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Physics Learning Using the Argument Driven Inquiry Model Integrated with Islamic Science to Improve the Argumentation Ability and Attitude Towards Physics of MA Students

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Abstract: Argumentation skills and positive attitudes toward physics are important aspects of 21st-century learning, but are still relatively low among Indonesian students. This study aims to improve these two aspects through the application of the Argument Driven Inquiry (ADI) learning model integrated with Islamic science. This study is a Classroom Action Research (CAR) conducted in two cycles on grade XI students of MAN 1 Pekanbaru with harmonic vibration material. The instruments used included attitude questionnaires, argumentation questions, observation sheets, and learning tools. Data were collected through observation and tests. The results showed a significant increase in teacher and student activities, attitudes toward physics, and students' argumentation skills. Learning activities developed from the Good to Very Good category. Attitudes toward physics increased from low to high and very high categories. Argumentation skills, which were initially classified as underdeveloped, became good to very good. These findings indicate that the ADI model integrated with Islamic science is effective in increasing student engagement and the quality of physics learning.

Keywords: Argumentation Ability; Argument Driven Inquiry (ADI); Attitude; Physics; Integrated Islamic Science.

Introduction

The rapid development of technology and the transformation of global society in the 21st century have profoundly impacted all aspects of life, including education. In response to these changes, education systems around the world—including Indonesia—are challenged to produce graduates equipped not only with cognitive knowledge but also with essential 21st-century competencies (Yanti et al., 2023; Zulkifli et al., 2022). Among the core competencies summarized in the 4Cs—communication, collaboration, critical thinking, and creativity—argumentation stands out as a skill that integrates both critical thinking and communication, making it a vital component of scientific literacy in the modern era (Hanifah & Admoko, 2019; Masniari. S et al., 2023).

In the context of science education, argumentation enables students to engage actively with scientific ideas, formulate logical conclusions based on evidence, and communicate their reasoning effectively. It transforms passive learning into a dynamic process of inquiry and reflection (Hardini & Alberida, 2022; Yokhebed, 2019). However, studies have shown that Indonesian students generally lack proficiency in constructing scientific arguments. According to the 2018 PISA results, Indonesia ranked 73 out of 78 participating countries in scientific literacy and argumentation skills, with a science score of just 396, far below the OECD average of 489 (Golla & Reyes, 2022).

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This national problem is also reflected at the classroom level. Observations and interviews with physics teachers at MAN 1 Pekanbaru indicate that most students are reluctant to express reasoned opinions and often resort to short, unsupported answers during discussions. Supporting this, Mahardika et al. (2015) found that only 7 out of 21 students demonstrated high-level argumentation skills in physics learning. This issue is exacerbated by teacher-centered pedagogical practices that limit students' opportunities to develop reasoning abilities (Rizal et al., 2020). While previous research has identified the low level of argumentation skills in Indonesia (Widhi et al., 2021), few have addressed it through a comprehensive pedagogical model that combines inquiry, argumentation, and values-based education. This is the novelty of the present study: the application of the Argument-Driven Inquiry (ADI) model integrated with Islamic science values as a learning strategy to improve both students' argumentation skills and their attitudes toward physics (Nurdiyanti et al., 2024).

The ADI model is an inquiry-based learning strategy that emphasizes the construction and evaluation of scientific arguments through student-led investigation and discussion (Akili et al., 2022; Franqueira & Horsman, 2020). By involving students in identifying problems, collecting data, developing arguments, and defending their reasoning, ADI fosters logical thinking, evidence-based communication, and reflective responses to opposing viewpoints (Syerliana et al., 2018). Furthermore, integrating Islamic values into this model provides a spiritual context that resonates with students in Islamic schools, encouraging them to see science as a way to understand the greatness of Allah SWT and fostering deeper engagement with the subject matter (Astuti, 2022; Zakaria et al., 2025).

This research is important for several reasons. First, it addresses a concrete and measurable skill gap—scientific argumentation—that is essential for developing 21st-century competencies (Illahi et al., 2024). Second, it offers an innovative and contextually relevant solution through the integration of ADI with Islamic values, making the learning process not only more engaging but also meaningful for students in Islamic educational settings (Sadiah et al., 2025). Finally, it responds to the growing need for student-centered pedagogies that empower learners to think critically, communicate scientifically, and appreciate the relevance of physics in both worldly and spiritual dimensions (Prasinta et al., 2023). Based on this rationale, the researcher is interested in conducting a Classroom Action Research at MAN 1 Pekanbaru with the aim of improving students' argumentation skills and attitudes toward physics through the application of the Argument-Driven Inquiry model integrated with Islamic science. Therefore, the proposed research title is, "Physics Learning Model Argument-Driven Inquiry Integrated with Islamic Science to Improve Argumentation Skills and Attitudes toward Physics of MA Students."

Method

This research employed the Classroom Action Research (CAR) approach modeled by Kemmis and McTaggart, which consists of four stages in each cycle: planning, action implementation, observation, and reflection. This research was conducted over two cycles in the even semester of the 2024/2025 academic year at MAN 1 Pekanbaru, with 32 students of grade XI 8 Engineering as subjects. The learning material was Harmonic Vibration in Physics. The learning model used was Argument-Driven Inquiry (ADI) integrated with an Islamic science approach. This approach aims to develop scientific argumentation skills and a positive attitude toward physics, while also instilling spiritual values through interpreting natural phenomena as signs of the greatness of Allah SWT.

The stages of the ADI model applied in this study include: (1) identifying material and investigative questions, (2) collecting data through experimental activities or observations, (3) developing arguments based on the data obtained, (4) argumentation sessions through presentations and group discussions, (5) reflective discussions to review conceptual understanding, (6) writing argumentative reports individually or in groups, (7) peer review among students, and (8) revising the report based on feedback received (Arsyim et al., 2022).

The research instruments consisted of a questionnaire on attitudes toward physics, argumentation skills tests, observation sheets for teacher and student activities, and learning materials developed based on the ADI model. Data collection techniques included observation, questionnaires, and written tests administered before and after each activity. The data obtained were analyzed descriptively and quantitatively to measure changes in student learning activities, attitudes toward physics, and argumentative skills. The success of the activities was determined based on the increase in scores on each indicator, with reference to the Good and Very Good categories.

Result and Discussion

The implementation of this research was conducted at MAN 1 Pekanbaru in class XI 8 Engineering with 32 students through the Classroom Action Research (CAR)

method for two cycles from February to April 2025, aiming to improve attitudes towards physics and students' argumentation skills through the Argument Driven Inquiry (ADI) learning model integrated with Islamic science. The learning materials raised include harmonic vibrations in cycle I and elasticity and Hooke's law in cycle II, each delivered in four meetings, including daily tests. The research began with the preparation of complete learning tools such as teaching modules, LKPD, questionnaires, and observation instruments, and began with a pre-cycle study in the form of argumentation questions and attitude questionnaires.

The implementation of learning follows the stages of the ADI model which include problem identification, data collection, development and delivery of arguments, reflective discussions, writing and revising reports, and peer review, all of which are aligned with Islamic values, such as linking scientific regularity with the greatness of Allah (Budiarti & Istiyono, 2023). Each activity is designed to develop critical thinking, scientific attitudes, and students' spiritual understanding of the physics material being studied. The activity was closed with reflection, delivery of conclusions, motivation, and prayer as a form of gratitude for the learning process that had taken place.

Table 1. Results of Attitudes Towards Pre-Cycle Physics

Category	Attitude Score (%)	Amount	Average (%)
Very high	85 ≤ p < 100	0	0.00
High	70 ≤ p < 85	1	3.10
Currently	55 ≤ p < 70	8	25.00
Low	40 ≤ p < 55	22	68.80
Very Low	0 ≤ p < 40	1	3.10
Total		32	100

Of the 32 students, the majority, namely 68.8%, had a low attitude towards physics, while only 3.1% had a high attitude and none were very high. Students with moderate attitudes reached 25%. This condition shows that most students do not have enough interest or positive feelings towards physics. This indicates the need for a more interesting and relevant learning approach in order to increase students' motivation and positive attitudes towards this subject. This improvement occurred because students were more actively engaged in learning, felt the material was more meaningful and relevant to their lives and faith, and had the space to discuss and express their opinions scientifically. This fostered growing interest, self-confidence, and a positive attitude toward physics.

Table 2. Results of the Pre-Cycle Argumentation Ability Test

Category	Ability Score (%)	Amount	Average (%)
Very Good	85 < Score ≤ 100	0	0.00
Good	70 < Score ≤ 85	2	6.25
Fair	55 < Score ≤ 70	4	12.50
Not Good	0 < Score ≤ 55	26	81.25
Total		32	100

As many as 81.25% of students are categorized as less good in argumentation skills, only 6.25% are in the good category, and none are very good. This indicates that students' ability to construct and convey arguments logically is still very low. This low ability is thought to be related to the learning method that is predominantly lecture-based and lacks active discussion that encourages argumentation skills. Therefore, a more interactive and participatory learning method is needed, such as the ADI model integrated with Islamic science which can improve students' argumentation skills. This is because students are trained to develop arguments based on data and facts through investigative activities, group discussions, and structured scientific presentations. The integration of Islamic values also encourages students to think more reflectively and critically, thus honing their ability to construct and present arguments logically.

Table 3. Results of Observations of Teacher Activities in Cycle I

Meet	Activity	Obs 1	Obs 2	Average (%)	Category
1	Introduction	2.75	3.50	69	Good
	Core	3.09	3.55		
	Conclusion	3.83	3.83		
2	Introduction	3.75	4.00	77	Good
	Core	3.45	4.00		
	Conclusion	4.00	4.00		
3	Introduction	4.00	4.75	83	Very Good
	Core	3.82	4.27		
	Conclusion	4.17	4.17		
Overall average				76	Good

Teacher activity showed an increase from meeting 1 to 3, with an overall average of 76% (Good category). At the initial meeting there were still obstacles, especially in the introduction and core of learning, such as poor time management and students who were not yet accustomed to the ADI model. Gradual evaluation and improvement succeeded in improving the quality of teacher teaching activities. This improvement occurred because teachers began to better understand the flow and strategies for implementing the ADI model, made improvements based on reflection at each meeting, and were able to manage their classes and time more

effectively. Furthermore, increased student responsiveness also encouraged teachers to be more confident and interactive in facilitating learning.

Table 4. Results of Observations of Student Activities in Cycle I

Meet	Average (%)	Category
1	53	Fair
2	70	Good
3	78	Good
Average	67	Good

Student activity increased significantly from meeting 1 to 3. At first it was still quite low because students were not used to using the ADI learning model. Intensive mentoring and gradual argumentation exercises helped students adapt, so that the average learning activity was in the good category. This improvement occurred because students began to understand the stages of the ADI model, became accustomed to discussions and expressing opinions, and felt more confident in constructing arguments. Supporting a collaborative learning environment relevant to Islamic values also encouraged their active participation in every activity.

Table 5. Results of Attitudes Towards Physics Cycle I

Category	Attitudes Score (%)	Amount	Average (%)
Very high	85 ≤ p < 100	0	0.00
High	70 ≤ p < 85	26	81.30
Currently	55 ≤ p < 70	6	18.70
Low	40 ≤ p < 55	0	0.00
Very Low	0 ≤ p < 40	0	0.00
Total		32	100

The majority of students (81.3%) have a high attitude towards physics after cycle I. None are very high, indicating that there is still room to improve motivation and interest in learning physics. This can be achieved with more interesting learning innovations and media. This improvement occurred because the ADI model, integrated with Islamic values, made learning more contextual, enjoyable, and meaningful. Students felt more emotionally and spiritually engaged and saw the connection between physics and life and faith, leading to an increased positive attitude toward physics (Wicaksono & Korom, 2023).

Table 6. Results of the Argumentation Ability Test Cycle I

Category	Ability Score (%)	Amount	Average (%)
Very Good	85 < Skor ≤ 100	2	6.25
Good	70 < Skor ≤ 85	2	6.25
Fair	55 < Skor ≤ 70	18	56.25
Not Good	0 < Skor ≤ 55	10	31.25
Total		32	100

The students' argumentation ability is in the fairly good category with a significant increase (60%) compared to the pre-cycle (17%). The data collection indicator received the highest score, while the qualifier and rebuttal indicators were still low, indicating that students need more focused practice on these aspects. This improvement occurred because the ADI model taught students to collect data independently, analyze findings, and develop arguments based on evidence. Structured argumentation exercises and group discussions also helped strengthen students' logical and scientific thinking skills.

Table 7. Results of Observations of Teacher Activities in Cycle II

Meet.	Activity	Obs 1	Obs 2	Average (%)	Category
1	Introduction	4.25	4.25	87	Very Good
	Core	4.09	4.36		
	Conclusion	4.67	4.33		
2	Introduction	5.00	4.25	93	Very Good
	Core	4.64	4.55		
	Conclusion	4.67	4.67		
3	Introduction	4.50	4.75	94	Very Good
	Core	4.64	4.73		
	Conclusion	4.83	4.83		
Overall average				91	Very Good

The average percentage of overall teacher activity in Cycle II was 91%, which is included in the very good category. It can be seen from the table that there was a consistent increase in teacher teaching activities from the first to the third meeting. At each stage of the activity—introduction, core, and closing—observation scores showed that the quality of learning continued to improve. This indicates that teachers are able to implement the Argumented Driven Inquiry (ADI) learning model integrated with Islamic science effectively and according to plan, without the need for recommendations for improvement from observers. This improvement occurred because teachers had fully mastered the flow and strategies of the ADI model, were

increasingly skilled at classroom management, and were able to integrate Islamic values naturally into the learning process. Experiences from previous cycles also served as a basis for effective improvement.

Table 8. Results of Observations of Student Activities in Cycle II

Meet.	Average (%)	Category
1	74	Good
2	84	Very Good
3	89	Very Good
Average	82	Very Good

The average percentage of student activity during Cycle II reached 82%, which is in the very good category. This data shows an increase in student involvement in the learning process from the first to the third meeting. This increase shows the effectiveness of implementing the ADI learning model integrated with Islamic science in building active student participation in harmonic vibration material. This improvement occurred because students became more familiar with the ADI stages, felt motivated by the connection between the material and Islamic values, and were aided by the collaborative learning environment. Activities such as experiments, discussions, and argumentation made students more active and enthusiastic in participating in the learning process.

Table 9. Results of Attitudes Towards Physics Cycle II

Category	Attitudes Score (%)	Amount	Average (%)
Very high	85 ≤ p < 100	19	59.38
High	70 ≤ p < 85	13	40.62
Currently	55 ≤ p < 70	0	0.00
Low	40 ≤ p < 55	0	0.00
Very Low	0 ≤ p < 40	0	0.00
Total		32	100

Of the 32 students, all had a positive attitude towards physics with 59.38% in the very high category and 40.62% in the high category. The average percentage of attitudes towards physics was at 85%, indicating a high level of acceptance and interest in physics after Cycle II learning. This proves that the applied ADI model is able to improve scientific attitudes, learning interests, and students' interest in physics as a whole. This improvement occurred because the ADI model provided active, meaningful, and relevant learning experiences to students' lives and Islamic values. Direct involvement in scientific experiments and discussions helped students better understand physics concepts, while spiritual integration fostered a sense of wonder and concern for science, fostering an overall positive attitude.

Table 10. Results of the Argumentation Ability Test Cycle II

Category	Ability Score (%)	Amount	Average (%)
Very Good	85 < Score ≤ 100	11	34.38
Good	70 < Score ≤ 85	18	56.25
Fair	55 < Score ≤ 70	3	9.37
Not Good	0 < Score ≤ 55	0	0.00
Total		32	100

As many as 90.63% of students have argumentation skills in the good to very good category, with an average score of 80%. This shows a significant increase compared to Cycle I which reached 60%. Of the six argumentation indicators assessed, the 'data' indicator has the highest percentage of 94%, indicating that students are very good at collecting and using data in their arguments. Other indicators also show an increase, proving the effectiveness of the integrated Islamic science ADI learning model in building students' argumentation skills (Nadrah, 2025). This improvement occurred because students became accustomed to the systematic scientific inquiry process in the ADI model, from formulating problems to developing arguments based on data. Repeated practice, teacher guidance, and the integration of Islamic values encouraged students to think critically, logically, and reflectively, significantly improving all aspects of argumentation skills.

The graph of the increase in teacher activity in cycle I and cycle II indicators can be seen in Figure 1.

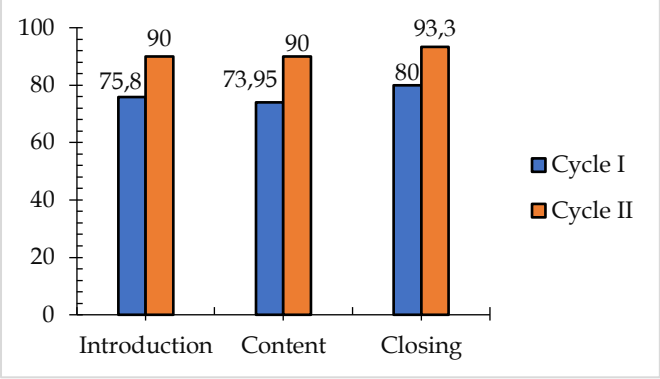

Figure 1. Teacher Activity for each Indicator in Cycle I and Cycle II

Based on Figure 1, there was an increase in the percentage of each indicator of teacher activity from cycle I to cycle II, nassmely introduction (75.8% to 90%), content (73.9% to 90%), and closing (80% to 93.3%), which indicates an improvement and effectiveness of learning. The highest increase occurred in the content indicator, caused by the teacher's ability to overcome previous obstacles such as a less active learning atmosphere, time management, and students' unfamiliarity with the Argument-Driven Inquiry (ADI)

model integrated with Islamic science. In cycle II, the teacher succeeded in creating more active, enjoyable, and focused learning, thus encouraging student activity and discipline, which had a positive impact on the quality of the learning process.

The graph of the increase in student activity in cycle I and cycle II per indicator can be seen in Figure 2.

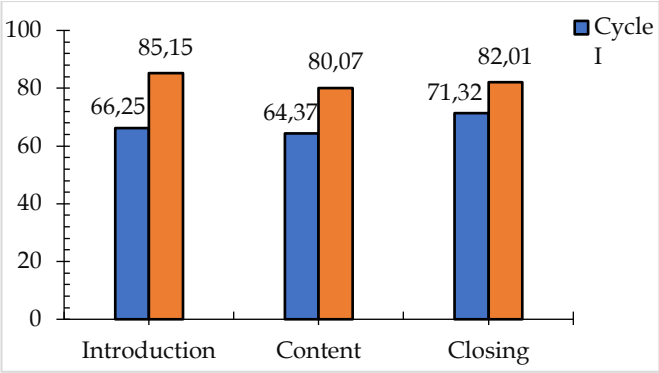

Figure 2. Student Activities for each Indicator in Cycle I and Cycle II

Based on Figure 2, there was an increase in the percentage of each indicator of student activity from cycle I to cycle II, namely introduction (66.3% to 85.1%), content (64.4% to 80.1%), and closing (71.3% to 82%), which reflects improvements and effectiveness of learning. The highest increase occurred in the introduction indicator, which was caused by improvements in teacher strategies in opening lessons, such as clearer delivery of objectives, the relevance of material to everyday life, and the provision of interesting triggers that increase students' attention and readiness to learn. This change has an impact on increasing student enthusiasm and involvement from the beginning of learning, thus creating a more conducive learning atmosphere and supporting the achievement of learning objectives optimally.

Based on observation data, the activeness of teachers and students in learning with the ADI model integrated with Islamic science showed good results and had met the success indicators, so that cycle III was not needed (Hasmawati et al., 2023). The increase in activity was seen significantly on both sides, in line with the findings of Puteri et al. (2022) which stated that this model was able to increase student learning activity. In addition, Zakaria et al. (2025) also emphasized that the implementation of the ADI model integrated with Islamic science encouraged teachers to be more active and creative, and increased student involvement in the learning process.

The graph of the average increase in each indicator of attitude towards physics in the pre-cycle, cycle I and cycle II can be seen in Figure 3. Based on Figure 3, students' attitudes towards physics increased significantly after the implementation of the integrated Islamic science Argument-Driven Inquiry (ADI) learning model. The adoption of scientific attitudes indicator increased from 58% (moderate category) in the pre-cycle to 76% (high category) in cycle I, and 91% (very high category) in cycle II. The interest in learning physics indicator increased from 47% (low category) to 74% (high category) in cycle I, and 84% (high category) in cycle II. The interest in increasing the time study of physics indicator increased from 49% (low category) to 73% (high category) in cycle I, and 83% (high category) in cycle II. Finally, the interest in physics career indicator increased from 44% (low category) to 74% (high category) in cycle I, and 84% (high category) in cycle II. This increase shows that the ADI model integrated with Islamic science is effective in fostering scientific attitudes, interest in learning, motivation to deepen the material, and students' interest in careers in physics through an active, contextual, and religious learning approach.

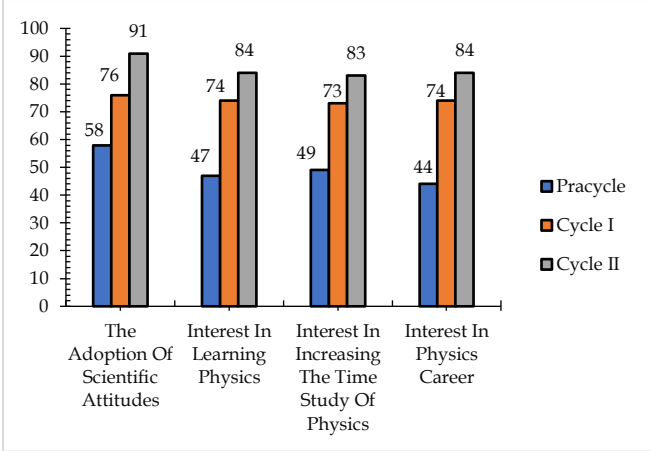

Figure 3. Attitudes Towards Physics for each Indicator at the Pre-Cycle, Cycle I and Cycle II Stages

Based on the questionnaire data, students' attitudes towards physics after participating in learning with the Argument-Driven Inquiry (ADI) model integrated with Islamic science showed good results and had met the success indicators, namely ≥75% of students were in the strong and very strong attitude categories. This increase reflects the increasing interest and positive attitudes of students towards physics after the implementation of the learning model. These results are in line with the findings of Desky et al. (2022) which stated that the application of the ADI model can significantly improve students' attitudes towards physics.

The graph of the increase in the average percentage of argumentation ability for each argumentation ability indicator at the pre-cycle stage, cycle I and cycle II can be seen in Figure 4. Based on

Figure 4, there is an increase in each indicator of argumentation ability at each stage. The percentage of students' argumentation ability in the claim indicator increased from 38% in the pre-cycle (less good category) to 59% in cycle I, and rose sharply to 82% in cycle II (good category). In the data indicator, there was an increase from 68% in the pre-cycle (quite good) to 80% in cycle I, and reached 94% in cycle II with a very good category. Warrant ability increased from 39% (less good) in the pre-cycle to 69% (quite good) in cycle I, then to 86% (very good) in cycle II. In the backing indicator, the percentage increased from 41% (less good) in the pre-cycle to 66% (quite good) in cycle I and 83% (good) in cycle II. The qualifier ability also increased from 38% (not good) in the pre-cycle to 43% (not good) in cycle I and increased significantly to 70% (good) in cycle II. Finally, the rebuttal indicator showed an increase from 37% (not good) in the pre-cycle to 42% (not good) in cycle I and reached 68% (quite good) in cycle II. Overall, all indicators showed consistent and significant improvement during the learning process.

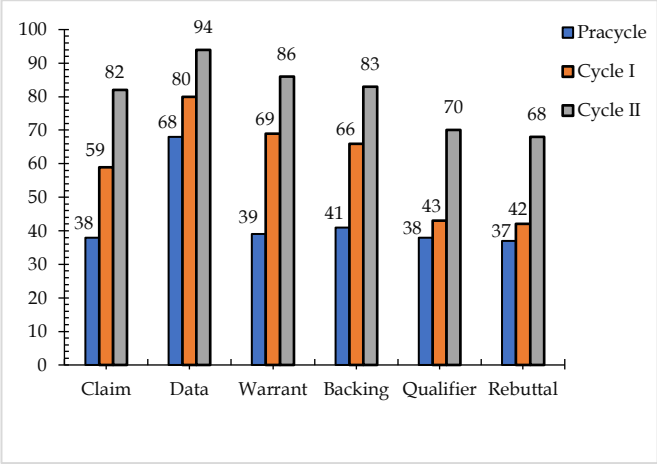

Figure 4. Students' Argumentation Skills for Each Indicator at the Pre-Cycle, Cycle I and Cycle II Stages

The results of the study indicate that the application of the Argument Driven Inquiry (ADI) learning model integrated with Islamic science is effective in improving students' argumentation skills in Physics learning. Argumentation ability test data showed a significant increase after the teaching and learning process using this model, in line with the findings of previous studies by Rizkia & Aripin (2022); Setiawan & Jumadi (2023); Utami et al. (2022) which confirmed the effectiveness of ADI in improving scientific argumentation skills. The ADI model helps students develop critical thinking and express opinions logically through argument components such as claims, data, warrants, backing, qualifiers, and rebuttals, so that the arguments compiled become stronger and more structured (Ahmad & Prasetyo, 2024). Thus, argumentation-based learning not only tests conceptual understanding but also encourages students to express and defend ideas scientifically and openly.

Conclusion

This study aimed to improve students' attitudes toward physics and their argumentation skills through the implementation of the Argument-Driven Inquiry (ADI) model integrated with Islamic science at MAN 1 Pekanbaru. The findings showed that this integrated learning model was effective in enhancing the quality of both teaching and learning processes. Throughout two learning cycles, there was a notable improvement in teacher and student activity, student engagement, and mastery of argumentation skills. Students became more active, confident, and reflective in presenting scientific arguments, while their attitudes toward physics shifted from predominantly negative to highly positive. These changes suggest that the ADI model, when combined with contextual values such as Islamic perspectives, can create a more meaningful and motivating learning experience. The significance of this improvement lies in the model's ability to foster critical thinking, scientific reasoning, and spiritual reflection simultaneously. It highlights the importance of shifting from teacher-centered to student-centered learning, where inquiry and values are integrated. For educators, this model offers a practical strategy to develop students' 21st-century skills in a way that aligns with their cultural and religious context. However, the study also recognizes that implementation of the ADI model requires adequate preparation, classroom management skills, and continuous reflection. Future research could explore how this model performs across different subjects, grade levels, or in diverse school settings to further validate and expand its applicability. In conclusion, the ADI model integrated with Islamic science not only enhances cognitive and scientific skills but also contributes to the development of students' character and attitudes—making it a promising approach for holistic science education in Islamic schools.

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Author Contributions

The authors i.e P.R, A, and D.I are jointly cooperative to complete this article at each stage.

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