

Implementation of the Science Learning Model to Improving Students' Scientific Argumentation Skills: A Review

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Abstract: Argumentation ability is one of the main goals of learning science because students who study science must know scientific explanations about natural phenomena, use them to solve problems and be able to understand other findings they get. This study is a Literature Review article which aims to identify the most effective learning models to improve students' scientific argumentation skills in science learning. A search of the literature study articles obtained twenty-five articles that met the inclusion criteria and were relevant for review. The results of the literature study show that one of the most effective learning models in improving students' scientific argumentation skills in science is Argument Driven Inquiry with approach socio scientific issues. The highest score range is 80-90 based on the research results contained in the 10 articles that have been analyzed. While the lowest range is in the 40-50 range found in 1 article that has been analyzed.

Keywords: Learning Model; Science Learning; Scientific Argumentation

Introduction

Global challenges in facing the 21st century which are quite diverse require competencies that tend to combine a variety of intra and interpersonal abilities (Graesser et al., 2020). Some of the competencies and skills that are essential for success in the 21st century have been identified by The Partnership for 21st Century Skills (P21) (Muliati, 2021; Lestari et al., 2023). There are six skills known as 6C consisting of critical thinking, compassion, computational logic, creativity, collaboration and communication (Maulidiyah et al., 2022). Education can be used as a support that can help improve the quality of human resources to meet the demands of 21st century competence.

The development of Science and Technology has brought many changes in various fields, one of which is the field of Education. Changes in the learning paradigm are marked by changes in curriculum, media and technology. Learning in the 21st century is the impact of changes in society from time to time, starting from primitive societies to the present that are informative (Rahayu et al., 2022). Teachers are also required to

facilitate students in the learning process so that educational goals are achieved and the quality of human resources will increase.

The ability to think argumentatively is one point that is considered important. This ability serves as a bridge or means to support the development of several 21st century competencies, including critical thinking and communication (Nur et al., 2022). Argumentation is the submission of an opinion accompanied by scientific evidence. The argument contains scientific basis as evidence makes the argumentation itself an important component in everyday social communication (Fatmawati et al., 2018). Scientific argumentation provides an alternative to improve students' understanding of concepts and ability's opinion with scientific reason (Zahratul & Suprpto, 2019).

Argumentation plays an important role in the scientific process (Firdaos et al., 2021). The ability to argue is one of the main objectives of learning science because students who study science must know scientific explanations about natural phenomena, use them to solve problems and be able to understand other findings they get, besides that they must understand the

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character of scientific knowledge that always develops from time to time (Nur et al., 2022).

Several previous studies have found that learning science does not provide opportunities for students to develop argumentation skills. Learning that facilitates students' arguments is only limited to questions and answers, but arguments in the form of claims, rebuttals and reinforcements are still lacking because they rarely conduct class discussions (Firdaos et al., 2021). In other research it was also found that students in the learning process only focused on aspects of knowledge but were less required to apply and reason and use the knowledge they obtained from the learning process (Karlina & Alberida, 2021). In Osborne's report it was also stated that the teacher and the school had not involved an argumentative approach in learning (Dawson & Carson, 2020).

By looking at the facts that occur in the field, an in-depth study is needed related to factors that can improve students' scientific argumentation abilities. One of them is the application of an innovative learning model that can help students improve their scientific argumentation skills. The application of various learning models is capable of producing new discoveries, so this article aims to examine various literature related to the implementation of science learning models in improving

students' scientific argumentation skills at the high school level.

Method

The research analysis used in this method is descriptive analysis by reviewing the results of the last 5 years' research using national and international accredited Scopus indexed article data sources that have been published. Descriptive analysis is a description process based on the data that has been collected. This literature review relating to models, approaches and strategies for learning science to improve Scientific Argumentation skills. Articles are accessed via the internet on the google scholar search page, Science Direct, and Research gate. The keywords used are science learning models, and scientific argumentation skills.

Result and Discussion

Literature study was conducted on 25 articles published in national and international journals that were relevant to students' scientific argumentation skills. The following presents the results of a review of scientific articles in Table 1.

Table 1. Results of Literature Study of Students' Science Scientific Argumentation Ability

Researchers	Article Title	Achievment of Argumentation ability
Zahratul & Suprpto, 2019	Application of Buzz Group Type Class Discussion Learning Models to Improve Scientific Argumentation Ability of Class X MIA Students on Business and Energy Materials	86.24
Siska et al., 2019	Socio Scientific Issues Strategy to Improve Students' Scientific Argumentation Ability on the Respiratory System Concept in Class XI MIPA SMAN 1 Suranenggala	84.57
Putra et al., 2019	The Effect of Argument Driven Inquiry on Students' Argumentation Skills in Respiratory System Material	71.25
Songsil, et al., 2019	Developing scientific argumentation strategies using revised argument-driven inquiry (rADI) in science classrooms in Thailand	66.17
Riwayani et al., 2019	Analysis of students' scientific argumentation abilities in optical material: Problem-based learning assisted by edu-media simulation	47.00
Istiana et al., 2019	Argumentation real-world inquiry to improve students' argumentation skill	68.00
Triani et al., 2020	Application of Socio Scientific Issues Based Learning to Improve Scientific Argumentation Ability	81.67
Roja et al., 2020	Argumentation Ability and Mastery of Rotation Dynamics Concepts with Inquiry Learning for STEM Education in Class XI Students of SMAN 2 Malang	82.15
Ping et al., 2020	Explicit teaching of scientific argumentation as an approach in developing argumentation skills, science process skills and biology understanding	83.60
Admoko et al., 2021	The implementation of Argument Driven Inquiry (ADI) learning model to improve scientific argumentation skills of high school students	87.50
Nurya et al., 2021	The Effectiveness of the STEM Education-Based Children Learning In Science (CLIS) Learning Model on Students' Scientific Thinking Ability	69.60
Firdaos et al., 2021	Argument Driven Inquiry Learning on Temperature and Heat Materials to Improve Students' Scientific Argumentation Ability	72.92

Researchers	Article Title	Achievment of Argumentation ability
Aini & Siprapo., 2021	Implementation of Online Performance Assessment to Measure Scientific Argumentation Ability of Students on Dynamic Fluid Material	83.22
Nisa et al., 2021	Application of E-learning Scientific Critical Thinking Model to Train Scientific Argumentation Skills and Self-Efficacy	81.88
Salsabila Utami et al., 2022	Application of the Argument-Driven Inquiry Learning Model in Stimulating Students' Scientific Argumentation Skills on Acid-Base Material	61.60
Lutfiatul H & Nuha, 2022	The Influence of the Guided Inquiry Model Using a Virtual Laboratory on the Scientific Argumentation Skills of Junior High School Students	76.72
Nur et al., 2022	Analysis of Students' Scientific Argumentation Ability Using Photovoice Media in Light Refraction Material	77.40
Prahestiningtyas & Sulisworo, 2022	Learning Physics Online with the Seesaw Application Based on Scientific Based Learning to Improve Scientific Thinking Ability	78.00
Mutiah & Ulfa, 2022	The Effectiveness of Learning Biology Through the Argument Driven Inquiry Model on Arguing Skills and Student Learning Outcomes	78.12
Wikara et al., 2022	Implementation Of 5E Plus Learning Model On Energy Subject Matter To Improve Students' Argumentation Skills	83.20
Santoso & Jatmiko, 2022	Learning Physics Using the PBL-Online Model to Improve Scientific Arguments for High School Students	85.35
Sandi & Yani, 2023	The Role of Image Animation Media and Active Debate Methods in Improving Arguing Ability	65.00
Putri et al., 2023	Quality of Student Scientific Argumentation Through the Application of Problem-Based Learning With Flipped Classroom Approach	73.40
Hasanah & Ulin Nuha, 2022	The Influence of Problem-Based Learning Model Based on Controversial Issues in Science Learning on Scientific Argumentation Skills of Junior High School Students	79.94

Based on table 1 it can be seen that the highest average value in improving the ability of science scientific argumentation is 87.5. Scientific argumentation ability increases influenced by the Learning Model Argument Driven Inquiry. Scientific argumentation ability can also be seen from the results of the pretest and posttest given. At the pretest, students only had argumentation abilities at levels 1 and 2. Meanwhile, at the posttest, argumentation abilities increased to levels 3 and 4. This was also supported by the results of the analysis of students' oral argumentation skills (Admoko et al., 2021). In addition, it was also found that there was the lowest average score in increasing the ability of scientific argumentation, namely 47.00. This increase is not very significant, but this increase shows that the application of problem-based learning assisted by online simulations is effective for increasing scientific argumentation skills (Riwayani et al., 2019).

Socio scientific issues approach in improving the ability of scientific argumentation was found to have a significant influence. This is because in the learning process students are required to be actively involved and students are given examples of socioscientific issues that occur in everyday life (Siska et al., 2019). Besides that the learning process uses a socioscientific issue approach, students are presented with issues from view of scientific knowledge (scientific background). Besides that, students are required to evaluate the social science

issues presented (evaluation of information), assess their impacts locally, nationally and globally (Triani et al., 2020). The ability of scientific argumentation can be measured through several indicators including claim (claim), data (data), warrant (justification), backing (support), and warrant (disclaimer) (Karlina & Alberida, 2021).

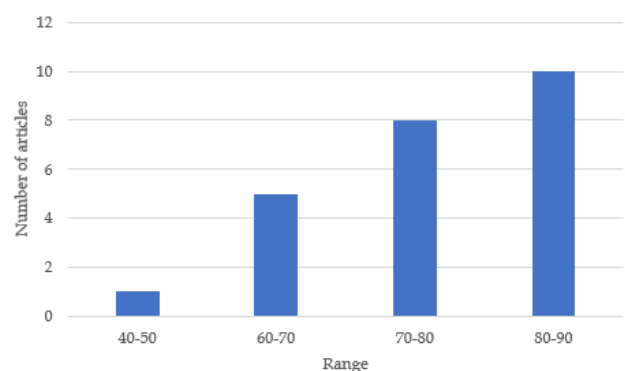


Figure 1. Range Of Average Scientific Argumentation Value in Reviewed Articles

Based on figure 1 can be seen the range of values of increasing scientific arguments based on research that has been done, where the highest value range is 80-90. The value range is obtained based on the research results contained in the 10 articles that have been analyzed.

While the lowest range is in the 40-50 range found in 1 article that has been analyzed

Conclusion

Based on the literature study that has been carried out, it can be obtained that there are various learning models that can be applied in science learning, one of the most effective learning models in improving students' scientific argumentation skills in science is Argument Driven Inquiry with socio scientific issues approach. The highest score range is 80-90. The value range is obtained based on the research results contained in the 10 articles that have been analyzed. While the lowest range is in the 40-50 range found in 1 article that has been analyzed.

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References

- Admoko, Setyo., Hanifah, N., Suprpto, Nadi., Hariyono, Eko., & Madlazim, M. (2021). The implementation of Argument Driven Inquiry (ADI) learning model to improve scientific argumentation skills of high school students. *Journal of Physics: Conference Series*, 1747(1). <https://doi.org/10.1088/1742-6596/1747/1/012046>
- Aini, I., & Siprapo, N. (2021). Penerapan Online Performance Assessment guna Mengukur Kemampuan Argumentasi Ilmiah Peserta Didik Materi Fluida Dinamis. *Inovasi Pendidikan Fisika*, 10(3), 13-20. <https://doi.org/10.26740/ipf.v10n3.p13-20>
- Dawson, V., & Carson, K. (2020). Introducing Argumentation About Climate Change Socioscientific Issues in a Disadvantaged School. *Research in Science Education*, 50(3), 863-883. <https://doi.org/10.1007/s11165-018-9715-x>
- Firdaos, I. N., Pursitasari, I. D., & Permana, I. (2021). Pembelajaran Argument Driven Inquiry Pada Materi Suhu dan Kalor Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa. *Jurnal Penelitian Pendidikan*, 21(2), 88-97. <https://doi.org/10.17509/jpp.v21i2.37134>
- Graesser, A. C., Greiff, S., Stadler, M., & Shubeck, K. T. (2020). Collaboration in the 21st century: The theory, assessment, and teaching of collaborative problem solving. In *Computers in Human Behavior* (Vol. 104). <https://doi.org/10.1016/j.chb.2019.09.010>
- Hasanah, M., & Ulin Nuha, dan. (2023). Pengaruh Model Problem-Based Learning Berbasis Controversial Issues Pada Pembelajaran IPA Terhadap Keterampilan Argumentasi Ilmiah Siswa SMP. <https://jurnal.unej.ac.id/index.php/fkip-epro/article/view/37110>
- Zahratul, H. N., & Suprpto, N. (2019). Penerapan Model Pembelajaran Diskusi Kelas Tipe Buzz Group Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Peserta Didik Kelas X MIA Materi Usaha dan Energi. *Inovasi Pendidikan Fisika*, 8(2), 608-612. <https://doi.org/10.26740/ipf.v8n2.p%25p>
- Istiana, R., Herawati, D., & Ardianto, D. (2020). Argumentation real-world inquiry to improve students' argumentation skill. *JURNAL BIOEDUKATIKA*, 8(2), 131. <https://doi.org/10.26555/bioedukatika.v8i2.12705>
- Putra, J. D., Hasnunidah, N., & Jalmo, T. (2019). Pengaruh Argument Driven Inquiry Terhadap Keterampilan Argumentasi Siswa pada Materi Sistem Pernapasan (Vol. 7, Issue 1). <http://jurnal.fkip.unila.ac.id/index.php/JBT/article/view/17062/12198>
- Karlina, G., & Alberida, H. (2021). Kemampuan Argumentasi Pada Pembelajaran Biologi. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, 5(1), 1-7. <https://doi.org/10.23887/jipp.v5i2>
- Kinantya Paramita, A., Wayan Dasna, I., & Artikel Abstrak, I. (2020). Pembelajaran Inkuiri Terbimbing dengan Pendekatan STEM (Science, Technology, Engineering, Mathematics) untuk Pemahaman Konsep dan Keterampilan Argumentasi Siswa SMA pada Materi Laju Reaksi. <http://journal.um.ac.id/index.php/jptpp/>
- Lestari, A., Ramdani, A., & Bachtiar, I. (2023). Validitas Modul Elektronik Berbasis Socio-Scientific Issues (SSI) Materi Zat Aditif dan Zat Adiktif Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Dan Pemahaman Konsep IPA. *Journal of Classroom Action Research*, 5(1). <https://doi.org/10.29303/jcar.v5i1.2870>
- Lutfiatul Hidayah, T., & Nuha, U. (2022). Pengaruh Model Inkuiri Terbimbing Menggunakan Laboratorium Virtual Terhadap Terhadap Keterampilan Argumentasi Ilmiah Siswa SMP. *Sains Dan Teknologi*, 9(1), 2022-2239. <https://doi.org/10.47668/edusaintek.v8i1.425>
- Roja, M. F. F., Yuliati, L., Suyudi, dan A.,. (2020). Kemampuan Argumentasi dan Penguasaan Konsep Dinamika Rotasi dengan Pembelajaran Inkuiri untuk Pendidikan STEM pada Siswa Kelas XI SMAN 2 Malang. *Jurnal Riset Pendidikan*

- Fisika), 5(2), 129-133. <http://journal2.um.ac.id/index.php/jrpf/>
- Maulidiyah, U., Wahyuni, S., & Ridho, Z. R. (2022). Pengembangan Media Pembelajaran Interaktif Berbasis Articulate Storyline Untuk Meningkatkan Keterampilan Komunikasi Siswa SMP Kelas VII Pada Materi Pencemaran Lingkungan. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, 12(2), 115-124. <https://doi.org/10.24929/lensa.v12i2.239>
- Mutiah, H., & Ulfa, A. Y. (2022). Efektivitas Pembelajaran Biologi Melalui Model Argument Driven Inquiry Terhadap Keterampilan Berargumentasi Dan Hasil Belajar Siswa. In *Jurnal Binomial* (Vol. 5). <https://doi.org/10.46918/bn.v5i1.1235>
- Nisa, H., Rusmansyah, R., Leny, L., & Rahman, Y. (2021). Penerapan Pembelajaran E-Learning Model Scientific Critical Thinking Untuk Melatihkan Keterampilan Argumentasi Ilmiah Dan Self-Efficacy. *JCAE (Journal of Chemistry And Education)*, 4(3), 116-123. <https://doi.org/10.20527/jcae.v4i3.833>
- Nur, F., Nisak, F., & Suprpto, N. (2022). Analisis Kemampuan Argumentasi Ilmiah Siswa Dengan Penggunaan Media Photovoice Pada Materi Pembiasan Cahaya. 11(1), 35-45. <https://doi.org/10.26740/ipf.v11n1.p35-45>
- Nurya, S., Arif, S., Sayekti, T., Faradisya Ekapti, R., Tadris, J., & Ponorogo, I. (2021). Efektivitas Model Pembelajaran Children Learning In Science (CLIS) Berbasis STEM Education terhadap Kemampuan Berpikir Ilmiah Siswa. <http://ejournal.iainponorogo.ac.id/index.php/jtii>
- Ping, I. L. L., Halim, L., & Osman, K. (2020). Explicit teaching of scientific argumentation as an approach in developing argumentation skills, science process skills and biology understanding. *Journal of Baltic Science Education*, 19(2), 276-288. <https://doi.org/10.33225/jbse/20.19.276>
- Prahestiningtyas, T., & Sulisworo, D. (2022). Pembelajaran Fisika secara Online dengan Aplikasi Seesaw Berdasarkan Scientific Based Learning untuk Peningkatan Kemampuan Berpikir Ilmiah. *Jurnal Penelitian Pembelajaran Fisika*, 13(1), 81-94. <https://doi.org/10.26877/jp2f.v13i1.11108>
- Putri, M. D., Lubis, N. A., & Fairuz, T. (2023). Quality of Student Scientific Argumentation Through the Application of Problem-Based Learning With Flipped Classroom Approach. *Jurnal Penelitian Pendidikan IPA*, 9(1), 369-377. <https://doi.org/10.29303/jppipa.v9i1.2504>
- Rahayu, R., Iskandar, S., & Abidin, Y. (2022). Inovasi Pembelajaran Abad 21 dan Penerapannya di Indonesia. *Jurnal Basicedu*, 6(2), 2099-2104. <https://doi.org/10.31004/basicedu.v6i2.2082>
- Retno Fatmawati, D., & Ramli, M. (2018). Meningkatkan Kemampuan Argumentasi Siswa melalui Action Research dengan Fokus Tindakan Think Pair Share Increasing (Vol. 15). <https://jurnal.uns.ac.id/prosbi/article/view/31790>
- Riwayani, R., Perdana, R., Sari, R., Jumadi, J., & Kuswanto, H. (2019). Analisis kemampuan argumentasi ilmiah siswa pada materi optik: Problem-based learning berbantuan edu-media simulation. *Jurnal Inovasi Pendidikan IPA*, 5(1), 45-53. <https://doi.org/10.21831/jipi.v5i1.22548>
- Salsabila Utami, S., Sari, R., Aisyah, S., Affifah, I., Kimia, P. P., Sultan, U., & Tirtayasa, A. (2022). Application of the Argument-Driven Inquiry Learning Model in Stimulating Students' Scientific Argumentation Skills on Acid-Base Material. *Jurnal Pendidikan Kimia Indonesia*, 6, 38-45. <https://doi.org/10.23887/jpk.v6i1>
- Sandi Wisdua Lubis, S., & Yani, N. (2023). Peran Media Animasi Gambar dan Metode Debat Aktif dalam Meningkatkan Kemampuan Berargumentasi. In *Educator Development Journal* (Vol. 1, Issue 1). <https://doi.org/10.2022/edj.v1i1.2483>
- Santoso, F. K. R., & Jatmiko, B. (2022). Pembelajaran Fisika Dengan Model Pbl-Online Untuk Meningkatkan Argumentasi Ilmiah Peserta Didik Sma. *Jurnal Pendidikan Fisika*, 11(1), 48. <https://doi.org/10.24114/jpf.v11i1.34622>
- Siska, Yunita, & Ubaidillah, M. (2019). Strategi Socio Scientific Issues untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa pada Konsep Sistem Respirasi Di Kelas XI MIPA SMAN 1 Suranenggala. *Jurnal Ilmu Alam Indonesia*, 2(1), 50-69. www.syekhnurjati.ac.id/jurnal/index.php/jia
- Songsil, W., Pongsophon, P., Boonsoong, B., & Clarke, A. (2019). Developing scientific argumentation strategies using revised argument-driven inquiry (rADI) in science classrooms in Thailand. *Asia-Pacific Science Education*, 5(1), 1-22. <https://doi.org/10.1186/s41029-019-0035-x>
- Triani, W., Maryuningsih, Y., & Mujib Ubaidillah, dan. (2020). Penerapan Pembelajaran Berbasis Socio Scientific Issues Untuk Meningkatkan Kemampuan Argumentasi Ilmiah. *Jurnal Pendidikan Sains & Matematika*, 8(1).
- Wikara, B., Sutarno, S., Suranto, S., & Sajidan, S. (2022). Implementation Of 5e Plus Learning Model On Energy Subject Matter To Improve Students' Argumentation Skills. *Jurnal Pendidikan IPA Indonesia*, 11(2), 237-245. <https://doi.org/10.15294/jpii.v11i2.30567>