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ORIGINAL RESEARCH

Learning alternative energy material using the argument driven inquiry (ADI) model assisted by wizer.me to practice scientific argumentation skills

Alfiah Setiawati, Aripin, Yanti Sofi Makiyah

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Abstract
This research is motivated by the suboptimal scientific argumentation skills of students in Physics learning at SMA Negeri 5 Tasikmalaya. Scientific argumentation skills are important for building conceptual understanding based on data and rational explanations. To address this problem, learning was implemented using the Argument Driven Inquiry (ADI) model assisted by Wizer.me which is designed to develop students' scientific argumentation skills. The main focus of this research is to examine the extent to which the ADI model contributes to scientific argumentation skills in alternative energy materials. This research applies a quasi-experimental approach with a matched-only posttest-only control group design. The sample consisted of two classes selected by purposive sampling, namely X-8 as the control and X-11 as the experiment, each totaling 36 students. Measurement of scientific argumentation skills was trained through a posttest in the form of an essay that includes 5 questions based on five indicators of scientific argumentation. Data analysis includes expert validation, instrument testing, model implementation analysis, prerequisite testing, and t-test ($\alpha = 0.05$) which was applied as an analysis procedure to test the validity of the hypothesis. The results prove that t_count>t_table, namely 4.7 > 1.67, this result in H_0 being rejected and H_a being accepted. Therefore, the application of the ADI model assisted by Wizer.me has a significant influence on the development of scientific argumentation skills.

Keywords: ADI Model · Wizer.me · Scientific Argumentation Skills · Alternative Energy

INTRODUCTION

Education is a crucial medium for developing individual abilities. Furthermore, education plays a crucial role in educating the nation and developing high-quality, high-achieving students. Through education, individuals can be holistically developed because the educational process helps individuals recognize, understand, and recognize various aspects of daily life (Tarigan et al., 2022). Law Number 20 of 2003 concerning the National Education System defines education as a conscious and structured process designed to create a learning environment that enables students to develop optimally, both in spirituality, self-control, intelligence, noble character, and skills that benefit themselves and society (Ujud et al., 2023).

Currently, the education system adheres to the Independent Curriculum. This curriculum is designed to address the challenges of learning delays that impact student competency achievement through the presentation of more varied intracurricular learning that aligns with the needs of 21st-century education (Lestari et al., 2023). Education in the 21st century

✉ Yanti Sofi Makiyah
yanti.sofi@unsil.ac.id

Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Siliwangi, Tasikmalaya, Indonesia

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emphasizes the development of critical thinking skills. One concrete manifestation of critical thinking skills is argumentation skills (Zubaidah, 2018). This skill is crucial because it enables students to express opinions rationally, supported by evidence and logical reasoning. Students skilled in argumentation are expected to be able to gather information, formulate valid claims, and deliver logical and well-structured rebuttals (Santoso & Jatmiko, 2022).

Argumentation skills are a key focus in 21st-century education. Students' academic achievement has the potential to improve through the application of learning strategies that encourage them to ask questions and actively present arguments. Characteristics of scientific argumentation skills include scientific literacy, critical thinking, logical reasoning, and metacognitive communication skills (Santoso & Jatmiko, 2022). According to Dulim (2022), physics learning has great potential to develop scientific argumentation skills, enabling students to demonstrate clear reasoning skills through various activities based on critical thinking in constructing scientific arguments (Nazidah et al., 2022). In everyday life, scientific argumentation skills are crucial because they help individuals make decisions based on evidence and critical reasoning, especially when dealing with current issues such as hoaxes and environmental problems. However, the level of mastery of these skills among students is still relatively low (Olii et al., 2025). Where learning in schools still emphasizes memorizing information rather than evidence-based discussions and logical reasoning (Sampson & Gleim, 2009).

A preliminary study at SMA Negeri 5 Tasikmalaya showed that the Independent Curriculum has been implemented in the school environment. However, classroom learning activities are still teacher-centered, with the teacher being the sole source of knowledge for students. Physics learning activities are still dominated by material delivery methods and have not fully utilized learning models that support the development of students' argumentative skills. Grade 10 Physics material is delivered generally according to the Independent Curriculum guidelines, because at that level there is no specialization based on student interests, so learning does not optimally accommodate individual needs. Physics learning, which contains many theoretical concepts, requires strong argumentative skills. These skills help students express their opinions and views on the material being studied. The ability to argue scientifically can build a dynamic and conducive learning environment and enable students to be directly involved in learning activities. Thus, mastery of scientific argumentative skills is a crucial aspect in efforts to improve learning effectiveness and student competency achievement.

The results of a preliminary study using a descriptive test instrument revealed that students' scientific argumentation skills were still at a low level. Most students were only able to achieve the third indicator, namely providing reasons or warrants, and had not yet demonstrated optimal achievement in the other indicators (Mcneill & Krajcik, 2008). The percentage breakdown for each indicator of scientific argumentation skills is shown in Table 1.

Table 1. Results of the Preliminary Study of Scientific Argumentation Skills

No.	Indicator	Percentages (%)	Category
1	Claim	54.6	Moderate
2	Data	40.3	Low
3	Warrant	23.4	Low
4	Backing	27.9	Low
5	Rebuttal	18.1	Very Low
Average		33	Low

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This table presents the findings of a preliminary study evaluating students' scientific argumentation skills based on five indicators: claim, data, warrant, backing, and rebuttal. Based on these results, the claim indicator is in the moderate category, while data, warrant, and backing are low, and rebuttal is classified as very low. These findings indicate students' improved ability to present claims and link data, but they still need reinforcement in the aspects of support, reasoning, and rebuttal in developing scientific arguments.

Researchers have interviewed several students who stated that the learning methods used in class are still difficult to grasp quickly. This encourages students to study independently to deepen their understanding of the material using the internet or other learning resources. Students also revealed that if they do not engage in independent study at home, their grades tend to be unsatisfactory. This situation requires the implementation of innovative learning models that play a role in developing students' confidence in arguing and motivating them to improve these skills. As one of the solutions offered, researchers implemented the Argument Driven Inquiry (ADI) model assisted by Wizer.me to observe its impact on training the quality of students' scientific argumentation skills.

The Argument Driven Inquiry (ADI) model was chosen because it guides students in systematically presenting scientific arguments through structured stages. The ADI model emphasizes the use of data as the basis for arguments and encourages interactive discussion and revision based on peer feedback (Hasnunidah et al., 2025). Firdaos et al. (2021, pp. 88-97) demonstrated that this model effectively improves argumentation skills, with an average gain (*N*-gain = 0.67) higher than the control class.

Research by Firdaos et al. (2021) demonstrated the effectiveness of the ADI model in improving students' scientific argumentation skills but did not integrate technological media into the learning process. Rizkia & Aripin (2022) also confirmed that scientific argumentation supports conceptual understanding and strengthens evidence-based claims. Therefore, this study developed a Wizer.me-assisted ADI model as an innovative effort to address the challenges of 21st-century learning while optimizing students' argumentation skills. The syntax of the ADI model is problem identification, data collection, tentative argument development, interactive argument sessions, report creation, revision process, peer review, discussion, and reflection (Fitria et al., 2025).

Wizer.me was selected as a supporting medium based on its ability to support scientific argumentation skills through interactive learning (Amanda et al., 2025). This platform serves as a means of developing e-LKPD and technology-based evaluations relevant to 21st-century demands (Odja et al., 2025). Wizer.me has proven effective in helping teachers design interactive digital LKPD, increasing student participation, facilitating access to materials, and creating more engaging and meaningful learning experiences (Erawati et al., 2023).

Empirical data collected through observation and interviews indicate a tendency for students to require more effective learning models to facilitate discussions, encourage courage in expressing opinions, and develop critical thinking skills through argumentative activities. Current learning practices have not supported active interaction and students' ability to convey scientific arguments based on data and evidence. Based on these findings, the researcher is interested in designing a study with the research title "The Effect of the Argument Driven Inquiry (ADI) Model Assisted by Wizer.me on Students' Scientific Argumentation Skills on Alternative Energy Material".

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METHODS

This study was conducted between April 14th and 29th, 2025, with a focus on Grade X students at SMA Negeri 5 Tasikmalaya. This study included 7 grade X students, for a total of 252 participants. The researcher collected daily Physics test scores from all classes to assess initial academic ability prior to treatment. Table 2 shows the average scores and standard deviations.

Table 2. Results of Calculation of Average Value and Standard Deviation

No.	Kelas	Jumlah Peserta Didik	Rata-rata Nilai	Standar Deviasi
1	X.4	36	79.83	8.40
2	X.5	36	77.42	9.38
3	X.6	36	74.50	9.73
4	X.7	36	76.08	10.45
5	X.8	36	72.97	12.81
6	X.9	36	75.75	11.83
7	X.11	36	73.33	11.23

The analysis reveals that class X.8 has an average value of 72.97 with a standard deviation of 12.81, whereas class X.11 has an average value of 73.33 with a standard deviation of 11.23. The two classes were chosen because they have a very small difference in average and deviation, 0.36 and 1.58, respectively, so academically they are considered to have almost equivalent initial abilities, and the distribution of student abilities in both classes has nearly the same level of diversity.

After determining the two classes with the most similar characteristics, the researcher designated class X.11 as the experimental class, which received instruction using the Argument-Driven Inquiry model assisted by Wizer.me, and class X.8 as the control class, which received instructions using the Direct Instruction model. The selection of these two classes was based on the principle that in a match-only post-test-only control group design, initial equivalence is achieved through matching based on previous academic data rather than a pretest. As a result, evidence of pre-intervention equivalence in this study was documented through the proximity of the mean scores and standard deviations of the daily test results, allowing differences in results that emerged after treatment to be interpreted more as the influence of the applied learning model, rather than differences in students' initial abilities.

This study used a quasi-experimental method that was based on a true experimental design but did not involve random grouping of participants. This design still included a control class, but it was less than optimal for controlling external variables (Sugiyono, 2022). However, significant results were obtained using techniques to mitigate threats to internal validity (Frankel et al., 2015). This opinion is consistent with the research's focus and objectives, which are to apply scientific argumentation skills using the ADI learning model. The matching-only post-test control group design was used in the study. The research design is shown in Table 3.

Table 3. Research Design

Class	Treatment		
Experiment	M	X	O
Control	M	C	O

Description: M: Matching between the experimental class and the control class. X: Treatment given to the experimental class in the form of; the ADI model assisted by Wizer.me.; C: Treatment given to the control class (no special treatment) or with the Direct Instruction model commonly used by teachers.; O: Posttest, which is the measurement of results after each class receives the planned treatment.

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The research instrument used by the researchers to collect data was an argumentation skills test. This test consisted of post-test questions that corresponded to the indicators of scientific argumentation skills, according to Toulmin. The test instrument outline is shown in Table 4.

Table 4. Test Instrument Matrix

Scientific Argumentation Skills Indicators	Question Indicator	Question Number	N
Claim, Data, Warrant, Backing, Rebuttal	Analyze the relationship between car speed and kinetic energy and its impact on damage.	1*	1
Claim, Data, Warrant, Backing, Rebuttal	Analyze the difference in potential energy of objects at two different height positions	2*	1
Claim, Data, Warrant, Backing, Rebuttal	Analyzing the efficiency of energy use in the heating process	3*	1
Claim, Data, Warrant, Backing, Rebuttal	Comparing the electrical energy used with the energy absorbed by the water	4*	1
Claim, Data, Warrant, Backing, Rebuttal	Calculate the chemical energy produced from fuel combustion based on the heat of combustion	5*	1
Total			5

*Note: *Questions are valid and used*

The following are the criteria for scoring each indicator for each scientific argumentation question, which can be seen in Table 5.

Table 5 Criteria for Scoring Each Indicator

Indicator	Criteria	Score 0	Score 1	Score 2	Score 3	Score 4
Claim (Statement)	Submit a claim.	Does not provide claims.	Wrong claim and no explanation provided.	Wrong claim and correct explanation	Provides relevant claims but is unclear in explanation	Provide relevant, clear, and strong claims.
Data (Evidence)	Provide supporting evidence or data.	Does not provide supporting data.	Incorrectly providing supporting data or making errors in calculations.	Incorrectly providing supporting data or incorrect calculation method.	Provides relevant data but does not fully support the claim.	Provide relevant, strong data that clearly supports claims.
Warrant (Reason)	Provide reasons that connect the data and claims	Does not provide a reason to link data and claims.	Wrongly providing reasons for linking data and claims.	Provides reasons, but the line of thought is often deviant or weak.	Provides logical reasons but lacks completeness of explanation or depth of argument.	Provide clear, logical, and strong reasons connecting data and claims.
Backing (Support)	Provide additional support (references, examples, etc.)	Does not provide additional support.	Wrong to provide additional support.	Provides support but is less relevant or weak.	Provides sufficient support but does not fully strengthen the reasons	Provide strong support and reinforce the reasons clearly.
Rebuttal	Providing rebuttals or counterarguments	Does not provide a rebuttal (refute).	Wrong to give a rebuttal (refute).	Provides a rebuttal but is irrelevant.	Provides a good enough rebuttal but not strong enough.	Provide a strong and logical rebuttal to the opponent's argument.

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The posttest instrument was first tested for validity through expert assessment using Aiken's V coefficient. Validation was carried out by a validator expert who assessed aspects of the suitability of the questions to the indicators, relevance to scientific argumentation skills, understanding of the answer key, and clarity of language. Validity was calculated using equation 1.

$$V = \frac{\sum S}{n(c\text{-}1)} \tag{1}$$

(Aiken, 1985: 135)

Where $S = r - l_0$; l_0 = Lowest assessment validation value; c = Highest assessment validation value; r = Value given by the validator; and n = Total of validators. The validation results show that all items obtained a validity coefficient of 0.804, so that all instruments were declared valid because they were in the high category. In addition to content validity, the instrument was also tested for reliability using Cronbach's Alpha formula because the instrument was in the form of a descriptive test with several items measuring the same construct. The equation 2 used to calculate reliability.

$$r_{11} = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum \sigma_b^2}{\sigma_t^2}\right] \tag{2}$$

where r_{11} = reliability coefficient; k = number of questions or number of questions; $\sum\sigma_b^2$ = number of item variances; and σ_t^2 = total of variance. The calculation results yielded a reliability coefficient of 0.614, which is considered high, indicating the instrument is reliable and suitable for use in research. This value indicates that the instrument has internal consistency.

The data analysis technique in this study was carried out by involving several stages of data analysis, namely expert validation, instrument trials, analysis of observation results of the implementation of the learning model, prerequisite tests, and testing of hypotheses carried out using statistical methods in the form of independent sample t-tests to compare two unpaired classes. This technique is used to compare the results of scientific argumentation skills between the experimental class and the control class (Opatha, 2025).

RESULT AND DISCUSSION

The focus of this study is to examine the influence of the Wizer.me-assisted ADI model on students' scientific argumentation skills in alternative energy topics. The ADI model encourages active student participation in developing logical arguments based on data and supported by scientific evidence. The use of Wizer.me digital media aims to support interactive learning and help students master their understanding of the learning material.

In accordance with the research design used, a posttest was given to both sample classes to measure students' scientific argumentation skills. There were five essay-shaped questions in the test instrument that reflected the five indicators of scientific argumentation skills according to Toulmin (2003), namely claim (making claims), data (finding evidence using relevant data), warrant (making reasons that link claims to data), backing (additional arguments to strengthen evidence usually based on Physics theory) and rebuttal (response to potential counterarguments or rebuttals from other points of view).

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The posttest results reflect the final level of understanding of the study participants in both the experimental and control classes. This study applied the ADI learning model assisted by Wizer.me for the experimental class and Direct Instruction (DI) for the control class in the Alternative Energy topic. The posttest results were based on five essay questions focused on measuring scientific argumentation skills. The posttest results are listed in Table 6.

Table 6. Posttest Results Statistical Data

Class	*n*	Score				Variance	St. Dev
		High	Low	Ideal	Mean		
Experiment	36	59	100	100	83.83	103.23	10.16
Control	36	54	95	100	71.17	154.89	12.45

The standard deviation score range of the experimental and control classes shows an intersection in the interval of 73.67 to 83.62. This indicates that there are 9 students (25%) from the experimental class and 6 students (16.7%) from the control class, with a total of 15 students (20.8%) who have scientific argumentation skills in that score range. However, with a higher average for the experimental class and a more concentrated distribution of scores above the intersection limit, it can be concluded that the Wizer.me-assisted ADI model has a significant effect on improving students' scientific argumentation skills. The data in the form of histograms and polygons in the experimental class can be seen in Figure 1.

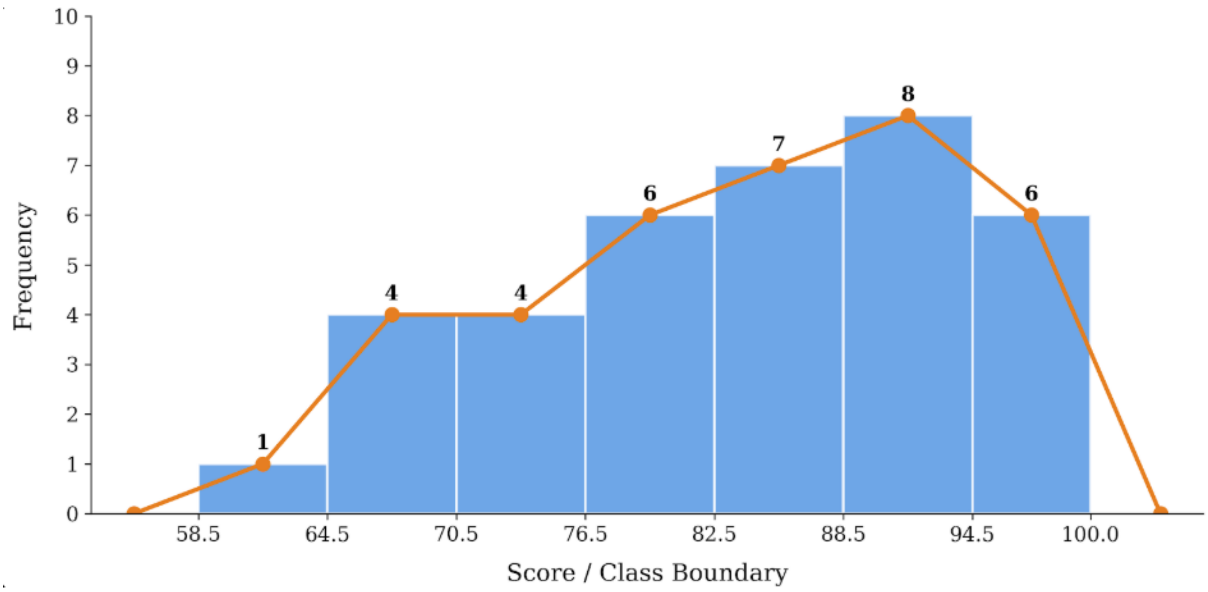

Figure 1. Histogram and Polygon of Experimental Class

Figure 1 displays the distribution of posttest scores on scientific argumentation skills for students in the experimental class. The lowest post-test score was in the interval of 58.5 to 64.5 with a frequency of 1. Meanwhile, the highest score was in the interval of 94.5 to 100.5 with a frequency of 6. The score range with the highest frequency was in the range of 88.5 to 94.5 with a frequency of 8.

The data distribution pattern shows similarities to a normal distribution, as seen from the histogram and frequency polygon, which are slightly skewed to the left, with values ranging from 90.5 (mode) to 84.5 (median) to 83.83 (mean). This indicates a higher frequency of high scores and a lower frequency of low scores. Based on the average score of the experimental

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class, which is 83.83, many students in the experimental class received a higher posttest score than the average posttest. Furthermore, data visualization in the form of histograms and polygons for the control class is shown in Figure 2.

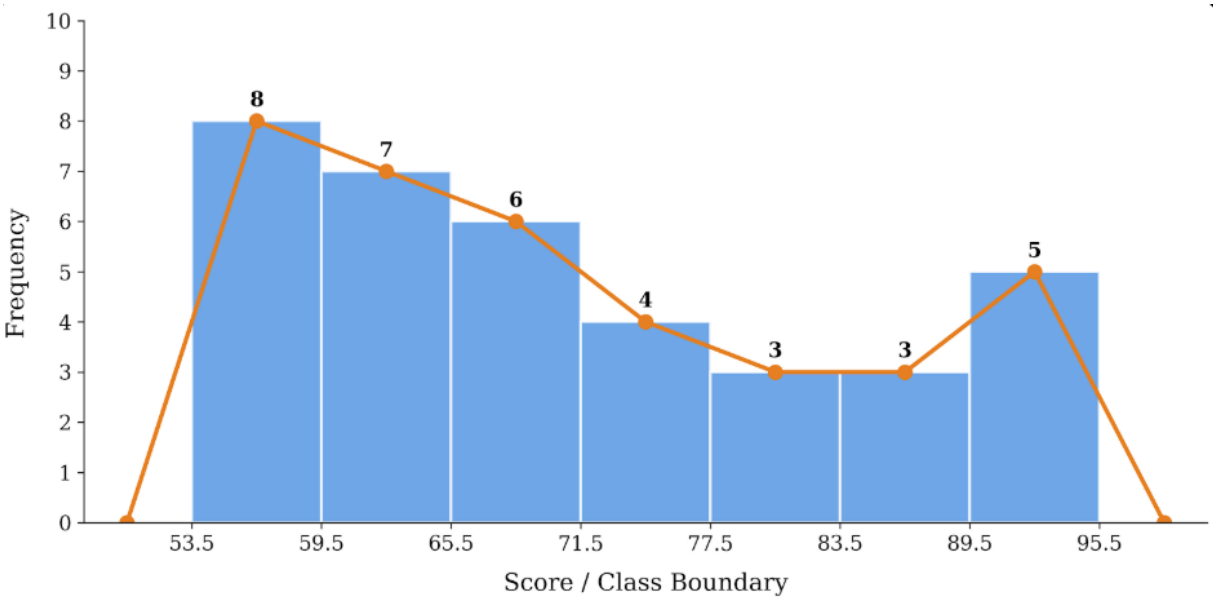

Figure 2. Histogram and Control Class Polygon

Figure 2 displays the distribution of posttest scores on students' scientific argumentation skills in the control class. The lowest posttest scores were in the interval of 53.5 to 59.5 with a frequency of 8, while the highest scores were in the interval of 89.5 to 95.5 with a frequency of 5. The score range with the highest frequency was in the interval of 53.5 to 59.5 with a frequency of 8.

Based on the histogram and frequency polygon displays, the data distribution pattern shows a rightward skew with a value of 58.83 (mode) < 67.5 (median) < 71.17 (mean). This means there is a higher frequency of low scores and a lower frequency of high scores. Based on the average score of the control class, which is 71.17, most students in the control class received a lower posttest score than the average posttest. The results of the posttest comparison in the two classes, namely experimental and control, are shown in Table 7.

Table 7. Comparison of Percentage of Scientific Argumentation Skills

Indicator	Experiment Class Percentages (%)	Category	Control Class Percentages (%)	Category
Claim	90.00	Very Good	80.80	Good
Data	87.90	Very Good	80.70	Good
Warrant	81.00	Very Good	74.30	Good
Backing	79.90	Good	60.40	Fair
Rebuttal	80.40	Good	60.30	Fair
Rata-rata	83.83	Very Good	71.17	Good

Based on the data in Table 7, which presents the percentage of scientific argumentation skills with standard deviations between the experimental and control classes, it was found that there was an overlap in the claim, data, warrant, and rebuttal indicators, while the backing indicator showed no overlap. This overlap indicates that although in general the achievement of students in the experimental class was higher, there were still some students with scores that

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overlapped with students in the control class, especially in indicators that require complex analysis and argumentation. This could occur due to differences in students' initial abilities, level of participation during learning, and individual understanding of the components of scientific argumentation. The absence of an overlap in the backing indicator indicates a significant increase in the ability of students in the experimental class to provide a theoretical basis for arguments, as all of them had higher scores than the control class. Table 8 below shows the findings of observations by three observers regarding the use of the ADI learning model in the experimental class.

Table 8. Observation Results of the Implementation of the Argument Driven Inquiry (ADI) Learning Model

No.	Indikator	Persentase (%)	Kategori
1	Problem Identification	100	Very Good
2	Data Collection	100	Very Good
3	Tentative Argumentation Process	100	Very Good
4	Interactive Argumentation	100	Very Good
5	Report Development	100	Very Good
6	Peer Review	100	Very Good
7	Revision Process	100	Very Good
8	Reflection and Discussion	100	Very Good
Average		100	Sangat Baik

The table presented is based on the results of data processing from the observation sheet on the implementation of the learning model, with very good implementation results for each learning model syntax. However, there were slight obstacles at the end of the lesson, especially in the reflection syntax and discussions, where time often ran out due to students' active participation in the interactive argument syntax. Because of this, learning often exceeded the Physics lesson time.

Hypothesis Testing

Prerequisite Test

Before conducting the hypothesis test, the researcher first conducted a prerequisite test on the research data. This test aimed to assess whether the data obtained met the requirements for normality and homogeneity. After the data was analyzed, the results of the performance test are presented in Table 9.

Table 9. Chi-Square Normality Test Results

Data	χ^2_{count}	χ^2_{table}	Hyptohtetica Conclussion	Analytical Conclussion
KAI Posttest Score (experimental class)	2.99	9.48	H_0 accepted	The sample was taken from a normally distributed population.
KAI Posttest Score (control class)	8.16		H_0 accepted	

The Chi-Square test was conducted using Microsoft Excel software. Based on the calculation results, the χ^2_{count} value was 2.99 for the experimental class and 8.16 for the control class. Because both χ^2_{count} values were smaller than the χ^2_{table} value, the decision taken was to accept H_0 and reject H_a. With H_0 stating that the data comes from a normally distributed population, it can be concluded that the data distribution in both classes meets the assumption of normality. The homogeneity test was conducted using the Fisher exact test. The data

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analyzed were the posttest results from the experimental and control classes. The results of the homogeneity test analysis in this study are shown in Table 10.

Table 10 Results of the Homogeneity Test (Fisher)

Kelas	N	Varians (S^2)	F_{count}	α	F_{table}	conclussion
Experiment	36	103.23	1.5	0.05	1.78	H_0 accepted
Control	36	154.89				

Based on the calculation results, it is known that the homogeneity test using the Fisher formula, that the variance value in the experimental class is 103.23, while in the control class it is 154.89, so that the $Fhitung$ value is 1.5. By using a significance level of $\alpha = 0.05$ and degrees of freedom (35.35), the F_{table} value is 1.78. Because F_{count} is smaller than $Ftabel$, the decision taken is to accept H_0 and reject H_a. Thus, the variance of the two classes is homogeneous. This homogeneity condition shows that the difference in variance between the experimental and control classes does not have a significant influence on the validity of the further analysis to be carried out.

Hypothesis Testing

Once the research data meets the assumptions of normal distribution and homogeneity of variance, the next step is to conduct a hypothesis test. The results of the hypothesis test analysis in this study are shown in Table 11.

Table 11. T-Test Results

Variabel	Description
Data	Experiment and control class
t_{count}	4.7
α	0.05
t_{table}	1.67
Hyptohtetica Conclussion	H_a accepted
Analytical Conclussion	The application of the Argument Driven Inquiry (ADI) model assisted by Wizer.me has an impact on students' scientific argumentation skills in alternative energy material.

From Table 11, the results of the hypothesis test calculation using the t-test with a significance level ($\mu = 0.05$) obtained $t_{count} > t_{table}$, namely $4.7 > 1.67$ so that H_0 is rejected and H_a is accepted. This means, at a 95% confidence level. To understand the interpretation of the statistical test results, an effect size calculation was also carried out using Cohen's d to determine the practical effect of the treatment. The data used came from the experimental class posttest average of 83.83 with a standard deviation of 10.16, while the control class had an average of 71.17 with a standard deviation of 12.45. Based on the calculation, the Cohen's D value of 1.11 is included in the large effect category because it is above 0.80. This indicates that the influence of the ADI model assisted by Wizer.me, it can be concluded that the application of the ADI model assisted by Wizer.me influences students' scientific argumentation skills in alternative energy material.

The ADI model approach in student learning facilitates the development of independent learning skills, evidence-based opinions, and critical and logical thinking at every stage of scientific learning. Activities such as constructing arguments, group discussions, and reflecting on peers' arguments encourage students to improve their reasoning skills and understand

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concepts based on data they obtain directly. This statement is reinforced by (Utami et al., 2022), namely that a constructivist approach such as ADI, with its emphasis on independent argument development and question formulation, is effective in encouraging active student involvement in the scientific thinking process, while deepening students' understanding of alternative energy concepts and scientific argumentation skills.

The scientific argumentation skills studied include five indicators according to Toulmin (2003), namely claim (making statements), data (looking for evidence using relevant data), warrant (making reasons that link claims with data), backing (additional arguments to strengthen evidence usually based on physics theory) and rebuttal (response to potential counter arguments or rebuttals from other points of view).

The posttest results showed that the claim indicator in the experimental class reached 90% (very good), while the control class only achieved 80.8% (good), which was influenced by differences in learning models. The ADI model syntax in the experimental class further encouraged students to convey relevant claims based on their own observations and calculations of the observed phenomena. This statement is supported by Dianti et al., (2023), namely that students who are accustomed to going through the exploratory stage in constructing arguments tend to be better able to convey claims that are accurate and in accordance with available evidence. In the experimental class, the ability to construct claims is closely related to the problem identification syntax in the ADI model, which encourages students to express temporary answers that will serve as the basis for constructing arguments. This stage hones students' ability to identify important and relevant information from videos accessible through the Wizer.me platform.

A comparison of the claim indicator results between the experimental and control classes showed an overlap. The percentage of claim indicators in the experimental class ranged from 81.8 to 98.2, while in the control class it ranged from 73.9 to 87.7. From these data, the overlap in the value range was found at 81.8 to 87.7. This overlap occurred because the ability to make claims was already possessed by students from the beginning, although not optimally according to the results of the preliminary study. With the implementation of ADI, students' claim abilities improved, but there were still some students whose results were close to those of the control class due to the adaptation process. However, the higher maximum score in the experimental class proved that the ADI model was effective in encouraging increased claim-making abilities.

Second, the data indicator in the experimental class reached 87.9% (very good), while in the control class it was only 80.7% (good), which was influenced by the difference in treatment even though the learning activities were similar. Students in the experimental class were helped by the ADI syntax stages, especially at the “collecting and analyzing data” stage, which gave them the opportunity to interact directly with data from video observations and independent exploration from other sources. In accordance with the opinion of Nurhidayati et al., (2023), active involvement of students in data processing can improve conceptual understanding and strengthen the validity of the scientific arguments they build.

A comparison of the data indicator results between the experimental and control classes shows an overlap. The percentage of data indicators in the experimental class was 79.49–96.31, while in the control class it was 70.43–90.97. From these data, there is an overlap in the range of 79.49–90.97. This overlap occurs because students' abilities in collecting and reading data have been sufficiently formed from the beginning, although not yet in-depth. The application

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of the ADI model helps students be more careful and focused in analyzing data, but some students still need to get used to it, so the results still overlap with the control class. However, the highest score in the experimental class remains higher, indicating a real improvement.

The warrant indicator in the experimental class reached 81% (very good), while in the control class it was only 74.3% (good). In ADI syntax, "tentative argument formation" contributes significantly to strengthening data indicators, as this stage provides an opportunity for students to develop arguments with their group members based on the data they have collected. This statement is reinforced by Handayani et al. (2021), namely that conceptual understanding and the ability to analyze logically are crucial in developing strong arguments, and both can only develop through learning that encourages active student participation.

A comparison of the warrant indicator results between the experimental and control classes showed an overlap. The percentage of the warrant indicator in the experimental class was 76.36–85.64, while in the control class it was 64.29–84.31. From these data, there is an overlap in the range of 76.36–84.31. This overlap occurs because students' ability to provide reasons or supporting explanations still needs more intensive training. With the ADI model, students are starting to be directed to connect data with claims through logical reasoning, but some students are not yet accustomed to compiling in-depth explanations, so the results still overlap with the control class. However, the highest achievement in the experimental class is still better, indicating an increase in the ability to create explanations (warrants).

The backing indicator in the experimental class reached 79.9% (good), while in the control class it was only 60.4% (moderate). Students in the experimental class were helped by the ADI syntax stage, especially at the “interactive argument” stage which demonstrated the ability to mention the laws of physics, such as the law of conservation of energy and the law of kinetic energy, as part of the scientific basis in constructing their arguments. This statement is reinforced by Dianti et al., (2023), namely that the inclusion of backing in arguments requires consistent practice and the habit of linking theoretical concepts with real phenomena, aspects that are less facilitated in the direct instruction learning model.

A comparison of the backing indicator results between the experimental and control classes shows that the data for both classes do not overlap. The percentage of backing indicators in the experimental class ranges from 73.74 to 86.06, while in the control class it ranges from 53.29 to 67.51, so there is no overlap in the values between the two classes. The absence of overlap between the backing indicator ranges strengthens the evidence that the ADI model at the interactive argument stage consistently has higher efficiency in honing students' ability to construct scientific arguments supported by strong theory or literature. This finding also indicates that the backing indicators are strongly influenced by the argument- and evidence-based learning approach.

The rebuttal indicator in the experimental class reached 80.4% (good), while in the control class it was only 60.3% (moderate). In the experimental class, students were given the opportunity to present and respond to their classmates' arguments through an "interactive argument" stage. This stage allowed students to evaluate other arguments and present rebuttals politely and logically. This statement is supported by Wahyunan Widhi et al. (2021), who emphasized that discussion spaces and opportunities to present rebuttals are crucial for developing advanced analytical skills and reflective argumentation, which are not achieved through lecture methods alone.

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A comparison of the rebuttal indicator results between the experimental and control classes showed an overlap. The percentage of the rebuttal indicator in the experimental class was 72.48–88.32, while in the control class it was 47.72–72.88. From these data, there is an overlap in the range of 72.48–72.88. This intersection indicates that the ADI model has an influence on rebuttal skills, but it is not completely evenly distributed. There are still some students in the experimental class who have rebuttal achievements like the best students in the control class. Therefore, it is necessary to strengthen the discussion phase and interactive arguments in ADI syntax, especially by providing explicit practice in distinguishing arguments and submitting rebuttals based on scientific evidence (Palma-Jiménez et al., 2025).

Different treatments impacted argumentative outcomes. Learning activities undertaken by students in the experimental class demonstrated that learning encouraged students to interact intensively with the material, their peers, and their own thinking processes. The ADI model, in this case, proved more effective because it provided a participatory, independent, and collaborative learning environment. This approach encouraged deeper engagement, enabling optimal development of students' argumentative skills. Technological support, such as Wizer.me, also strengthened the effectiveness of the E-LKPD implementation in the experimental class due to its interactive and responsive interface. This platform facilitated students' understanding of the flow of activities and their ability to respond to questions that required data analysis and critical thinking. Thus, the integration of digital technology supports the creation of a more meaningful and in-depth learning experience.

Scientific argumentation skills through the ADI learning model can be applied to students regarding alternative energy material. The level of students' scientific argumentation skills after the posttest was higher in the experimental class using the ADI approach with a very good category, when compared to the control class applying the Direct Instruction model which only achieved a good category. This difference shows the superiority of ADI, which encourages active involvement of students in in-depth discussions, critical thinking, and building arguments with complete and complex structures. This is in line with the findings of Khoirun Nisah Lubis et al. (2024) that the Direct Instruction learning approach dominates the role of teachers in learning activities, causing low active participation of students, so that the learning process becomes less interactive and focused.

In implementing the ADI model assisted by Wizer.me, researchers encountered challenges in time management and classroom dynamics. Students were initially confused about the ADI syntax, resulting in insufficient learning time. After several meetings, they became accustomed to it, and learning progressed more effectively. However, during the interactive argument stage, discussions became difficult to control due to participants' over-enthusiastic and lack of direction. To address this, teachers need to thoroughly understand the ADI syntax, implement flexible classroom management strategies, and maximize the use of digital media such as Wizer.me to maintain focus and support smooth learning.

CONCLUSION

Based on the research results and discussion of the data processing results, it was concluded that the application of the Argument Driven Inquiry (ADI) model assisted by Wizer.me influenced students' scientific argumentation skills on alternative energy material in class X of SMA Negeri 5 Tasikmalaya in the 2024/2025 academic year. This was indicated by the results

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of the hypothesis test using the t test with a significance level (α = 0.05) obtained $t_{\text{count}} > t_{\text{table}}$ namely 4.7 > 1.67 so that H_0 was rejected and H_a was accepted.

The contribution of this research lies in the integration of the ADI learning model with the digital media Wizer.me in Physics instruction, specifically on alternative energy. The use of this digital platform provides students with a more interactive platform to access materials, observe phenomena, develop arguments, and revise. Thus, this research contributes to the development of technology-based learning strategies relevant to the demands of 21st-century education, particularly in the development of critical thinking skills and scientific argumentation.

However, this study has limitations. The study was conducted on only one learning material and included a sample of two classes in one school. Therefore, generalization of the results requires caution. Furthermore, the limited learning duration meant that some ADI stages, particularly reflection and discussion, could not be optimally implemented due to the high level of student participation in the interactive argumentation stage.

Therefore, further research is recommended to apply the digital media-assisted ADI model to other Physics materials or other science fields with a broader sample size. Future research could also develop the use of other digital platforms that support scientific argumentation and examine their impact on students' critical thinking, scientific communication, and problem-solving skills in greater depth. With this development, it is hoped that increasingly effective learning models will be developed to improve the quality of science learning in schools.

REFERENCES

Amanda, D., & Alfiandra, A. (2025). Efektifitas E-LKPD Berbantuan Website Wizer Me dalam Meningkatkan Kemampuan Berpikir Kritis Peserta Didik. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, *8*(6), 6930-6937

Dianti, P., Sunandar, A., & Setiadi, A. E. (2023). Analisis Penguasaan Konsep dan Kemampuan Berargumentasi Siswa dengan Model Argument Driven Inquiry Berbasis Socio-Scientific Issue. *Qalam: Jurnal Ilmu Kependidikan*, *12*(2), 1-14.

Erawati, N. K. E. N. K., Kadek, N. K. R. P. N., Purwati, R., Wayan, N. W. S. P. N., Putri, S., & Wardika, I. W. G. (2023). Pelatihan Pemanfaatan Wizer. Me Sebagai Media Pembelajaran Digital. *Puan Indonesia*, *4*(2), 125-134.

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

Fitria, A. R., Hasnunidah, N., Fadiawati, N., & Suyatna, A. (2025). Enhancing Scientific Argumentation through the Integration of Argument-Driven Inquiry and STEM in E-Worksheets for Secondary *Science Education. 11*(7), 263–272. https://doi.org/10.29303/jppipa.v11i7.11603

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2015). How to Design and Evaluate Research in Education. McGraw-Hill.

Handayani, M., Puryatmi, H., & Hanafi, H. (2021). Peningkatan Keterampilan Berpikir Kritis melalui Model Problem Based Learning dalam Pembelajaran IPA di Sekolah Dasar. *Edukatif : Jurnal Ilmu Pendidikan, 4*(1), 548–555. https://doi.org/10.31004/edukatif.v4i1.1829

Hasnunidah, N., Meriza, N., Fadhila, S., & Rosidin, U. (2025). Impact of STEM-Integrated Argument-Driven Inquiry on Developing Scientific Argumentation in Indonesian Middle Schools. *Jurnal Penelitian Pendidikan IPA*, *11*(10), 986-997.

https://doi.org/10.17509/wapfi.111.7

Lubis, K. N., Sari, N., & Gusmaneli, G. (2024). Konsep Dasar Strategi Pembelajaran Langsung (Direct Instruction). *Guruku: Jurnal Pendidikan Dan Sosial Humaniora*, *2*(2), 60-70. https://doi.org/10.59061/guruku.v2i2.638

Lestari, N., Permatasari, R., Eveline, E., Fery Haryadi, E. S., & Apsari, N. (2023). Kepuasan Peserta Pelatihan Implementasi Kurikulum Merdeka Pada Mata Pelajaran IPA/Fisika. *Community Development Journal, 4*(2), 3903–3908.

McNeill, K. L., & Krajcik, J. (2008). Inquiry and scientific explanations: Helping students use evidence and reasoning. *Science as inquiry in the secondary setting*, *121*(34), 26.

Nazidah, F., & Admoko, S. (2022). Analisis bibliometrik penelitian argumentasi ilmiah dalam pembelajaran sains di era Revolusi Industri 4.0 Society 5.0. *Jurnal Ilmu Pendidikan Dan Pembelajaran*, *1*(1), 7-14.

Nurhidayati, E., Masykuri, M., Isma, D., & Fakhrudin, A. (2023). Pengaruh Model Pembelajaran Argument Driven Inquiry (ADI) Dengan Pendekatan STEM Terhadap Keterampilan Argumentasi Pada Materi Cahaya dan Alat Optik. J*urnal Pendidikan IPA, 12*(3), 171–182. https://doi.org/10.20961/inkuiri.v12i3.79317

Odja, A. H., Abdjul, T., Payu, C. S., Pikoli, M., Yusuf, M., Sambel, N., ... & Mahmud, A. P. M. (2025). Edukasi Guru Melalui Transformasi Pembelajaran IPA Berbasis Kearifan Lokal dan Teknologi Digital. *Amal Ilmiah: Jurnal Pengabdian Kepada Masyarakat*, *6*(3), 509-524.

Olii, R., Laliyo, L. A. R., Kilo, A. K., La Kilo, A., Tangio, J. S., & Kurniawati, E. (2025). Analisis Kemampuan Berargumentasi Ilmiah Siswa Kelas XI di SMA Negeri 1 Telaga pada Materi Larutan Elektrolit dan Nonelektrolit. *Algoritma: Jurnal Matematika, Ilmu pengetahuan Alam, Kebumian dan Angkasa*, *3*(1), 131-141.

Opatha, H. H. D. N. P. (2025). Conceptualization in HRM Research and Conceptualization of HRM Research: A Simplified Conceptual Study. *Sri Lankan Journal of Human Resource Management*, *15*(02).

Palma-Jiménez, M., Cebrián-Robles, D., & Blanco-López, Á. (2025). Impact of instruction based on a validated learning progression on the argumentation competence of preservice elementary science teachers. *Science & Education*, *34*(1), 423-455.

Rizkia, R. F., & Aripin, I. (2022). Penerapan model pembelajaran argument driven inquiry (ADI) pada pembelajaran biologi di sma. In *Prosiding Seminar Nasional Pendidikan* (Vol. 4, pp. 225-232).

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.

Tarigan, M., Alvindi, A., Wiranda, A., Hamdany, S., & Pardamean, P. (2022). Filsafat Pendidikan Ki Hajar Dewantara dan Perkembangan Pendidikan di Indonesia. *Mahaguru: Jurnal Pendidikan Guru Sekolah Dasar, 3*(1), 149–159. https://doi.org/10.33487/mgr.v3i1.3922

Ujud, S., Nur, T. D., Yusuf, Y., Saibi, N., & Ramli, M. R. (2023). Penerapan Model Pembelajaran Discovery Learning Untuk Meningkatkan Hasil Belajar Siswa SMA Negeri 10 Kota Ternate Kelas X Pada Materi Pencemaran Lingkungan. *Jurnal Bioedukasi, 6*(2), 337–347. https://doi.org/10.33387/bioedu.v6i2.7305

Utami, P. Q., Sumari, S., & Dasna, I. W. (2022). Penerapan Model Pembelajaran Argument Driven Inquiry terhadap Kemampuan Argumentasi Ilmiah. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan 7*(4), 122. https://doi.org/10.17977/jptpp.v7i4.15217

Wahyunan Widhi, M. T., 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. PE*NDIPA Journal of Science Education, 5*(1), 79–91. https://doi.org/10.33369/pendipa.5.1.79-91

Zubaidah, S. (2018, October). Mengenal 4C: Learning and innovation skills untuk menghadapi era revolusi industri 4.0. In *2nd Science Education National Conference* **13** (2), 1-18.

https://doi.org/10.17509/wapfi.111.7