

Analysis of the Implementation of Argument Driven Inquiry (ADI) in Students' Argumentation Skills

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Abstract: This study uses a literary study method using a type of qualitative research which aims to describe a suitable learning model to improve students' argumentation skills, namely the Argument Driven Inquiry (ADI) model because it requires students to learn independently to understand material concepts and practice directly. In the ADI model there is a syntax that the teacher can apply to students during science learning so that students are able to convey their arguments correctly and correctly based on existing material concepts. Because to face the challenges of 21st century education, skills such as thinking skills, analytical skills, and creativity skills are needed. Of the 56 articles found with similar topics, 13 were selected to obtain 13 articles which were analyzed to obtain the result that the existence of the Argument Driven Inquiry (ADI) model was able to improve students' argumentation abilities in the sense of students' ability to think critically in facing a problem or solving a problem, increasing students' understanding skills to the concept of science material presented by the teacher, and improve students' ability to practice directly in the environment so that they better understand events around them so as to be able to provide solutions in an argumentative manner related to theoretical science.

Keywords: Analysis; Argument Driven Inquiry; Argumentation Skills

Introduction

In the regulations made by the Indonesian Ministry of Education and Culture it is stated that in the world of education there are several aspects that can be produced in the learning process written in Number 22 of 2016 (2016 Education). There are physical skills (hard skills) and mental skills (soft skills) that can be acquired and trained by someone from scientific activities. Where these two things can be implemented with the existence of communication to students. In the 21st century, information from (Pacific Policy Research Center 2010) states that there are 4C demands that must be owned by students and are an important requirement to face the 21st century. The 4C skills are Critical Thinking, Creativity, Collaboration, and Communication. These 4C skills will later require students to communicate well because it is very much needed to be able to convey an argument from the results of observation or direct practice based on activities that are analyzed in oral or

written form. With this in mind, argumentation is a skill that students must have, because argumentation skills are often considered very significant to existing educational goals and have an important role in learning science (Bao & Koenig, 2019).

Argumentation can be interpreted as an element that has several structures and strategies used to solve a problem by using argumentative sentence statements (Widhi et al., 2021). Argumentation can be defined as a verbal, social, and rational activity that has the goal of convincing a reasonable or logical critic about the acceptability of a point of view by putting forward a constellation of propositions that justify or can deny the proposition that has been given. Argumentation is said to be an ability that is considered important to be developed in order to be able to assist individual abilities in this case, namely students to be actively involved in learning, by creating ideas, and in assessing various viewpoints of opinion, taking into account the scientific evidence that will be provided and also able to make the

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right decisions from every problem that has been faced by students and presented by the teacher (Ambarawati et al., 2021). Ability in argumentation is a very important thing to analyze for every student in school, because argumentation is able to direct students to have the ability to express opinions from different points of view in the form of arguments, by providing several reasons or evidence based on facts in the surrounding environment, as well as being able to evaluate what has been presented, as well as providing justification for information from various sources during the investigation or observation process so that it can lead to a conclusion that is also supported by scientific theory or IPA. Seeing the importance of argumentation skills to face the 21st century, we know that this ability needs to be developed in students through a learning process in appropriate schools (Widiastiningsih & Effendihasibuan, 2022)

However, seeing the reality that there is, there is no learning in schools that specifically trains students' argumentation abilities specifically. The survey results obtained support the problem that from the Ministry of Education and Culture it shows that there are only 2% of junior high school students in Indonesia who apparently have the ability to claim statements by providing an argument in writing in the best possible and patterned manner (Songsil et al., 2019). The results of other studies show that there are students who are only able to provide answers by claiming a problem, have not been able to include reasons that connect with scientific evidence. The lack of students' argumentation abilities in the learning process as well as problem solving, makes teachers aware that the importance of argumentation skills is trained. The purpose of having this argumentation ability is to be able to clarify and improve some of the existing ideas, so that in this way an appropriate and good, and correct decision can be taken. One of the techniques used to assess, classify students, and show a quality or level of argumentation that students have is to use a pattern that is easy to understand and apply, namely Toulmin's Argument Pattern (TAP). This TAP pattern can consist of data that supports a given claim so that it can be strengthened by a warrant or justification linking the claim and data, based on backing or support according to IPA theory, but can be rebutted from a different point of view. This will later be interrelated between existing TAP patterns such as data, claims, warrants, backing, and rebuttals.

The implementation of Argument Driven Inquiry will train students' argumentation skills so that they are able to convey arguments properly and precisely both orally and in writing. Arguments that students are trying to build as in the activity of expressing an idea or opinion from several points of view related to the causes of pollution, as well as the impact of pollution on the

environment, or in the form of ideas (ideas) and solutions to overcome existing problems in the environment surrounding. In accordance with what was disclosed (Mcneill et al., 2016), that there is a process in building a knowledgeable society that can be encouraged by the existence of argumentation skills as an implication of the existence of 21st century skills. On the other hand, a student's argument is considered to be developed through a learning process in a group or individual discussion activity with the teaching teacher, so that in this study the role of the Argument Driven Inquiry (ADI) learning model will be analyzed which can only improve students' abilities in argumentation skills according to understanding. Analysis of the argumentation abilities of students aims to be able to find out the argumentation skills possessed by students, so that later the initial ability data that has been obtained in this argument can be used by teaching teachers to be able to determine a learning design that is more appropriate and appropriate for students in future learning (Martini et al., 2021).

However, it is known that it not only requires or directs students to understand concepts or material being taught, but also is able to build or train their abilities in terms of argumentation according to the existing Toulmin pattern. So that teachers and elements in schools can realize that what model is right to be able to measure students' argumentation skills (Petersburton & Stehle, 2019), so that students in schools are able to deal with 21st Century skills as well and as much as possible. The success of learning in the classroom is very much determined if the learning process carried out is able to develop the potentials that exist in students so that students need to get what is directly beneficial in their personal development and scientific attitudes.

Method

This research method uses the Literature Review Study method or literature study with a qualitative research type. Literature study can be reached by collecting several references consisting of several previous studies which are then compiled to draw conclusions from the results of the analysis. The results of the compilation of several previous studies were used to conclude the effect of the implementation of the Toulmin pattern on students' argumentation skills.

The data analysis technique that can be used in this study is using the article content analysis method which can be used to obtain a valid inference and is able to re-examine based on the context of the discussion. In the analysis, selection, comparison, merging, and sorting will be carried out so that relevant things can be found (Irvan & Admoko, 2020). Checks carried out between

libraries and paying attention to supervisor comments are carried out in order to maintain the immutability of the process of evaluating several articles that have been obtained, preventing and eliminating misinformation which is a human misunderstanding that may arise or occur due to a lack of literature writer (Afgani et al., 2020).

Result and Discussion

Based on the results of the classification of articles that have been found in the research category with the topic of discussion "Implementation of Argument Driven Inquiry to Improve Students' Argumentation Skills" 56 articles were obtained that matched the topic of the matter to be studied, then a screening was carried out regarding the similarity of the article titles. After the screening process was carried out, there were 25 articles with the same title. Furthermore, 25 articles were screened based on the suitability of the requirements with the inclusion criteria and exclusion criteria, so only 13 articles were obtained that had the same title and content of article discussion. The following is a literature search strategy in Table 1.

Table 1. Literature search strategy based on RQ, Inclusion and Exclusion

Indeks Journal	Sinta				
	1	2	3	4	5
Search results	3	5	4	21	23
Fulltext, pdf, 2016-2022	3	5	4	21	23
Appropriate title	1	2	2	13	7
Based on title criteria					25
Based on inclusion criteria					13
Result					13

In the table 1, it can be seen that the process of searching for articles that match the object of a study can be taken from Google Scholar sources and in fact 56 articles were obtained. A total of 52 articles indexed by the Science and Technology Index (SINTA) were obtained and analyzed based on journals through search engines on the existing website, namely www.sinta.ristekbrin.go.id. Meanwhile, there are 4 articles that have not been indexed by SINTA, so these articles cannot be included in the search process for appropriate literature studies. Articles based on eligibility which have several studies that must be carried out from various provinces in Indonesia. From the results of the analysis of the 25 articles, it turned out that there were 14 articles with a qualitative descriptive research design, then 5 articles using a review article design, 4 articles using a quasi-experimental design and 2 other articles using a descriptive approach. After reviewing from several aspects of the assessment of the

quality of existing studies from 25 articles extracted the data contained therein.

Based on the analysis of the article, we can see that the implementation of Argument Driven Inquiry has an effect on students' learning and argumentation skills, although there are still challenges in implementing the ADI learning model. According to the journal (Ginanjar et al., 2015) which supports that the ADI model is a learning model that is capable of being inquiry-oriented which can emphasize or demand argumentation activities which turn out to be able to train students to have good argumentation skills. The ADI model syntax can include four stages, namely: (1) problem identification; (2) collect data; (3) making tentative arguments; and (4) argumentation session. In the first stage, namely problem identification, students are asked to identify a problem based on the physical phenomena presented by the teacher in the classroom. The teacher then explains the main problem topics in laboratory activities that will be carried out by students. At the data collection stage, students are also trained to develop initial claims in the form of temporary hypothesis formulation as a form of temporary answers to problems for further discussion regarding appropriate data collection procedures. Learners work in collaborative groups with the aim of designing or implementing work procedures as a steps to answer experimental or practicum problems explained in the early stages. This stage is considered capable of training students to be able to design a work procedure that is believed to be more effective and also to carry out an investigation to obtain data and analyze the experimental data at the stage of making a tentative argument and to be able to train students' abilities to be able to develop a scientific argument existing ones based on Toulmin Argumentation Pattern (TAP) through group discussion activities in class.

The Argument-Driven Inquiry (ADI) model is considered capable of facilitating and serving students to be able to carry out arguments through several phases or stages in the tentative argument and the final stage of the argumentation session, so that in this way students will be able to cultivate their habits in terms of scientific thinking. The results of this study found that it was in accordance with the benefits of the Argument Driven Inquiry model that had been applied according to Nazila et al. (2019) which also stated that the Argument Driven Inquiry learning model was considered to be able to help develop students' scientific literacy abilities and also help students in terms of improving their habits. how to think scientifically which was not previously a habit of students in learning.

According to the article Lulu'Atul Farida et al. (2018), supports it by stating that the application of an ADI model in class can actually make students able to

argue scientifically, because at its stage there is also an argumentation session. In the third stage, the tentative argument production stage, therefore students and their groups will make an argumentation scheme composed of 3 parts, namely a claim, evidence, and warrant/backing. Claims referred to here can be in the form of several statements which turn out to be answers to questions from research or a problem, evidence can be in the form of several facts that can be obtained based on a direct experiment, and warrants/backing can be in the form of rational or logical reasons based on why the evidence can be used to support a claim. Then looking at the existing stage, namely the fourth stage, namely the interactive session of the arguments presented by the researcher, students will be given an opportunity to assess or revise an argument they have after discussion with other groups in the class, and at this stage too, students will be trained to be able to observe the quality of an existing argument based on argumentation patterns such as claims, evidence and warrants/backing both from their own group and from other groups that have been directly observed.

According to an article from Utami & Dasna (2022) who also participated in stating that one of the ADI learning models is more effective for use in developing argumentation skills compared to the guided inquiry model that was previously applied. Through the ADI model students are taught and required to write arguments in laboratory activities by using their scientific thinking and encouraging students to think critically and also think logically in expressing arguments so that they can connect a series of facts into a concept that can be related to the ongoing learning material. Viewed as a whole, students' scientific argumentation abilities can experience an increase in each indicator after learning Argument Driven Inquiry (ADI) in the learning process.

Table 2. Argumentation Level Criteria

Level	Criteria
1	Arguments that contain one claim and can counter other claims.
2	Arguments that have arguments from a claim against other claims are assisted by the presence of data, warrants, backing, but do not contain a refutation.
3	Arguments that have arguments with a series consisting of claims or counter claims, data, warrants, backing and rebuttals are still considered weak.
4	Arguments that show arguments with clear rebuttals and contain several different claims
5	Arguments that can present an argument that can be expanded with more than one clear rebuttal.

According to the article by (Ningtyas et al., 2018) it shows that by implementing an ADI learning model which is specifically designed to achieve an achievement from scientific observation or learning as a form of effort to grow an argument that also supports an explanation of a research question. As it turns out, the criteria for the level/level of argumentation skills possessed by each student, which certainly have differences, can be seen in Table 2.

In (Kleimola & Leppisaari, 2022) it is also stated that there is a lesson that can be used in an effort to improve and train students' argumentation skills which turn out to be able to use the Argument-Driven Inquiry (ADI) model. One of the things that can encourage students to carry out an experimental activity which will later be able to foster an understanding of important concepts from students and also practical in the science learning process by using an effective Argument-Driven Inquiry learning model. The process of selecting an inappropriate learning model by the teacher in a learning process which will later cause various kinds of problems such as the low ability of students to solve a problem which will have an impact on students' critical thinking skills which are relatively weak, therefore in the application of the Argument Driven model Inquiry (ADI) students will be directed to immediately be able to provide many arguments or communicate among fellow students in the class so that they can convey their respective arguments both orally and in writing (Irfando et al., 2020). Evidence states with the results of the N-gain test that student results increase due to the implementation of the ADI learning model which can be seen in Figure 1.

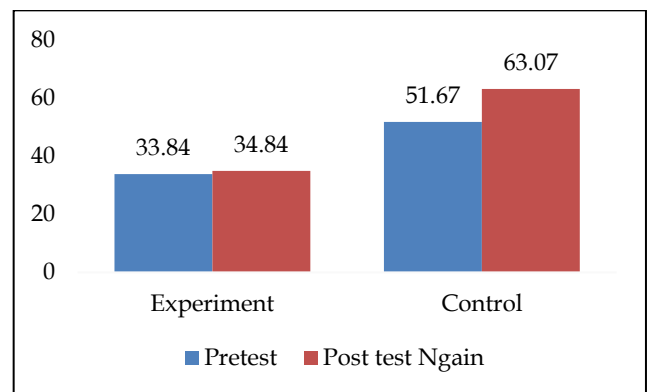


Figure 1. Average Percentage Value Control Class and Experimental class

According to Ika Noviyanti et al. (2019), it also supports that the application of the Argument-Driven Inquiry (ADI) learning model is a learning model specifically made to prepare students and provide opportunities for students to be able to develop a method and their own understanding in acquiring some

data, by carrying out an investigative activity on a problem, and using the data that has been obtained to answer several questions related to environmental observations, writing and being able to think more speculatively. This ADI model turns out to be able to provide an opportunity for students during the learning process to be directly involved in scientific argumentation and peer review, its application in the science learning process is indeed not an easy thing because students will really be required to think independently and independently learn about a material concept. Science because the ADI model applied will present an integrated meaningful learning in the short term with efforts to support students actively involved in work with integrity so that this can improve students' understanding of conceptual and practical material. So that it is able to make the teacher aware that the importance of the ADI model is applied in the learning process. With this, students are able to independently work on questions that require analysis and the solutions presented. Students will have the ability to think scientifically in overcoming existing problems.

According to the article by Turiman et al. (2012) application of one of the ADI learning models will lead to being able to train students to be skilled in arguing by going through all the stages in the syntax, especially at the stages of preparing tentative arguments and interactive discussion of arguments between students. At the stage of generating an argument, students will be asked to be able to make an argument consisting of explanations, evidence based on facts, and theoretical reasons. In addition to the learning model there are other factors that cause it, that it turns out that argumentation skills can also be influenced by gender. Gender which has the same meaning as the difference in gender, which consists of men and women by revealing that it turns out that women have more abilities in terms of conveying an opinion to other people or other parties. Seeing a different side in responding to a problem, the male students here turned out to have curiosity and a sense of interest that was considered to be greater than a female in that regard. There are criteria for giving a score to an argument shown in Table 3.

Analysis of the article Afandi et al. (2021) states that ADI learning will later provide an opportunity for students to learn how to generate methods to be able to generate data, by carrying out an investigative activity, by using data to answer several research questions by how to write, and carry out a discussion activity that is more effective after direct investigation activities are carried out so that through this combination students can understand some of the content that is considered important from the existence of a learning process which is carried out to encourage students to understand a science material concept. According to Williams (2021),

the ADI model that is applied is proven in the learning process that is applied in the class to be able to familiarize students with good arguments. Then get arguments from class discussion groups carried out in the explicit reflective phase, students will later express their opinions from each group in this argumentation phase regarding what they have done in their respective groups in class. Where next, other groups will also be given the opportunity to be able to express their opinions from a different point of view. That way, students in this phase will be more active in the ongoing learning process. In Figure 2 it can be seen that there is an increase in student results with the ADI model applied in the science learning process.

Table 3. Argumentation Score Framework

Score	Descriptor
1	An argument can consist of several arguments with a counter claim or a claim against another claim that is different
2	Arguments also have arguments that are composed of patterns of claims, data, warrants or backings, but do not contain rebuttals or disclaimers
3	An argument can have arguments with a series of claims or counter claims with data, warrants or backings, with arguments too weak to defend
4	Arguments also denote arguments with claims of a clearly identifiable rebuttal, such as an argument that has several claims in it and counter claims but is not required to be presented
5	Argumentation is also capable of presenting extended arguments with more than one rebuttal or rebuttal given

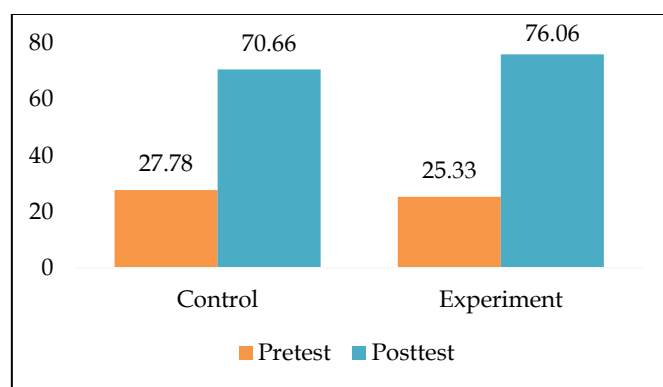


Figure 2. The average result of the percentage of Pre-test and post-test

The application of Argument Driven Inquiry certainly has its own challenges, which often occurs when teachers do not understand the syntax of the ADI model. So it is not uncommon for students to be less familiar with the ADI model which places more emphasis on argumentation skills and ways of thinking about understanding material concepts. Even though after applying the ADI model, there are lots of influences

experienced by students as obtained from some of the analysis of the articles above. The ADI model can improve students' ability to argue so that students better understand a problem related to everyday life, the concept of material explained by the teacher, and students are able to think critically about a problem presented. According to the Ishimine & Bennett (2010), article which states that students excel in argumentation skills because of students' understanding of the material concepts that have been explained so that students' claim skills are very high in answering argumentation questions.

Conclusion

Based on the analysis of the review study results, it can be concluded that the Argument Driven Inquiry (ADI) learning model has an influence that is able to improve science learning better. The implementation of the Argument Driven Inquiry (ADI) model can be sourced from various teaching materials such as modules, books, worksheets, so that these teaching materials can be assigned to teachers as teaching materials during the science learning process. As a teaching material, the ADI model can be applied during the learning process so that it can improve students' ability to build their understanding of a material and a problem presented, so that students will begin to confidently give opinions or arguments from the point of view of each different student. That way the teacher familiarizes students with the ADI learning model.

Author Contributions

The main author, Annisa Setiawan, contributed to designing research, conducting research, and writing research of articles. The second author, Jumadi who played a role in guiding the research to writing articles. And all authors have read and support to the published version of the articles.

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Conflicts of Interest

The authors declare no conflict of interest.

References

- Afandi, A., Tenriawaru, A. B., & Anita, A. (2021). Konstruksi Perangkat Pembelajaran Menggunakan Model Argument Driven Inquiry (Adi) Disertai Socioscientific Issues (Ssi). *Biologi Edukasi: Jurnal Ilmiah Pendidikan Biologi*, 13(1), 6–16. <https://doi.org/10.24815/Jbe.v13i1.19920>
- Afgani, T., Hasnunidah, N., & Subakti, A. (2020). Pengaruh Model Pembelajaran Argument-Driven Inquiry (Adi) Dan Gender Terhadap Keterampilan Argumentasi Siswa. *Assimilation: Indonesian Journal of Biology Education*, 8(1), 1–10. <https://doi.org/10.17509/Aijbe.v1i2.13046>
- Ambarawati, D. S. H. E., Muslim, M., & Hernani, H. (2021). Analisis Kemampuan Argumentasi Siswa Smp Pada Materi Pencemaran Lingkungan. *Inkuiri: Jurnal Pendidikan Ipa*, 10(1), 13–17. <https://doi.org/10.20961/Inkuiri.v10i1.29780>
- Bao, L., & Koenig, K. (2019). Physics Education Research For 21st Century Learning. *Disciplinary And Interdisciplinary Science Education Research*, 1(1), 1–12. <https://doi.org/10.1186/s43031-019-0007-8>
- Ginanjari, W. S., Utari, S., & Muslim, M. (2015). Penerapan Model Argument-Driven Inquiry Dalam Pembelajaran Ipa Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa SMP. *Jurnal Pengajaran MIPA*, 20(1), 32–37. Retrieved from <https://ejournal.upi.edu/index.php/jpmipa/article/view/36195>
- Ika Noviyanti, N., Rosyadah Mukti, W., Dahlia Yuliskurniawati, I., Mahanal, S., & Zubaidah, S. (2019). Students' Scientific Argumentation Skills Based On Differences In Academic Ability. *Journal Of Physics: Conference Series*, 1241(1). <https://doi.org/10.1088/1742-6596/1241/1/012034>
- Irfando, I. K., Sadewa, D., Rosidin, U., Distrik, I. W., Keguruan, F., & Lampung, U. (2020). Pengaruh Penerapan Model Argument Driven Inquiry Terhadap Keterampilan Berpikir Kritis Siswa Smp Berdasarkan Perbedaan Gaya Belajar. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, 12(1), 14–23. Retrieved from <http://repository.lppm.unila.ac.id/26201/>
- Irvan, A., & Admoko, S. (2020). Analisis Kemampuan Argumentasi Ilmiah Siswa Berbasis Pola Toulmin's Argument Pattern (Tap) Menggunakan Model Argument Driven Inquiry Dan Diskusi Pada Pembelajaran Fisika Sma. *Inovasi Pendidikan Fisika*, 9(3), 318–324.
- Ishimine, K., & Bennett, J. (2010). Quality And Early Childhood Education and Care: A Policy Initiative For The 21st Century. *International Journal of Child Care and Education Policy*, 4(2), 67–80. <https://doi.org/10.1007/2288-6729-4-2-67>
- Kleimola, R., & Leppisaari, I. (2022). Learning Analytics To Develop Future Competences In Higher Education: a Case Study. *International Journal of Educational Technology in Higher Education*, 19(1). <https://doi.org/10.1186/s41239-022-00318-w>
- Martini, Widodo, W., Qosyim, A., Mahdiannur, M. A., & Jatmiko, B. (2021). Improving Undergraduate Science Education Students' Argumentation Skills Through Debates On Socioscientific Issues. *Jurnal Pendidikan Ipa Indonesia*, 10(3), 428–438. <https://doi.org/10.15294/Jpii.V10i3.30050>

- Mcneill, K. L., Katsh-Singer, R., González-Howard, M., Loper, S., Mcneill, K. L., Katsh-Singer, R., & González-Howard, M. (2016). Factors Impacting Teachers' Argumentation Instruction in Their Science Classrooms. *International Journal of Science Education*, 38(12), 2026-2046. <https://doi.org/10.1080/09500693.2016.1221547>
- Nazila, L., Rosidin, U., Distrik, I. W., Herlina, K., & Hasnunidah, N. (2019). The Effect Of Applying Argument Driven Inquiry Models To The Critical Thinking Skills Of Students Based On Gender Differences. *Scientiae Educatia: Jurnal Pendidikan Sains*, 8(1), 36-50. Retrieved from <http://repository.lppm.unila.ac.id/19748/>
- Ningtyas, N., Hasnunidah, N., & Sikumbang, D. (2018). Pengaruh Model Pembelajaran Argument-Driven Inquiry Terhadap Keterampilan Argumentasi Siswa. *Jurnal Bioterdidik: Wahana Ekspresi Ilmiah*, 6(5), 12-21. Retrieved from <http://repository.lppm.unila.ac.id/9994/>
- Peters-Burton, E. E., & Stehle, S. M. (2019). Developing Student 21 St Century Skills in Selected Exemplary Inclusive Stem High Schools. *International Journal of Stem Education*, 6(1), 1-15. <https://doi.org/10.1186/s40594-019-0192-1>
- Lulu'Atul Farida, L. F., Undang Rosidin, U. R., & Hasnunidah, N. (2018). Pengaruh Penerapan Model Pembelajaran Argumentdriven Inquiry (Adi) Terhadap Keterampilan Argumentasi Siswa Smp Berdasarkan Perbedaan Jenis Kelamin. *Journal of Physics and Science Learning*, 2(2), 25-36. Retrieved from <http://repository.lppm.unila.ac.id/10556/>
- 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>
- Turiman, P., Omar, J., Daud, A. M., & Osman, K. (2012). Fostering The 21st Century Skills Through Scientific Literacy And Science Process Skills. *Procedia-Social And Behavioral Sciences*, 59, 110-116. <https://doi.org/10.1016/j.Sbspro.2012.09.253>
- Utami, P. Q., & Dasna, I. W. (2022). Penerapan Model Pembelajaran Argument Driven Inquiry Terhadap Kemampuan Argumentasi Ilmiah. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 7(4), 122-129. Retrieved from <http://journal.um.ac.id/index.php/jptpp/article/view/15217>
- Widhi, M. T. W., Hakim, A. R., Wulansari, N. I., Solahuddin, M. I., & Admoko, S. (2021). Analisis keterampilan argumentasi ilmiah peserta didik pada model pembelajaran berbasis toulmin's argumentation pattern (TAP) dalam memahami konsep fisika dengan metode library research. *PENDIPA Journal of Science Education*, 5(1), 79-91. <https://doi.org/10.33369/Pendipa.5.1.79-91>
- Widiastiningsih, R., & Effendi-Hasibuan, M. H. (2022). Pengembangan E-Modul Berbasis Pola Argumentasi Toulmin Untuk Meningkatkan Argumentasi Siswa Pada Materi Asam Basa. *PENDIPA Journal of Science Education*, 6(2), 410-414. <https://doi.org/10.33369/pendipa.6.2.410-414>
- Williams, H. P. (2021). The Role of Federal and State Policy in Addressing Early Childhood Achievement Gaps: Parent Perceptions and Student Outcomes Related To 21st Century Learning Centers Programming In The United States. *International Journal of Child Care and Education Policy*, 15(1), 1-13. <https://doi.org/10.1186/s40723-021-00093-7>