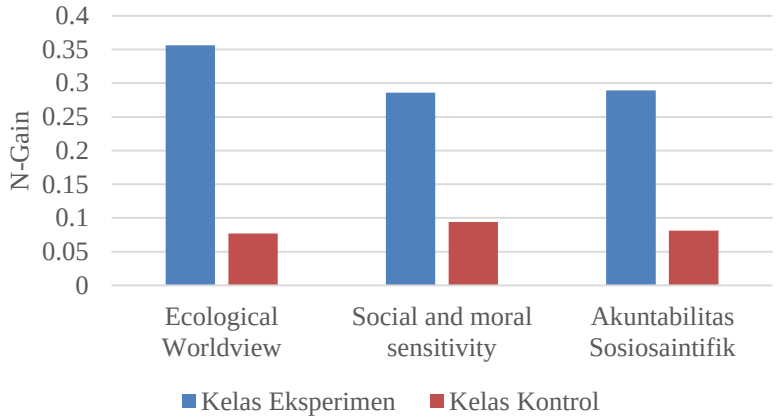

Figure 4. Comparison Chart of Average N-Gain for Each Global Citizen Character

The results of the N-Gain value per indicator in the experimental class show the medium category in the ecological worldview indicator. Indicators of social and moral sensitivity and socioscientificsocioscientificsocioscientific accountability show the low category (Figure 4). Meanwhile, the results of the N-Gain value per global citizen character indicator in the control class show a low category for all indicators. The N-Gain results per indicator show that the global citizen character indicator in the experimental class has increased compared to the control class. Indicators of the ecological worldview have improved the most.

Discussion

Students Critical Thinking Skills

The T-test results between the pretest scores of the control and treatment classes did not show any difference after being given the learning model treatment, which showed a difference in the T-test results. The difference in the T-test results showed that critical thinking abilities increased in the experimental class. This increase refers to the learning model implemented, namely the SSI-based inquiry model. Through inquiry activities, students' critical thinking skills are improved through investigation activities into the SSI context presented. Maharani et al. (2019) research supports the SSI-based inquiry model, which has a positive influence on increasing students' critical thinking abilities compared to the discovery learning model. The differences in the results of students' critical thinking abilities in the two classes are influenced by the use of the SSI learning model and context.

The average of the initial and final tests from the control class and experimental class, as shown in Figure 1, shows that there has been a significant increase in students' critical thinking abilities. The final test results of the experimental class were superior to those of the control class. These differences indicate that the SSI-based inquiry model can improve students' critical thinking abilities. This aligns with previous research by Mahanani et al. (2019) that the average student score is superior in classes where the inquiry learning model with the SSI context is applied.

The results of the N-Gain test support the average initial-final test scores, namely an increase in the experimental class scores in the medium category and the control class in the low category. The experimental class showed a significant increase, while the control class did not show a

significant increase. This is shown by the average N-Gain value of students in the experimental class, namely 0.416, and the control class, namely 0.019.

Students can learn to solve problems through investigative activities (Ramdhayani et al., 2023). The integration of SSI regarding problems in the material used in research supports inquiry learning, where students think about appropriate solutions to the problems that occur, not just solving the problem. The SSI-based inquiry learning model provides opportunities for students to investigate critically and conduct decision-making evaluations. Zeidler (2014) explains that SSI integration allows students in science learning to carry out analyses based on other people's points of view, focusing on critical reasoning, decision-making, and evaluating critically.

A comparison of the increase in students' critical thinking skills between the control class and the experimental class for each indicator is presented in Figure 2 below. A comparison of the average N-Gain on critical thinking ability indicators in Figure 2 shows that the experimental class's interpretation, evaluation, inference, explanation, and self-regulation indicators are higher than those for the control class. Using the SSI-based inquiry model can improve students' critical thinking skills with the learning syntax used.

The average N-Gain of the experimental class in the evaluation indicator is the highest indicator, namely 0.662 in the medium category. This indicator has experienced a significant increase because this evaluation indicator is trained through dialogue syntax. Students carry out dialogue syntax by discussing after investigating by seeking information through other sources to check the truth of the investigation that has been carried out (Knippels & Van Harskamp, 2018). Through the issues presented, students look for information to support the results of the investigation, using questions that have been presented by considering scientific and social aspects. In addition, the reflection syntax also supports increasing N-Gain in the experimental class. In this syntax, students conduct evaluations by reviewing activities that have been carried out so that students can understand and apply critical thinking and evaluate ways to deal with problems that arise.

The inference indicator with an N-Gain value of 0.4567 in the medium category shows a significant difference from the control class's N-Gain. There is an increase in the N-Gain value because there is a syntax supporting decision-making in the learning model. SocioscientificSocioscientificSocioscientific issues in the inquiry model can connect scientific concepts with the issues presented to find solutions to these issues. Students make decisions as solutions to the issues presented after conducting investigations and group discussions based on the information and evidence they have obtained. This syntax allows students to provide solutions that will help resolve the issues (Knippels & Van Harskamp, 2018). Therefore, students critical thinking skills are used for problem-solving and making decisions with strong considerations through inference indicators.

The N-Gain result on the interpretation indicator was 0.447 in the medium category, showing a significant difference between the control and experimental classes. Students can interpret indicators by explaining the problems that occur at SSI. The syntax of introducing dilemmas and forming initial opinions will introduce students to socioscientificsocioscientificsocioscientific issues so that students are interested in finding out and explaining their opinions about the issues that occur so that they can increase students' interpretation indicators. Based on this syntax, students will be trained to understand an issue and be able to interpret and formulate the problems that occur (Wahyudi et al., 2020).

The self-regulation indicator shows an N-Gain result of 0.407 in the medium category. This indicator also shows a significant difference in the N-Gain results with higher results in the experimental class. This is because, in the last syntax, namely reflection syntax, the researcher explores the information that students have obtained, asks for opinions during learning, steps taken to make decisions, and if students face similar problems in the future (Ariza et al., 2021). Therefore, through reflection activities, students can consider and understand the process of understanding that has been obtained and can train students' self-regulation indicators.

The N-Gain indicator of explanation in the experimental class is superior, with a value of 0.312 in the medium category compared to the control class. This is because introducing dilemmas and forming initial opinions raises various questions for students and enters the syntax of asking questions. Students discuss the questions asked through investigative syntax by carrying out prepared

experiments or searching for data on the internet from reliable sources. This syntax trains students' explanation indicators, where students determine logical opinions according to data and facts. Investigation activities will provide students with knowledge about various opinions, understanding of concepts, and values contained in socioscientificsocioscientificsocioscientific issues (Knippels & Van Harskamp, 2018).

The lowest average in the analysis indicator is 0.247 in the low category. The analysis indicators show the same average N-Gain results in both classes. Students can analyze the issues presented on the LKPD to determine the decisions to be taken. However, the questions presented on the LKPD do not train students' analysis indicators. Therefore, increasing analytical indicators need to be used in learning so that students can hone their analytical skills (Mahanal, 2014).

This SSI-based inquiry learning model needs to be implemented with more time allocation because the investigation syntax in this learning model requires much time so that the investigation process can be carried out well. There is no difference in the student analysis indicators in the N-Gain results because the learning syntax focuses less on the analysis process; this learning model focuses on investigating and resolving the issues presented.

Students' Global Citizen Character

The results of the T-test between the treatment and control classes based on the initial test did not show any differences, with a significance value of 0.585. The learning model treatment applied to both classes stated differences in the T-test results based on the final test scores. The learning model treatment influenced the differences in the T-test; the experimental class applied the SSI-based inquiry model, while the control class applied the discovery learning model.

The average pre-final test score on global citizen character based on Figure 3 states that the experimental and control classes' post-test results have improved. There was a more significant increase in the average posttest results in the treatment class compared to the control class. The results of data analysis in the N-Gain test also support the results of the average pretest and post-test scores, namely that there is an increase in the global citizen character questionnaire scores of students in the treatment class, which is in the medium category and the low category in the control class. A significant increase in global citizen character among students occurred in the experimental class, and a significant increase was not seen in the control class.

Through the SSI-based inquiry learning model, students explore the issues presented by implementing inquiry activities combined with considerations and actions that must be taken to overcome the issues presented (Ariza et al., 2021). The control class that applies the discovery learning model emphasizes understanding concepts and structures in a scientific discipline (Sartono, 2018). So, students do not understand and are directly involved in socioscientific issues that develop students' global citizen character. Therefore, it can be concluded that the SSI-based inquiry learning model effectively improves students' global citizen character. The increase in students' global citizenship character in each indicator in the treatment and control classes is presented in Figure 4 below.

Figure 4 compares the average N-Gain for each global citizen character indicator. The average N-Gain results show that all indicators of global citizen character in the treatment class are higher than in the control class. Zainuddin et al. (2014) stated that inquiry learning syntax supports the formation of students' caring character in the cognitive and affective aspects of students. Caring character is an attitude that exists in the global citizen character; through SSI issues, students will be actively involved in the issues presented. The SSI-based inquiry model applied in research provides real experience through the learning syntax.

The ecological worldview indicator has a high category N-Gain value, namely 0.356. The results of the N-Gain indicator of the ecological worldview show a significant increase between the experimental and control classes. This is because the experimental class, which applies the SSI-based inquiry model in the dilemma introduction syntax, introduces students to socioscientific issues so that the indicators of the ecological worldview increase through the introduction of issues to students, namely providing an understanding that environmental sustainability and its components influence each other. One example of an issue presented in the learning process is human activity that smuggles wild animals; this impacts animal scarcity and threatens the ecosystem's sustainability.

The lowest N-Gain value in the social and moral sensitivity indicator is 0.286 in the high category. Social and moral indicators are sensitivity and empathy for problems that arise in the environment. An increase in the N-Gain value shows that students have social and moral sensitivity to socioscientificsocioscientificsocioscientific issues, students find out about problems that occur through the syntax of submitting statements and investigations to find appropriate solutions and actions in dealing with these issues. Findings in research by Lee et al (2013) show that students experience an increase in social and moral indicators through SSI, so students become more sensitive and open through moral and ethical aspects to problems that arise.

Socioscientific accountability indicator with an N-Gain value of 0.289 in the high category. The syntax of decision-making and action supports improving N-Gain results on socioscientific accountability indicators. The learning process in the experimental class provides students with the opportunity to solve the issues presented. SocioscientificSocioscientificSocioscientific accountability indicators are the attitudes they have in dealing with socioscientificsocioscientificsocioscientific issues, where students understand the relationship between science and social issues that give rise to problems so that students feel responsible and need to overcome these problems. The N-Gain results on this indicator are also the lowest of the three indicators because students still feel confused when making decisions about syntax

in the learning process.

SSI's controversial context will train students to make decisions based on investigations carried out with scientific and social considerations. The integration of SSI in the inquiry learning model allows students to understand the process and skills to become responsible citizens (Chowdhury et al., 2020).

Social and moral sensitivity and social accountability are the lowest indicators because some students still feel confused when dealing with the socioscientific issues presented. The issues presented must also be considered when applying the SSI-based inquiry learning model. Students also feel that they still lack confidence in making decisions and taking action on the issues presented.

4. CONCLUSION

Based on the research and discussion results, a conclusion can be drawn, namely that the SSI-based inquiry learning model effectively improves students' critical thinking skills and global citizen character. This result is supported by the results of the T-test, namely that there is a significant difference in critical thinking abilities between the two classes with a significance value of <0.001. The average N-Gain value for students' critical thinking abilities in the experimental class was 0.416, and the control class was 0.111. The effectiveness of the learning model is based on the results of the T-test of students' global citizen character, showing a significant difference between the control class and the experimental class with a sig value of 0.04. The average N-Gain value for students' global citizen character increased in the experimental class, namely 0.339, and in the control class, it was 0.009. The researcher can suggest that the analysis indicator is lower than other indicators because the questions given in the dialogue syntax are less varied. The investigation syntax in this learning model also requires quite a lot of time so that the investigation process can be carried out correctly. Therefore, this SSI-based inquiry learning model needs to be applied with a more significant time allocation so that students can focus on the learning process. Then, the N-Gain indicator of social and moral sensitivity and socioscientific accountability is the lowest because some students still feel confused when dealing with the socioscientific issues presented. Students also feel confused about how to take their attitude toward the issue. Therefore, students need to be guided in understanding the issue. Applying this SSI-based inquiry learning model also requires considering issues that are easy for students to understand

ACKNOWLEDGMENT

Thanks to all those who helped in this research

REFERENCES

Adri, R. F. (2020). The Effect of Pre-Test on the Level of Understanding of Political Science Study Program Students in Basic Natural Science Courses. Menara Ilmu, 14(1). https://www.jurnal.umsb.ac.id/index.php/menarailmu/article/view/1742

Al Asadullah, S., & Nurhalin. (2021). Peran Pendidikan Karakter dalam Membentuk Kemampuan Berfikir Kritis Generasi Muda Indonesia. Kaisa: Jurnal Pendidikan Dan Pembelajaran, 1(1), 12–24. https://doi.org/10.56633/kaisa.v1i1.202

Al-Tabany, I. B. T. (2017). Mendesain Model Pembelajaran Inovatif, Progresif , dan Kontekstual: Prenada Media Group.

Arikunto, S. (2010). Prosedur Penelitian Suatu Pendekatan Praktik. Rineka Cipta.

Ariza, M. R., Christodoulou, A., van Harskamp, M., Knippels, M. C. P. J., Kyza, E. A., Levinson, R., & Agesilaou, A. (2021). SocioscientificSocioscientificSocioscientific inquiry-based learning as a means toward environmental citizenship. Sustainability (Switzerland), 13(20), 1–22. https://doi.org/10.3390/su132011509

Azwar, S. (2015). Metode Penelitian. Pustaka Belajar.

Chowdhury, T., Holbrook, J., & Rannikmäe, M. (2020). SocioscientificSocioscientificSocioscientific Issues within Science Education and their Role in Promoting the Desired Citizenry. Science Education International, 31(2), 203–208. https://doi.org/10.33828/sei.v31.i2.10

Emzir. (2013). Metodologi Penelitian Pendidikan: Kuantitatif & Kualitatif. Rajawali Pers.

Facione. (2013). Critical Thinking: What It Is and Why It Counts. Measured Reasons and The California Academic Press.

Firdausi, Y. R. U. (2022). Pembelajaran Ipa Berbasis Socioscientific Issues Untuk Menumbuhkan Karakter Global Citizen. Universitas Tidar, Skripsi

Hsu, Y.-S., & Lin, S.-S. (2017). Prompting students to make socioscientificsocioscientificsocioscientific decisions: embedding metacognitive guidance in an e-learning environment. International Journal of Science Education, 39(7), 964–979. https://doi.org/10.1080/09500693.2017.1312036

Hutabri, E. (2022, January 14). Validitas Media Pembelajaran Multimedia Pada Mata Pelajaran SImulasi Dan Komunikasi DIgital.

I Made Tri Pramana Putra. (2022). Kajian Literatur Sistematis: Integrasi Model Inkuiri Berbasis Socioscientific Issues pada Pembelajaran IPA. Jurnal Pendidikan Mipa, 12(3), 919–928. https://doi.org/10.37630/jpm.v12i3.704

Irawan, T. A., Rahardjo, S. B., & Sarwanto. (2017). Analisis Kemampuan Berpikir Kritis Siswa Kelas VII-A SMP Negeri 1 Jaten. Prosiding Seminar Nasional Pendidikan Sains (SNPS), 21, 232–236.

Jeramat, E., Mulu, H., Jehadus, E., & Utami, Y. E. (2019). Penanaman Sikap Peduli Lingkungan dan Tanggung Jawab Melalui Pembelajaran IPA Pada Siswa SMP. Journal of Komodo Science Education, 01, 24–33.

Kartini, L. (2018). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbantuan Media Leaflet Materi. Skripsi, Institut Agama Islam Negeri Palangka Raya.

Knippels, M.-C. P. J., & Van Harskamp, M. (2018). An Educational Sequence for Implementing SocioscientificSocioscientificSocioscientific Inquiry-Based Learning (SSIBL). School Science Review, 371, 46–52.

Lee, H., Yoo, J., Choi, K., Kim, S. W., Krajcik, J., Herman, B. C., & Zeidler, D. L. (2013). SocioscientificSocioscientificSocioscientific Issues as a Vehicle for Promoting Character and Values for Global Citizens. International Journal of Science Education, 35(12), 2079–2113. https://doi.org/10.1080/09500693.2012.749546

Lestari, R., Haryono, T., & Erman, E. (2021). Using comic-based socioscientific issues in inquiry learning increases interest and achievement in science learning. Thabiea : Journal of Natural Science Teaching, 4(1), 62. http://dx.doi.org/10.21043/thabiea.v4i1.9919

Lismaya, L. (2019). Berpikir Kritis & PBL (Problem Based Learning). Surabaya: Media Sahabat Cendika.

Mahanal, S. (2014). Peran Guru Dalam Melahirkan Generasi Emas Dengan Keterampilan Abad 21. Seminar Nasional Pendidikan HMPS Pendidikan Biologi FKIP Universitas Halu Oleo, 20, 1–16.

Mahanani, I., Rahayu, S., & Fajaroh, F. (2019). Pengaruh Pembelajaran Inkuiri Berkonteks Socioscientific-Issues Terhadap Keterampilan Berpikir Kritis Dan Scientific Explanation. Jurnal Kependidikan, 1, 53–68. https://doi.org/10.21831/jk.v3i1.20972

Maslakhatunni'mah, D., Safitri, L. B., & Agnafia, D. N. (2019). Analisis Kemampuan Berpikir Kritis pada Mata Pelajaran IPA Siswa Kelas VII SMP. Seminar Nasional Pendidikan Sains 2019, 179–185.

Murdiono, M. (2018). Pendidikan Kewarganegaraan Untuk Membangun Wawasan Global Warga Negara Muda. Jurnal Pendidikan Karakter, 5(2). https://doi.org/10.21831/cp.v3i3.2379

Nazilah, N., Muharrami, L. K., Rosidi, I., & Wulandari, A. Y. R. (2018). Pengembangan Bahan Ajar Berbasis Socio-Scientific Issues Pada Materi Pemanasan Global. Natural Science Education Research, 1(2), 192–205. https://doi.org/10.21107/nser.v2i1.4162

Norrizqa, H. (2021). Berpikir Kritis dalam Pembelajaran IPA. Prosiding Seminar Nasional Pendidikan IPA, 147–154. https://orcid.org/0000-0003-3663-4163

Nurjanah, W. (2020). Historical Thinking Skills and Critical Thinking Skills. Historika, 23(1), 92–104. https://doi.org/10.20961/historika.v23i1.41241

Peach, S., & Clare, R. (2017). Global Citizenship and Critical Thinking in Higher Education Curricula and Police Education: A Socially Critical Vocational Perspective. Journal of Pedagogic Development, 7(2).

Powell, W. (2021). Effects of Place-Based SocioscientificSocioscientificSocioscientific Issues on Rising Middle School Students' Evidence-Based Reasoning and Critical Thinking on Hydraulic Fracking. Journal of Education in Science, Environment and

Prayetno. (2017). Perkembangan Nasionalisme Di Indonesia Dalam Perspektif Sejarah. Jurnal Pusham Unimed, VII(1), 1–20.

Putra, I. M. T. P. (2022). Kajian Literatur Sistematis: Integrasi Model Inkuiri Berbasis Socioscientific Issues pada Pembelajaran IPA. Jurnal Pendidikan Mipa, 12(3), 919–928. https://doi.org/10.37630/jpm.v12i3.704

Putra, I. M. T. P. (2023). Pengembangan E-Lkpd Ipa Model Inkuiri Berbasis Socioscientific Issues Untuk Meningkatkan Kemampuan Literasi Sains Peserta Didik Kelas VII SMP. Tesis, Universitas Pendidikan Ganesha.

Rahmawati, F. (2017). Eksperimentasi Model Pembelajaran Kuantum dan Discovery Learning Terhadap Prestasi Belajar Ditinjau Dari Motivasi Belajar Siswa Pada Materi Aturan Sinus, Cosinus dan Luas Daerah Segitiga di SMA 5 Surakarta. Universitas Sebelas Maret.

Ramdhayani, E., Syafruddin, & Dekayanti, L. (2023). Pengaruh Model Pembelajaran Inkuiri Terhadap Berpikir Kritis Siswa Pada Materi Pertumbuhan. Jurnal Ilmiah Wahana Pendidikan, 9(6), 93–99. https://doi.org/10.5281/zenodo.7774851

S. F, Y. (2014). Beliefs, values, ethics, and moral reasoning in socioscientific education. Issues in Educational Research, 3(24), 299–319.

Sari, D. V. P. M., Aini, K., Syarifah, Damayanti, F., Handayani, T., & Nurokhman, A. (2021). Review: Berpikir Kritis Pada Peserta Didik. Prosiding Seminar Nasional Pendidikan Biologi, 104–111.

Sartono, B. (2018). Penerapan Model Pembelajaran Discovery Learning Berbantuan Lembar Kerja Siswa Untuk Meningkatkan Prestasi Belajar Fisika Materi Fluida Pada Siswa Kelas XI MIPA 3 SMA Negeri 1 Ngemplak Boyolali Semester Ganjil Tahun Pelajaran 2018/2019. Prosiding SNFA (Seminar Nasional Fisika Dan Aplikasinya). https://doi.org/10.20961/prosidingsnfa.v3i0.28510

Shoba, T. M., Hardianti, R. D., Pamelasari, S. D., Elektronik, M., & Issue, S. (2023). Penerapan Pendekatan Socio-Scientific Issue (SSI) Berbantuan Modul Elektronik Terhadap Kemampuan Berpikir Kritis Siswa. Prosiding Seminar Nasional IPA. 571, 571–579.

Sudjana. (2005). Metoda Statistika (Edisi ke-5). Tarsito.

Sugiyono, D. (2013). Metode Penelitian Kuantitatif, Kualitatif, dan Tindakan. Bandung: Alfabeta.

Sumaryati. (2016). Penguatan Pendidikan Karakter Untuk Mewujudkan Warga Negara Global. Seminar Nasional, Kongres Dan Deklarasi.

Sutoyo, & Priantari, I. (2019). Discovery Learning Meningkatkan Kemampuan Berpikir Kritis Siswa. BIOMA: Jurnal Biologi Dan Pembelajaran Biologi, 4(1), 31–44.

Syafitri, E., Armanto, D., & Rahmadani, E. (2021). Aksiologi Kemampuan Berpikir Kritis. Journal of Science and Social Research, 4307(3), 320–325.

Wahyudi, M., Suwatno, & Santoso, B. (2020). Kajian Analisis Keterampilan Berpikir Kritis Siswa Sekolah Menengah Atas. Jurnal Pendidikan Manajemen Perkantoran, (5)1.

Walangadi, H., Umar, E., & Palilati, K. (2020). Membentuk Siswa Sebagai Global Citizen Melalui Mata Pelajaran Pkn Di Sekolah Dasar. Prosiding Webinar Tesis Pendidikan Dasar Pascasarjana Universitas Negeri Gorontalo, 1–11.

Xiao, S. (2018). Rhetorical use of inscriptions in students' written arguments about socio-scientificsocioscientific issues. Research in Science Education.

Yofamella, D., & Taufiq, T. (2020). Penerapan Model Inquiry Learning Dalam Pembelajaran Tematik Terpadu Di Kelas III Sekolah Dasar (Studi Literatur). E-Journal Inovasi Pembelajaran SD, 8(8).

Zainuddin, H. M., Mustofa, H., & Sufyan Hakam, D. (2014). Membentuk Karakter Peduli Lingkungan dengan Model Pembelajaran Inkuiri. Mimbar: Jurnal Sosial Dan Pembangunan, 30(1), 11–17. https://doi.org/10.29313/mimbar.v30i1.435

Zeidler, D. (2015). Encyclopedia of Science Education. In Encyclopedia of Science Education. Springer Science+Business Media Dordrecht.

Zeidler, D. L. (2014). SocioscientificSocioscientificSocioscientific Issues as a Curriculum Emphasis: Theory, Research, and PracticePracticePractice (1st Edition, Vol. 2). Handbook of research in science education.

Zeidler, D. L., & Khan, S. (2014). It is Debatable! Using SocioscientificSocioscientificSocioscientific Issues to Develop Scientific Literacy K-12. NSTA Press.