

Effectiveness of Socioscientific Issues (SSI) Based Learning to Improve Argumentation Skills

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Abstract: The study aimed to examine the effectiveness of Socioscientific Issues (SSI) based learning to improve students' argumentation skills (KArg) on additive materials. The learning tools had been developed using the ADDIE model comprising analysis, design, development, implementation, and evaluation. The learning tools were declared valid by expert judgments. There were 33 eighth-grade students at SMP Negeri 1 Pucanglaban, Tulungagung, Indonesia, chosen purposively as the research participants. The study used a one-group pretest-posttest research design to test the effectiveness of the learning tools. The students' argumentation skills were measured using a rubric with a claim, evidence, and reasoning indicators. The obtained KArg scores before and after the implementation of the learning tools were analyzed using N-gain Score. The results showed that there was an increase in students' KArg scores with the N-gain values on the three indicators of 0.87, 0.84, and 0.82 respectively, of which the scores were categorized in the high criteria. The increase in the three indicators showed that SSI-based learning tools on additive materials are effective in improving junior high school students' argumentation skills.

Keywords: ADDIE Model; Argumentation Skills (KArg); Socioscientific Issues (SSI)

Introduction

The Indonesian education system has implemented the 2013 curriculum by a means of permeating and accelerating 21st-century learning competencies (Andrian & Rusman, 2019). The 2013 curriculum is expected to be able to support learner-centered learning mode by increasing peer interactions and being able to argue, debate, and collaborate. The learning process is carried out in order to prepare students to face the multifaceted challenges of the 21st century (Kemdikbud, 2020). In addition, the 2013 curriculum requires students to play an active role in learning including the use of information and communication technology. Students are expected to become qualified and critical individuals in responding to available information (Wijaya, 2016). The 2013 curriculum is augmented with the Merdeka curriculum that facilitates students to develop their thinking and affective competencies. Thinking

competencies include critical thinking, creative thinking, and problem-solving skills. Affective competencies include communication, collaboration, digital and technological literacy, and living-survival competencies that encompass initiative, self-direction, global understanding, and responsibility. In addition, the challenge in implementing the Merdeka curriculum is to train students' soft skills through various school and learning activities (Indarta et al., 2022).

In coping with the students' learning activities in the digital era, it is undeniable that the internet is one of the main learning resources. This is supported by the results of the APJII survey where internet access has increased by 77.02%, one of which is in the world of education. The level of internet users who are still students reaches 99.26% (APJII, 2022). Obtaining reliable information and responding to various information (e.g., argument skills) need to be applied in learning. Basically, the information needed by students is always

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related to science including food, health, clothing, daily equipment, and natural phenomena (Erman et al., 2019).

Scientific phenomena occurring in society or better known as Socio Scientific Issues (SSI) are important to apply in the learning process (Erman et al., 2019). Learning managed with the SSI approach can potentially improve students' argumentation skills (KArg) (Ozturk & Doganay, 2019). Zeidler (2009) suggests that SSI requires the use of evidence-based reasoning and understanding scientific information in problem-solving skills. Learning that entails evidence-based reasoning and provides a context for understanding scientific information becomes meaningful and interesting for students (Christenson, 2015).

Based on the results of interviews with teachers at the target schools, SSI-based learning has never been carried out, but giving the task of finding material using the internet has been undertaken. In accordance with pre-research data on KArg with the presentation of the video "Facts/myths that chili powder is not safe for consumption", students can decide to agree/reject the claim. Pre-research shows that 10% of students can present supporting data and there are no students who are able to make reasons (e.g., connecting claims and data). This shows that the quality of the participants' arguments is still in the low category. Students who have a high quality of argumentation are able to explain a reason that has relevant statements and evidence (Atabey & Topcu, 2017).

Argumentation skills used in this study focused students on three indicators. McNeill and Martin (2011) suggest that KArg for grades 6, 7, and 8 only includes claims, evidence, and reasons or justifications that connect claims with evidence. These three things are sufficient to show a quality argument (Atabey & Topcu, 2017). Atabey and Topcu research the highest level of argumentation is 2, but in this study the highest level is 3, the difference lies in the identification of information from various aspects (science, observations, experts, and other information) which must be included in the evidence indicators. In practice, the teacher provides content that is in the student's environment to assess claims. At the time of proving students in searching for data must include information that is related to aspects of science, observations, expert opinions, or other information. At the time of reasoning students are expected to combine aspects that have been determined at the time of evidence with claims.

This study focuses on additive materials because, recently, the inappropriate use of additives has been in the public spotlight and has emerged as a controversial SSI (Rostikawati & Permanasari, 2016). SSI can pose complex and controversial issues (Sadler, 2011). Students who aim to respond to or evaluate SSI information need to be equipped with respectable

argumentation skills. These skills help students analyze, evaluate, and make relevant decisions regarding the information obtained.

Some studies have examined the SSI learning context for argumentation skills. Fassenda (2019) found that the chemical equilibrium material showed that the group of students who were taught the Argument-Driven Inquiry (ADI) model with the SSI context achieved good argumentation skills compared to the control group. Siska et al. (2020) found that there was an increase in students' scientific argumentation skills using relevant learning strategies in Biology classes. Based on these empirical studies, the researcher predicts that the learning of additive materials designed in the SSI context is effective in improving the students' argumentation skills.

Method

This study aimed to describe the effectiveness of SSI-based learning tools to measure students' argumentation skills. Development of learning tools following the ADDIE model (eg Analysis, Design, Develop, Implementation, and Evaluation) (Branch, 2009). The study began with analysis of student needs, assignments, and materials. Then design by making a lattice of indicators argumentation skills on the learning device. The development of learning tools in the form of lesson plans, student worksheet, and assessment sheets. These tools had been validated through expert judgments and declared valid. The effectiveness of the learning tools was measured using a one-group pretest-posttest design. Implementation in this study was conducted in the academic year of 2022/2023 with 33 eighth-grade students at SMPN 1 Pucanglaban, Tulungagung Regency, as the research participants. The effectiveness of the learning tools can also be examined based on students' responses after conducting the teaching and learning process using learning tools, this is part of evaluation.

The test consisted of four news stories with SSI nuances that were made into a package of argumentation skills tests. There were 11 total questions for three KArg indicators namely claim, evidence, and reasoning. In the first stage, students were given a pretest and were trained in learning argumentation skills for four meetings. At the end of the learning process, students were given a posttest. The increase in argumentation skill scores was analyzed descriptively using normalized gain (N-gain). SSI-based learning tools to improve students' argumentation skills were effective if they had an N-gain test score above 0.3 (Triyana, 2016).

Result and Discussion

Argumentation skills were measured by giving a pre-test before the lesson was conducted to determine initial abilities. Afterward, a post-test after implementing SSI learning tools was carried out to look at students' final argumentation skills. Figure 1 depicts the results of the pretest and posttest scores of argumentation skills.

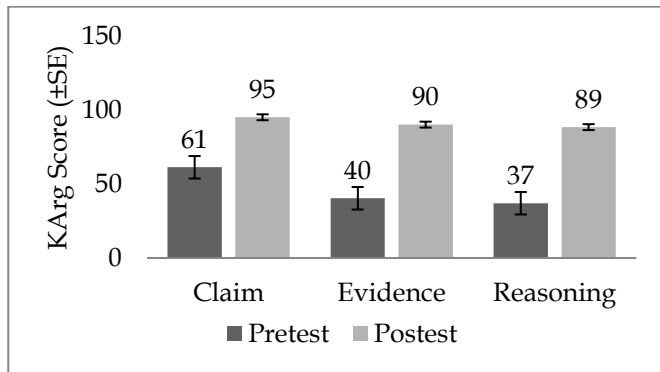


Figure 1. The Result of Pretest and Posttest scores KArg

Figure 1 portrays that there was an increase in the pretest score to the posttest score for argumentation skills. In the claim indicator, there was an increase from a score of 61 to 95. In the evidence indicator, there was an increase from a score of 40 to 90. In the reasoning indicator, there was an increase from a score of 37 to 89. Table 1 shows the results of the analysis of the *N-gain* score of argumentation skills (KArg).

Table 1. *N-gain* Argument Skills Score (KArg)

Argumentation Skill Indicator	<i>N-gain</i>
Claim	0.87
Evidence	0.84
Reasoning	0.82

N-gain value provided a description of the increase in argumentation skills indicators of claims, evidence, and reasoning that were in the high category. SSI-oriented additive learning tools had proven to be effective in improving junior high school students' argumentation skills. Descriptive evidence of effectiveness was shown by the high value of *N-gain* on the three argumentation skills indicators.

Based on result, Socio Scientific Issues (SSI) was one of the context-based learning especially on the students' surrounding environmental problems that required them to do a roleplay in a form of dialogue, discussion, and debate (Zeidler, 2014). SSI consisted of complex social issues that were connected to science (Sadler, 2011). These issues could be grasped in the media or news coverage, or everyday discussion in which there

was often no exactly correct answer, however, it was possible to use scientific evidence, reasoning, argumentation, and decision-making to support a particular perspective or stance (Sadler et al., 2017; Presley et al., 2013).

The present study found that SSI conveyed a positive relationship with KArg. Similarly, Samosa (2021) argued that the SSI context involved a scientific basis such as forming opinions and requiring students to make choices, i.e., determining claims. Hasanudin & Susilo (2014) stated that argumentation was a form of communication that required reasoning through a series of scientific discourses, which was significant in a learning process (Aliandra & Nana, 2018).

Hakim et al. (2020) stated that argumentation was one of the skills that must be developed in the 21st century. This skill helped students build scientific explanations, develop critical thinking skills, and become an alternative to evaluating an opinion. Efforts to improve the quality of students' argumentation skills, especially in the field of science, intended to scientifically drill individuals who were willing to participate in public debates and think critically (Christenson, 2015), use scientific knowledge to explain a phenomenon, and present evidence-based conclusions (Vitasari & Supahar, 2018).

McNeill & Martin (2011) specified that the indicators of eighth-grade students' argumentation skills included the claim, evidence, and reason (Atabeya & Topcu, 2017). Students were expected to be able to make a claim, provide relevant evidence, and present logical reasons to connect the claim and evidence. In accordance with the results of the study, the claim indicator had the highest score compared to another two indicators namely evidence and reasoning (*N-gain* = 0.87, $M_{posttest}$ = 95). According to several researchers and the results of previous studies, students found obstacles in expressing claims on an issue as they could not present the claims briefly and clearly. This happened even though the issue was about their surrounding environmental phenomena. Topçu & Atabey (2017) revealed that the claims made by the students before the SSI learning undertaken were already high. Similarly, the present study found that the participants' initial ability in determining claims was already good, so the scores in this claim indicator were included in the high category.

The evidence indicator presented the second highest score after the claim indicator (*N-gain* = 0.84, $M_{posttest}$ = 90). In providing relevant evidence, students were given a number of information involving indicators of identifying information based on topics, seeking relevant information, and processing information (USAID, 2015), which aimed to make the students easier to determine the relevant evidence to support the claim. This information indirectly helped reflect their

understanding when making the best conclusions in dealing with problem-solving skills (KArg) (Phua and Tan, 2018).

The reasoning indicator showed the lowest score among others but was still in the high category in argumentation skills ($N\text{-gain} = 0.82$, $M_{\text{posttest}} = 89$). Regarding the results of the students' responses after participating in the SSI-based learning, 94% of them stated that they could do reasoning well. Samosa (2021) also found that the reasoning indicator showed the lowest score among the other two indicators namely claim and evidence. McNeill & Martin (2011) indicated that the most difficult indicator in argumentation skills was reasoning (Vitasari et al., 2016). The low improvement in this indicator was due to the fact that students were not yet proficient at reviewing the data linkage with the initial claims.

The present study showed that each argumentation indicator increased and the students showed a positive response. The results of this increase could not be separated from learning activities conducted by researchers and activities in student worksheet that stimulated each indicator of argumentation skills. The success of this learning process relied on the theory of constructivism and scaffolding. In connection with the teaching process of argumentation skills, the researchers first directed the students to compile more information according to the researchers' guidance. The guide was a form of assistance or scaffolding, which helped describe the steps for solving problems, providing examples, and fostering students' autonomous learning process (Slavin, 2015). In solving problems, students were taught to be independent by being trained to find information to form quality arguments (constructivism).

The results of this study were in line with the findings of Atabeya & Topcu (2017), which involved students to observe the quality of their arguments. The study showed that SSI-based instruction could significantly increase students' claims, evidence, and reasoning (Atabeya & Topcu, 2017). Similarly, Presley et al. (2013) discovered that SSI-based activities provided opportunities for students to generate claims, collect evidence, and present reasoning in some observable environmental issues. Henceforth, the SSI-based learning tools had been effective to improve students' argumentation skills and could be used as a reference for further research in this related topic.

Conclusion

Based on result and discussion, the three KArg indicators show an increase and are categorized at a high level with the $N\text{-gain}$ values of 0.87 for the claim indicator, 0.84 for the evidence indicator, and 0.82 for the reasoning indicator. Thus, it could be concluded that the

SSI-based learning tools on additive materials are effective in improving junior high school students' argumentation skills.

References

- Aliandra A.L. & Ana. A. (2018). Argumentation and Reasoning Skills in Socioscientific Issues. *Journal Innovation of Vocational Technology Education*, 14(2), 44-45. <https://doi.org/10.17509/invotec.v14i2.14356>
- Andrian, Y. & Rusman. (2019). Implementasi Pembelajaran Abad 21 Dalam Kurikulum 2013. *Jurnal Penelitian Ilmu Pendidikan*, 12(1), 14-23. <https://doi.org/10.21831/jpipfip.v12i1.20116>
- APJII. (2022). *Survei Pengguna Internet APJII 2022: Penetrasi Internet Indonesia*. Jakarta: APJII. Retrieved from <https://apjii.or.id/content/read/39/559/Laporan-Survei-Profil-Internet-Indonesia-2022>
- Atabey, N., & Topcu, M. (2017). The Effects of Socioscientific Issues Based Instruction on Middle School Students Argumentation Quality. *Journal of Education and Practice*, 8(36), 61-71. Retrieved from <https://www.iiste.org/Journals/index.php/JEP/article/view/40439>
- Branch, R. M. (2009). *Instructional Design the ADDIE Approach*. USA: University of Georgia.
- Christenson, N. (2015). *Socioscientific Argumentation (Dissertation)*. Karisted University Studies. Retrieved from <http://diva-portal.org/smash/get/diva2:806023>
- Erman. E, Liliyasi L, Ramdani M, & Wakhidah N. (2019). Addressing Macroscopic Issues: Helping Student Form Associations Between Biochemistry and Sports and Aiding Their Scientific Literacy. *International Journal of Science and Mathematics Education* 18, 831-853. Retrieved from <https://link.springer.com/article/10.1007/s10763-019-09990-3>
- Fassenda, N. (2019). *Pengaruh Model Argument-Driven Inquiry (ADI) Berkonteks Socioscientific Issues (SSI) terhadap Kualitas Keterampilan Argumentasi dan Kepercayaan Diri (Self Efficacy) pada Materi kesetimbangan kimia*. Thesis Universitas Negeri Malang: Retrieved from <https://edukatif.org/index.php/edukatif/article/view/2589>
- Hakim, A., Shamadesti, I., & Hadisaputra, S. (2019). Promoting students' argumentation skill through development science teaching materials based on guided inquiry models. *Journal of Physics Conference Series*, 1521(4), 042117. <https://doi.org/10.1088/1742-6596/1521/4/042117>

- Indarta, Y., Nizwardi, J., Agariadne, Afif, R.R., & Novi, H.A. (2022). Relevansi Kurikulum Merdeka Belajar Dengan Model Pembelajaran Abad 21 Dalam Perkembangan Era Society 5.0. *Jurnal Ilmu Pendidikan*, 4(2), 3011-3024. <https://doi.org/10.31004/edukatif.v4i2.2589>
- Kemdikbud. (2020). *Permendikbud 22 Tahun 2020 tentang Rencana Strategis Kementerian Pendidikan dan Kebudayaan Tahun 2020-2024*. Jakarta: Kementerian Pendidikan dan Kebudayaan.
- McNeill, K. L., & Martin, D. M. (2011). *Claims, Evidence, and Reasoning: Demystifying data during a unit on simple machines*. Washington, DC: National Academies Press, 48(8), 52. Retrieved from <http://searkscience.pbworks.com/w/file/attach/70117336/2-Claimsevidence.pdf>
- Ozturk, A., & Doganay, A. (2019). Development of Argumentation Skills through Socioscientific Issues in Science Course: A Collaborative Action Research. *Turkish Online Journal of Qualitative Inquiry*, 10(1), 52-89. <https://doi.org/10.17569/tojqi.453426>
- Phua, M. P. E., & Tan, A. L. (2018). Promoting productive argumentation through students' questions. *Asia-Pacific Science Education*, 4(1), 1-24. <https://doi.org/10.1186/s41029-018-0020-9>
- Presley, M. L., Sickel, A. J., Muslu, N., Merle-Johnson, D., Witzig, S. B., Izci, K., & Sadler, T. D. (2013). A framework for socio-scientific issues-based education. *Science Educator*, 22(1), 26-32. Retrieved from <https://www.proquest.com/docview/1438027822>
- Rostikawati, D. A., & Permanasari, A. (2016). Rekonstruksi bahan ajar dengan konteks socio-scientific issues pada materi zat aditif makanan untuk meningkatkan literasi sains peserta. *Jurnal Inovasi Pendidikan IPA*, 2(2), 156. <https://doi.org/10.21831/jipi.v2i2.8814>
- Sadler, T. D., Foulk, J. A., & Friedrichsen, P. J. (2017). Evolution of a model for socio-scientific issue teaching and learning. *International Journal of Education in Mathematics, Science and Technology*, 5(2), 75-87. <https://doi.org/10.18404/ijemst.55999>
- Sadler, T. D. (2011). Socio-scientific issues-based education: What we know about science education in the context of SSI. In *Socio-scientific Issues in the Classroom. Contemporary Trends and Issues in Science Education: Springer, Dordrecht*, 39, 355-369. <https://doi.org/10.1007/978-94-007-1159-4>
- Samosa, R. C. (2021). Effectiveness Of Claim, Evidence and Reasoning as An Innovation to Develop Students' Scientific Argumentative Writing Skills. *Journal Multidisciplinary*, 7(5), 2581-4230. <https://doi.org/10.17605/OSF.IO/9QJUZ>
- Slavin, R. E. (2015). *Cooperative Learning*. Bandung: Nusa Media.
- Siska, Wili Triana, Yunita, Yuyun Maryuningsih, & Mujib Ubaidillah. (2020). Penerapan Pembelajaran Berbasis Socio Scientific Issues Untuk Meningkatkan Kemampuan Argumentasi Ilmiah. *Jurnal Pendidikan Sains & Matematika*, 8(1), 22-33. <https://doi.org/10.23971/eds.v8i1.1490>
- Triyana, D. (2016). *Dampak Kualitas Penjelasan Peserta didik Ahli Terhadap Prestasi Akademik Peserta didik Pemula Dalam Pembelajaran Fisika SMA Menggunakan Model Kooperatif Tipe Jigsaw*. Tesis. Universitas Pendidikan Indonesia.
- USAID. (2015). *Modul Pelatihan: Praktik yang Baik dalam Pembelajaran di SMP dan MTs*. Indonesian: USAID Prioritas
- Vitasari, Shita Dhiyanti. & Supahar. (2018). Assessment Instrument of Scientific Literacy Skills Based on Nature of Science for Middle School. *Journal Of Development Research*, 2(2), 59-65. <https://doi.org/10.28926/jdr.v2i2.55>
- Wijaya, E. Y., Sudjimat, D. A., Nyoto, A., & Malang, U. N. (2016). Transformasi pendidikan abad 21 sebagai tuntutan pengembangan sumber daya manusia di era global. *Prosiding Seminar Nasional Pendidikan Matematika*, 1(26), 263-278. Retrieved from <https://core.ac.uk/download/pdf/297841821.pdf>
- Zeidler, D. L., & Nichols, B. H. (2009). Socioscientific issues: Theory and practice. *Journal of Elementary Science Education*, 21(2), 49-58. <https://doi.org/10.1007/BF03173684>