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Comparison of Mathematical Reasoning Ability and Learning Interest of Students through the ARIAS Learning Model and Discovery Learning at State Junior High School 12 Tasikmalaya

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Abstract

This study aims to determine which learning model ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) and Discovery Learning (DL) is more effective in improving students' mathematical reasoning ability, as well as to examine students' learning interest in each model applied. The research method used was an experimental method, with the population being all eighth-grade students at SMP Negeri 12 Tasikmalaya. The sample was taken randomly, with class VIII C assigned as the first experimental group using the ARIAS learning model and class VIII A as the second experimental group using the DL model. Data collection in this study was conducted through reasoning ability tests, with the instruments used being test items and questionnaires. Based on data processing, analysis, and hypothesis testing, the conclusions are as follows: (1) students' reasoning ability using the ARIAS learning model is better than those using the DL model, (2) students' learning interest in the first experimental class with the ARIAS model falls into the medium category, (3) students' learning interest in the second experimental class with the DL model also falls into the medium category.

Keywords: ARIAS, discovery learning, reasoning ability, learning interest

Abstrak

Penelitian ini bertujuan untuk mengetahui kemampuan penalaran matematis peserta didik manakah yang lebih baik antara yang menggunakan model pembelajaran ARIAS (*Assurance, Relevance, Interest, Assessment, Satisfaction*) dan *Discovery Learning* (DL) serta melihat minat belajar peserta didik dari setiap model yang digunakan. Metode penelitian yang digunakan adalah metode eksperimen dengan populasi adalah seluruh peserta didik kelas VIII SMP Negeri 12 Tasikmalaya dan sampel diambil secara acak, yaitu kelas VIII C sebagai kelas eksperimen I dengan model pembelajaran ARIAS dan kelas VIII A sebagai kelas eksperimen II dengan model DL. Pengumpulan data dalam penelitian ini dilakukan dengan melakukan tes kemampuan penalaran dimana instrumen yang digunakan adalah instrumen tes dan angket. Berdasarkan hasil pengelolaan, analisis data dan pengujian hipotesis diperoleh kesimpulan bahwa: (1) kemampuan penalaran peserta didik dengan model pembelajaran ARIAS lebih baik dari model DL, (2) minat belajar peserta didik pada kelas eksperimen I dengan model pembelajaran ARIAS tergolong dalam klasifikasi kriteria sedang, (3) minat belajar peserta didik pada kelas eksperimen II dengan model DL tergolong dalam klasifikasi kriteria sedang.

Kata kunci: ARIAS, *discovery learning*, kemampuan penalaran, minat belajar

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INTRODUCTION

Mathematics is a discipline that continues to evolve in line with the demands of the times and plays an important role in shaping students' critical and logical thinking skills (Ennis, 2011; Rifqi et al., 2021). Mathematics education should be carried out from an early age with material that is tailored to the cognitive development stage and age of the students. The National Education Department emphasizes that one of the objectives of mathematics learning is to develop reasoning skills, whether through patterns of properties, mathematical manipulation, generalization, evidence compilation, or

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explanation of mathematical ideas and statements (Nasional, 2007). This indicates that mathematical reasoning is a fundamental aspect that every student must possess in learning mathematics (NCTM, 1989). In line with this, Geiger et al. (2015) and Jeannotte & Kieran (2017) emphasize that mastery of concepts in mathematics learning cannot be separated from reasoning skills.

Reasoning ability is understood as a thinking process to draw conclusions from various pieces of information that are considered true (Sternberg & Sternberg, 2017). Shadiq (2019) defines reasoning as a thinking activity to obtain conclusions from a number of available pieces of information. Meanwhile, Hendriana et al. (2017) explain that mathematical reasoning is a thinking process for drawing conclusions based on existing data, concepts, and methods. Good reasoning helps students connect concepts, organize evidence, and solve problems systematically (Christianidis, 2021; Jeannotte & Kieran, 2017; Weber & Alcock, 2004). Thus, reasoning ability can be viewed as a higher-order thinking skill involving the analysis and synthesis of various mathematical information.

However, the results of diagnostic tests on the mathematical reasoning abilities of eighth-grade students at Tasikmalaya State Junior High School 12 showed an average score of only 42.14 out of a maximum score of 100. This means that the average score has not yet reached the minimum passing criteria (KKM). This condition indicates that students' mathematical reasoning abilities are still relatively low. The causes of this may be internal or external, including a lack of interest in learning, motivation, and an unsupportive learning environment (Febriyanti & Seruni, 2015; Sirait, 2016). Syamsuddin (2021) and Sirait (2016) emphasize that low interest in learning will have an impact on the weakness of students' mathematical reasoning, while high interest will increase their enthusiasm for learning. Therefore, systematic efforts are needed to create a conducive learning atmosphere so that students are encouraged to develop their reasoning skills.

One alternative solution is the use of an appropriate learning model. The ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) learning model is one approach that can be implemented. According to Rahman & Amri (2014), the ARIAS model is designed to foster students' self-confidence, connect the material to everyday life, increase interest in learning, provide meaningful evaluation, and foster a sense of pride in their achievements. The five components of ARIAS—assurance (confidence), relevance (connection), interest (engagement), assessment (evaluation), and satisfaction (satisfaction)—complement each other in creating an effective learning process (Noviyana et al., 2020). Research by Kurniawati et al. (2017) shows that ARIAS can increase students' self-confidence, engagement, and satisfaction in mathematics learning.

In addition to ARIAS, the Discovery Learning (DL) model is also relevant for use in mathematics education in the 2013 curriculum. Mulyatiningsih (2011) explains that Discovery Learning is a learning strategy that requires students to discover mathematical concepts on their own with guidance from the teacher. Mabhoza & Olawale (2024) explain that this model does not present concepts in a ready-made form but rather provides space for students to organize and discover these concepts independently. Simamora & Saragih (2019) and Edi & Rosnawati (2021) also emphasize that Discovery Learning

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involves various mental activities such as classifying, analyzing, and formulating hypotheses. Thus, this model enables students to be more active, critical, and creative in discovering mathematical concepts.

Both learning models have their own advantages. ARIAS emphasizes the motivational and emotional aspects of students, while Discovery Learning emphasizes cognitive involvement through the discovery process (Noviyana et al., 2020; Simamora & Saragih, 2019). Previous studies have shown that both models have a positive impact on mathematics learning outcomes, but few have specifically compared their effects on mathematical reasoning skills (Prasasti et al., 2019; Yusuf & Pangestu, 2021). Given this research gap, it is important to conduct an empirical study comparing the effectiveness of the ARIAS and Discovery Learning models in enhancing mathematical reasoning.

Based on this background, this study aims to analyze and compare the mathematical reasoning abilities of students taught using the ARIAS and Discovery Learning models in grade VIII of Tasikmalaya State Junior High School 12. The results of this study are expected to provide practical contributions for teachers in choosing the right learning model, as well as providing a theoretical basis for the development of mathematics learning strategies at the junior high school level.

METHODS

This study used an experimental method with the aim of determining the differences in mathematical reasoning abilities of students taught using the ARIAS and Discovery Learning models. The experimental approach was chosen because it is suitable for testing the causal relationship between the learning model (independent variable) and students' mathematical reasoning abilities and learning interest (dependent variables). The research design used was a posttest-only control design as described by Ruseffendi (2010). In this design, there were two randomly selected experimental groups, namely experimental group I (A1) which was given treatment with the ARIAS model and experimental group II (A2) which was given treatment with the Discovery Learning (DL) model. Next, both groups were given a mathematical reasoning ability test after the treatment to determine the learning outcomes obtained.

The population in this study was all eighth-grade students at SMP Negeri 12 Tasikmalaya during the current academic year. The sampling technique was conducted using random sampling, resulting in class VIII C as the first experimental group with the ARIAS model treatment and class VIII A as the second experimental group with the Discovery Learning model treatment. Random selection was conducted to minimize bias in the study and ensure that both groups were in relatively equivalent initial conditions. Thus, any differences in learning outcomes that emerged could be more reliably attributed to the differences in the learning models used.

Data collection techniques were carried out using two main instruments, namely a mathematical reasoning ability test and a learning interest questionnaire. The reasoning ability test was designed in the form of essay questions that measured mathematical reasoning aspects in accordance with predetermined indicators. The learning interest questionnaire was administered to determine the extent of students' interest in mathematics learning after using both models. The collected data were analyzed using an independent sample t-test to test the hypothesis of a difference between two means. This test was chosen to determine whether there was a significant difference in the mathematical reasoning ability of students in the two treatment groups.

RESULT AND DISCUSSION

Mathematical reasoning in the ARIAS and Discovery Learning models

Students' mathematical reasoning abilities were measured based on the following indicators: (1) making assumptions; (2) performing manipulations; (3) drawing conclusions, constructing evidence, providing reasons or evidence for several solutions; (4) drawing conclusions from statements; (5) checking the validity of an argument; and (6) finding patterns for the properties of mathematical phenomena to make generalizations. The following are the test scores for reasoning ability based on the indicators obtained from Experiment Class I and Experiment Class II, as presented in Table 1.

Table 1 Average Presentation of Each Mathematical Reasoning Ability Indicator

Indicators number	Results			
	ARIAS Model		Discovery Learning Model	
	$\bar{x}$	%	$\bar{x}$	%
1	3,69	92,25	3,84	96,00
2	3,38	84,50	3,22	80,50
3	2,44	61,00	1,75	43,75
4	2,78	69,50	2,06	51,50
5	3,28	82,00	2,12	53,00
6	3,09	77,28	3,50	87,5
Mean ($\overline{\overline{x}}$)	18,66		16,18	
Percentage (%)	77,75		67,42	

Based on Table 1, it can be seen that the indicators that received the highest scores in experimental class I were those using the ARIAS learning model. In the first indicator, the final average score was 3.69, which means that 92.25% of students were able to solve the problem. The mistakes that occurred in solving this problem were that students were not careful enough in their calculations and the information they obtained was not accurate. Based on the field trial results, while working on the LKPD, students were able to write down what they knew and what was asked in the first indicator question. This was demonstrated by students writing down the available information, knowing what is called a rib, writing down the base side, and what is called height. Students were also able to complete each step in solving the problem in accordance with what they had learned. In the second experimental class using the DL model, the first indicator had the highest score, with an average final score of 3.84. This means that 96% of students were able to solve the problem. The mistake that occurred in solving this problem was that students were not careful enough in their calculations. Based on the results of the study, while working on the LKPD, students were able to write down what they knew and what was asked in the first indicator question, such as writing down the available information, knowing which was the rib, the base, and which was the height.

Meanwhile, the indicator with the lowest score in experimental class I was the third indicator, with an average score of 2.44. This means that 61% of students were able to solve the problem. The errors that occurred in solving this problem were the students' carelessness in performing calculations, incomplete work, the use of formulas that were not entirely accurate, insufficient information from the questions used, students who were still unable to draw conclusions, and difficulty in compiling evidence or providing reasons for the problems given. Based on the research results, while working on the LKPD, students were able to write down what was stated and asked in the question. However, students still had difficulty identifying information not mentioned in the question, leading to errors in finding the solution.

In experimental class II, the third indicator had an average score of 1.75. This means that only 43.75% of students were able to solve the problems given. The errors that occurred in solving this problem were the students' carelessness in performing calculations, incomplete work, the use of formulas that were not entirely accurate, insufficient information from the questions used, students who were still unable to draw conclusions, and difficulty in compiling evidence or providing reasons for the problems given. Based on the research findings, during the completion of the LKPD, some students still appeared confused about writing down what was stated and asked in the question and also struggled to identify information not mentioned in the question, leading to errors in finding the solution.

The indicator that received a moderate score in experimental class I was the fifth indicator, with an average score of 3.28 or 82%. The errors that occurred in solving this problem were errors in using the formula, carelessness of students in performing calculations, and inappropriate use of information from the question. Based on the research findings, while working on the LKPD, students were able to write down the information provided in the question. Students also understood the intent of the fifth indicator question. Each step performed by the students was done independently, with only occasional questions asked to the teacher. Furthermore, the sixth indicator showed an average score of 3.09 or 77.29%, with students able to complete it. The errors that occurred in solving this problem included some students still using manual calculations without identifying patterns, resulting in errors in performing calculations. Based on the research results, while working on the LKPD, students were able to understand what was known and asked in questions in the form of the sixth indicator. However, there were still students who were confused in determining the correct number pattern for the given problem. Therefore, students preferred to use manual procedures, namely calculating one by one from the first term to the term asked in the question.

Meanwhile, the average score for the second indicator in the experimental class was 3.22 or 80.5%. The errors that occurred in solving this problem were the use of inappropriate formulas and the students' lack of thoroughness in performing calculations. Based on the results of the study, while working on the LKPD, the students appeared to be able to determine what was being asked and what was known in the questions. Students were also able to manipulate questions in the form of stories or images, though a few of them asked about aspects they still did not fully understand. The fifth indicator showed a score of 2.12 or 53% of students were able to solve the problem. The errors that occurred in solving this problem were that there were still students who could not understand the information in the question, resulting in errors in each step of the solution, as well as the use of inappropriate formulas and the students' carelessness in performing calculations. Based on the research findings, during the completion of the LKPD, some students were able to understand what was being asked and stated in the questions. However, students still struggled to extract information not explicitly stated in the questions. During the learning process, students asked questions related to the fifth indicator, such as how to proceed with the problem-solving process and other related matters.

When viewed from the achievement of each mathematical reasoning ability indicator in experiment class I, there are four indicators that achieve the average passing score. Meanwhile, in experiment class II, there are three indicators whose average scores achieve the passing score. Therefore, it can be concluded that the ARIAS learning model is better than the DL model. Furthermore, when looking at the total average results for each class, the ARIAS model in experimental class I scored 18.66 and the DL model in experimental class II scored 16.18. Therefore, it can be concluded that the ARIAS learning model is better than the DL model. Furthermore, based on the results of the hypothesis test calculation, where t_calculated ≥ t_table, this leads to the rejection of H_o and the acceptance of H_1. This means that the mathematical reasoning ability of students who use the ARIAS learning model is better than those who use the DL model. Based on the above discussion, it can be concluded that the mathematical reasoning ability of students using the ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) learning model is better than those using the Discovery Learning (DL) model.

These results reveal an interesting pattern. The first indicator (making assumptions) consistently achieved the highest scores in both models. This is reasonable, as this skill emphasizes factual knowledge and direct recognition of information from the question. According to Bergqvist (2005) and Ningsih (2023), making assumptions often involves basic logical thinking skills, making it easier for students to achieve. This trend is also reinforced by observation results, where students appear confident in writing down basic information even though they sometimes make mistakes in calculations.

Conversely, the third indicator (constructing evidence and drawing conclusions) is the main obstacle. Students' difficulties in this section indicate that higher-order reasoning is still weak. In DL classes, the obstacle is greater because learning emphasizes independent exploration. Without structured guidance, students tend to be confused when they have to draw logical conclusions or construct mathematical arguments. This is in line with the view of Lessani et al. (2017), that discovery learning requires adequate cognitive readiness, and if not, it can cause frustration in students.

On the other hand, the ARIAS class showed better results on indicators that require precision, such as checking the validity of arguments (82%) and drawing conclusions from statements (69.5%).

This can be explained because the ARIAS model emphasizes the Assessment and Satisfaction steps. Through Assessment, students receive feedback on their work, while Satisfaction provides a sense of fulfillment when successfully completing a task. According to Kurniawati et al. (2017) and Anjariyah & Karlina (2016), these two aspects are crucial in building self-confidence and motivation to continue thinking critically.

This difference in achievement shows that ARIAS is more capable of guiding students in building complex mathematical reasoning, while DL is more prominent in the initial exploration aspects, such as manipulation and hypothesis formulation. Thus, ARIAS provides an advantage in guiding students through sequential thinking stages, while DL is suitable for training independence but requires additional reinforcement so that students do not stop in the middle of the thinking process.

Learning interest in the ARIAS and Discovery Learning models

Based on the research results, to answer the research questions, namely (1) how is the learning interest of students after participating in the ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) learning model? (2) How is the learning interest of students after participating in the Discovery Learning (DL) model? Therefore, using learning interest as an indicator, the researcher employed the following guidelines: (1) feelings of enjoyment, (2) students' interest, (3) students' engagement, (4) diligence in learning and completing mathematics assignments, and (5) perseverance, discipline in learning, and having a study schedule. The results of the analysis of the students' learning interest questionnaire can be seen in Table 2.

Table 2. Results of learning interest questionnaire

Indicators	Average Score and Classification Criteria			
	ARIAS Model		Discovery Learning Model	
	Indicator	Total	Indicator	Total
1	21,75 (Medium)	82,03 (Medium)	18,16 (Medium)	80,63 (Medium)
2	22,41 (High)		20,31 (Medium)	
3	10,66 (Medium)		16,57 (Medium)	
4	10,19 (Medium)		16,47 (Medium)	
5	16,47 (High)		10,19 (Medium)	

Based on Table 2, the learning interest of students in experimental class I, which used the ARIAS learning model, showed a better trend than experimental class II, which used the Discovery Learning model. This is evident from the higher average scores on several indicators, particularly the student interest indicator (22.41, high category) and the indicators of perseverance and discipline in learning (16.47, high category). Meanwhile, in the Discovery Learning class, most indicators fall into the moderate category, such as the feeling of enjoyment indicator (18.16) and interest indicator (20.31).

Overall, both the ARIAS and DL classes received a moderate classification for learning interest. However, the advantage of the ARIAS model is evident from the presence of two indicators that reached the high category, indicating that students are more consistent in showing interest in mathematics learning. This finding suggests that the components of Assurance, Relevance, Interest, Assessment, and Satisfaction in ARIAS have a positive influence on students' emotions and motivation during learning.

Based on the analysis of the average overall scores of the learning interest questionnaire distributed to students at the end of the study, it was found that the learning interest in experimental class I, which used the ARIAS (Assurance, Relevance, Interest, Assessment, Satisfaction) learning model, was classified as moderate. Similarly, experimental class II, which used the Discovery Learning (DL) learning model, was also classified as moderate. This means that students showed good learning interest during the mathematics learning process. This can be seen from the students' activities during the learning process, which were more enthusiastic during discussions and when working on the practice problems provided. Students diligently worked on the problems and asked questions about aspects they did not understand.

The results of this study are in line with Schiefele (1991) view that learning interest is the result of interactions between cognitive, affective, and motivational factors influenced by learning strategies. The ARIAS model, which emphasizes the aspects of Interest and Satisfaction, can encourage students to be more engaged, as they not only understand the material but also feel valued and derive satisfaction from the learning process (Noviyana et al., 2020). This supports Keller (2012) findings in the ARCS theory, which state that providing a sense of relevance and satisfaction significantly influences long-term learning motivation. Furthermore, these results align with Hamalik (2009) research, which emphasizes that students' learning interest can grow if learning provides opportunities for active participation, a sense of achievement, and enjoyable learning experiences. Thus, the high scores in the interest and discipline indicators in the ARIAS class strengthen the argument that this model is more effective in enhancing learning interest compared to Discovery Learning.

In addition, the results of the study also show that Discovery Learning, although good at encouraging students to actively explore, is not yet fully capable of generating stable interest. This is because the DL model requires more independence from students in discovering concepts, while some students still need structured guidance so they do not lose direction (Mabhoza & Olawale, 2024; Richards & Samuels, 2023). This finding is consistent with the studies by Chase & Abrahamson (2018) and Edi & Rosnawati (2021), which state that pure discovery-based learning is often ineffective without adequate scaffolding, especially in the context of abstract mathematics learning. Thus, it can be concluded that while both models generate moderate levels of learning interest, ARIAS offers a more significant advantage by integrating structured motivational aspects, thereby enabling students' learning interest to develop more optimally.

CONCLUSION

Based on the results of the research and analysis, it was concluded that the mathematical reasoning abilities of students taught using the ARIAS learning model (Assurance, Relevance, Interest, Assessment, Satisfaction) model are better than those taught using the Discovery Learning (DL) model, with an average score of 18.66 (77.75%) for the ARIAS class and 16.18 (67.42%) for the DL class. The results of the hypothesis test also indicate that t-calculated ≥ t-table, so H0 is rejected and H1 is accepted, meaning there is a significant difference in mathematical reasoning ability between the two groups. Meanwhile, the results of the learning interest questionnaire showed that both ARIAS and Discovery Learning were in the moderate category, but ARIAS had an advantage in the indicators of interest (22.41; high category) and learning discipline (16.47; high category). These findings prove that ARIAS is more effective in facilitating both the cognitive and motivational aspects of students. Therefore, ARIAS can be recommended as an alternative mathematics learning model to enhance mathematical reasoning and maintain students' learning interest. Further research is suggested to examine the application of ARIAS on different subject matter or educational levels, as well as to explore the integration of ARIAS with other learning models to obtain more comprehensive results.

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