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Applying the ARIAS Learning Model with QuizWhizzer Support to Enhance Students' Understanding of Mathematical Concepts

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ABSTRACT

Students' low level of mathematical conceptual understanding requires more effective learning strategies. Research integrating the ARIAS learning model with interactive digital media such as QuizWhizzer is still limited. This study examined the effects of the ARIAS learning model assisted by QuizWhizzer, the ARIAS model alone, and Conventional learning on high school students' mathematical conceptual understanding. A quantitative approach with a post-test only control group design was employed, involving three Grade XI classes at SMA Muhammadiyah 1 Pekajangan. The instrument was an essay test developed from indicators of mathematical conceptual understanding, and data were analyzed using Scheffe's post hoc test. The findings showed that both the ARIAS model and the ARIAS model assisted by QuizWhizzer significantly improved students' conceptual understanding compared to Conventional learning. However, no significant difference was found between the ARIAS model with and without QuizWhizzer. These results indicate that QuizWhizzer did not substantially enhance the effectiveness of the ARIAS model. The study highlights the importance of further investigation into the integration of digital media within specific learning models to maximize their potential impact on mathematics learning.

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Introduction

As one of the fundamental disciplines, mathematics plays a strategic role in the development of science and technology and makes a direct contribution to various aspects of daily life, including numerical computation, the application of arithmetic concepts in social contexts, and data processing (Abdillah & Hamami, 2021; Sengkey et al., 2023). Therefore, mathematics learning in schools is expected to equip students with logical and systematic thinking skills to solve various contextual problems (Ramadhan et al., 2025). Nevertheless, field research has revealed that a considerable number of students continue to face difficulties in understanding mathematical concepts, which negatively affects their motivation and learning outcomes (Astini & Purwati, 2020).

Based on interviews with mathematics teachers at SMA Muhammadiyah 1 Pekajangan (Table 2), it was found that students' conceptual understanding remains inadequate. Students often struggle with tasks that require constructing counterexamples or applying concepts in real-life contexts. This situation highlights the need for a structured learning model that can systematically facilitate students in developing a deeper understanding of concepts. In the learning domain, conceptual understanding is defined as students' ability to integrate new knowledge with prior knowledge, present mathematical ideas through various representations, and appropriately apply this understanding across different learning situations and problem-solving contexts (Rochmah et al., 2021). This involves complex cognitive processes that require interactive, contextual, and meaning-oriented learning approaches.

The ARIAS learning model (Assurance, Relevance, Interest, Assessment, Satisfaction) is considered to align well with these characteristics. It is designed to build students' confidence, connect material with real-world contexts, foster learning interest, provide formative assessment, and create a sense of satisfaction in learning (Humaidah & Fadilah, 2020). Previous studies have shown that ARIAS effectively enhances meaningful learning experiences and supports conceptual understanding (Andrian, 2021; Maulana & Suhendri, 2022).

In particular, the components of *Interest* and *Assessment* strongly emphasize the role of learning media. *Interest* focuses on stimulating students' curiosity about the material, while *Assessment* refers to formative evaluation and tasks. One medium that supports both components is QuizWhizzer, a game-based quiz platform that enables students to learn interactively, for example, through digital board games similar to Snakes and Ladders (Faijah et al., 2022).

QuizWhizzer allows students to actively engage in learning through interaction and collaboration, while also providing instant feedback on their responses. It further enables teachers to monitor learning progress in real time and provide necessary interventions (Susanto & Ismaya, 2022). Its high level of interactivity and gamified features have been proven to increase student engagement and reinforce information processing and concept retention (Hermawan & Suharto, 2025).

Accordingly, the integration of the ARIAS learning model with interactive media such as QuizWhizzer is expected to create a fun, challenging, and meaningful learning environment. This approach has the potential to improve students' mathematical conceptual understanding through a more structured and motivating process. In line with the findings of Rahmatyas (2024), motivation-based learning and interactive digital technology positively contribute to conceptual understanding. Similarly, Hidayat et al. (2024) reported that the use of technology significantly influences the relationship between conceptual understanding and student engagement.

Previous studies have generally focused either on the effectiveness of the ARIAS model (Marjawati et al., 2019; Wiyanoto et al., 2022; Mohtar & Siligar, 2022; Shalihat et al., 2023) or on the independent use of digital media (Wayan Sumandya & Gita Saraswandewi, 2023; Annisa et al., 2023). This indicates a gap in understanding the impact of integrating the two on students' mastery of mathematical concepts. The present study offers novelty by quantitatively examining the differences in the effects of implementing ARIAS with QuizWhizzer, ARIAS without media, and Conventional learning on students' conceptual understanding of mathematics. The findings provide theoretical implications that the pedagogical structure of ARIAS is the dominant factor in supporting conceptual understanding, while digital media serves as an additional element that enhances student motivation and participation.

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https://doi.org/10.51574/kognitif.v5i3.3639 Volume 5, No 3, Juli - September 2025, pp. 1290– 1302

Considering this background, the purpose of this study is to compare the effectiveness of the ARIAS model, the ARIAS model assisted by the interactive media QuizWhizzer, and Conventional learning in improving students' mathematical conceptual understanding. This comparison aims to identify the most optimal learning strategy to foster deep and applicable concept mastery.

Method

Type of Research

This study employed a quantitative approach with a quasi-experimental design using a post-test only control group pattern. The focus of the research was to examine the extent to which the implementation of the ARIAS learning model assisted by QuizWhizzer could improve students' mathematical conceptual understanding. This design was selected because it is relevant for testing the influence of a learning model as the independent variable on students' conceptual understanding as the dependent variable, within real classroom settings where full control over all factors involved is not feasible (Hartono, 2019). In this study, the post-test only control group design was applied with the administration of tests. The research involved three groups: (1) The first experimental group experienced learning through the ARIAS model integrated with interactive media, namely QuizWhizzer; (2) The second experimental group received learning using the ARIAS model without interactive media support; and (3) The control group participated in learning using conventional methods commonly applied in classrooms. The experimental and control groups each received different treatments, and all groups were administered only a post-test to measure their mathematical conceptual understanding after the learning process.

Table 1. Research Design

Class	Treatment	Post-test
Experiment 1	X_1	O_1
Experiment 2	X_2	O_2
Control	X_3	O_3

Notes:

X_1 : Learning with the ARIAS model assisted by QuizWhizzer
X_2 : Learning with the ARIAS model
X_3 : Learning with the Conventional model
O_1 Post-test results of Experiment 1 after learning with ARIAS assisted by QuizWhizzer
O_2 : Post-test results of Experiment 2 after learning with ARIAS
O_3 : Post-test results of the Control group after learning with the Conventional model

Population and Sample

The population of this study comprised all Grade XI students at SMA Muhammadiyah 1 Pekajangan in the 2024/2025 academic year. The sample was selected using the cluster random sampling technique, a random method based on naturally formed class groupings (Martono, 2011). The participants were divided into three groups: Group A, consisting of 21 students, served as the first experimental class and received the ARIAS learning model assisted by QuizWhizzer; Group B, consisting of 21 students, served as the second experimental class and was taught using the ARIAS learning model; and Group C, consisting of 22 students, served as the control class and was taught using the Conventional learning model. Each experimental and control group was exposed to different treatments, and all groups were administered only a post-test to assess their level of mathematical conceptual understanding after the assigned treatment.

Instruments

The research instruments were developed beginning with interviews with mathematics teachers as an initial step to understand the learning conditions in the classroom. Through these interviews, the researcher obtained insights into students' difficulties in understanding mathematical concepts as well as the challenges encountered during the learning process. The information gathered was then used as a basis for identifying the initial problems and designing research instruments relevant to the needs of mathematics learning.

Table 2. Interview Guidelines

No	Questions
1	How is the sequence of the learning process you usually carry out during instruction?
2	How is students' engagement during the learning process?
3	What teaching materials do you usually select for classroom instruction?
4	How often do you use instructional media/tools in teaching?
5	Are you familiar with the QuizWhizzer learning media?
6	How do you address the challenges encountered in using learning media?
7	Do students experience difficulties in understanding mathematical concepts? If yes, in which areas?
8	Please specify which points are least mastered by students: a. Restating learned concepts. b. Classifying objects based on mathematical concepts. c. Applying concepts algorithmically. d. Providing examples or counterexamples of the learned concepts. e. Presenting concepts in various representations. f. Connecting mathematical concepts internally or externally.
9	What forms of difficulties do students encounter in the indicator(s) you selected from number 8?
10	How do you overcome these difficulties?

In this study, an essay-type test instrument was used to measure students' level of mathematical conceptual understanding. The test was designed on the topic of geometric transformations and consisted of 11 items developed based on the indicators of conceptual understanding proposed by Lestari & Yudhanegara (2015), ensuring that the instrument had a strong and relevant theoretical foundation, as shown in Table 3.

Table 3. Indicators of Mathematical Conceptual Understanding

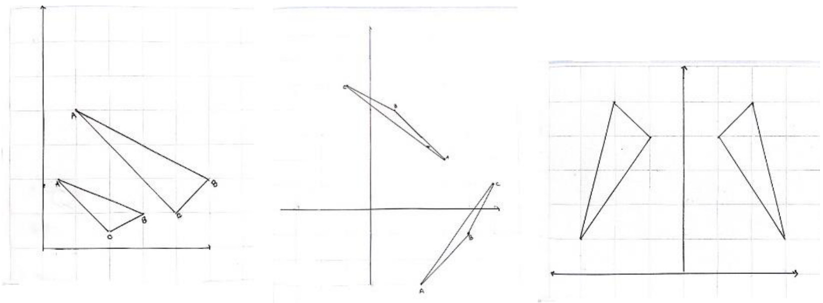
No	Indicators of Mathematical Conceptual Understanding
1	Restating a learned concept
2	Classifying objects based on mathematical concepts
3	Applying concepts algorithmically
4	Providing examples or counterexamples of the learned concepts
5	Presenting concepts in various representations
6	Connecting mathematical concepts internally or externally

The test instrument used in this study is presented in Table 4

Table 4. Test Items for Students' Mathematical Conceptual Understanding

No	Test Item
1	Explain the meaning of *translation* and *rotation*.
2	Define the meaning of *reflection* and *dilation*.
3	Which of the following events represent a rotation? – Day turns into night. – The Earth rotates on its axis. – Budi walks from home to school. – A map is drawn at a scale of 1:1,000,000.
4	Explain, with justification, and identify each of the following events according to the relevant type of transformation (translation, dilation, or rotation): – Moving a table – Movement of a clock hand –

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v5i3.3639 Volume 5, No 3, Juli - September 2025, pp. 1290– 1302

	Resizing a photo – Scale on a map – A wheel turning – A child walking straight – An apple falling from a tree to the ground
5	Identify and classify the following events according to the relevant type of transformation (translation, dilation, or rotation): – Arjuna moves an unused chair to the back storage room of the school. – A world map is a smaller representation of the Earth. – A bicycle wheel always rotates on its axis.
6	A point A(-2, -5) is dilated with respect to the origin (0,0) using a scale factor of -2. Determine the coordinates of the image point and sketch the dilation process.
7	Several diagrams will be shown. Identify which diagram most accurately represents the translation of point A to point A′ in the plane according to the given distance and direction. 
8	If point A(3,5) is translated by $T = \binom{-2}{4}$, determine the coordinates of the image point and sketch the translation process.
9	If point A(2,3) is translated by T(-3,4), determine the coordinates of the image point.
10	An architect is designing a miniature replica of a building. The original building has vertices at A(6,12), B(12,9), and C(15,21). To create the miniature, the building will be dilated with respect to the origin O(0,0) using a scale factor k = 1/3. Determine the coordinates of the vertices A′, B′, and C′ after dilation.
11	A cartographer plans to relocate a building represented by triangle vertices A(24,21), B(18,15), and C(20,18). If these vertices are translated by vector D(2,4), determine the final coordinates of the vertices.

The instrument was validated by two mathematics education experts to ensure content validity and to guarantee its appropriateness and feasibility. Subsequently, the instrument was administered to a trial class to test its reliability, item difficulty, and item discrimination for the mathematical conceptual understanding test.

Table 5. Instrument Testing Results

Test	Results
Validity	The validity analysis showed that the Pearson product–moment r_{table} with N=16 at a 5% significance level ($\alpha = 0.05$) was 1. Based on the testing criteria, since the calculated rr value exceeded the r_{table}, all 12 items in the test instrument were declared valid and suitable for measuring students' mathematical conceptual understanding.
Reliability	The reliability analysis using Cronbach's Alpha coefficient yielded a value of 0.717, which exceeded the minimum threshold of 0.05. This result indicates that the test instrument had an adequate level of reliability and good consistency in assessing students' mathematical conceptual understanding, confirming its feasibility as an assessment tool in the learning process.
Item Discrimination	Based on the discrimination analysis, items 1, 4, 7, 9, and 10 were categorized as good, while items 2, 3, 5, 6, and 8 were categorized as very good. Meanwhile, item 11 was rated as fair and therefore excluded from the final set of test items used in this study.
Item Difficulty Index	The analysis of the item difficulty index showed that items 1–12 fell into the medium category.

Based on Table 5, item number 11 was not included in the final data analysis.

Data Collection

Data collection was carried out in two stages. First, a preliminary interview was conducted to obtain information about the problems faced by teachers and students in understanding mathematical concepts. Second, a post-test was administered after each group received treatment according to its respective learning model. The test was conducted in a single scheduled session and was directly supervised by the researcher and the teacher.

Analysis

The data analysis process in this study was conducted using a one-way ANOVA to identify differences in students' levels of mathematical conceptual understanding among groups. Prior to performing ANOVA, assumption testing was carried out, including a normality test using the Kolmogorov–Smirnov test and a homogeneity of variance test using Levene's test. If both assumptions were met, the analysis proceeded with the one-way ANOVA. When the ANOVA results indicated significant differences at the significance level of $\alpha < 0.05$, a post hoc Scheffe test was performed to identify the groups that differed significantly (Huda, 2025). All analyses were conducted using the latest version of SPSS software.

Results

This study was conducted in the even semester of the 2024/2025 academic year at SMA Muhammadiyah 1 Pekajangan, Pekalongan City. The purpose of the research was to analyze the effectiveness of the ARIAS learning model integrated with the digital media QuizWhizzer in developing students' conceptual understanding of mathematics on the topic of Geometric Transformations. The participants consisted of three Grade XI classes: Group A as the first experimental group, Group D as the second experimental group, and Group C as the control group. The research began with oral interviews involving subject teachers and several students to identify problems occurring in the school environment. The problems identified at this stage served as the basis for the design and implementation of the study. Subsequently, the classes that would receive treatments were determined as part of the experimental design. The next stage was the trial testing of the mathematical conceptual understanding test instrument to ensure its validity, reliability, discrimination power, and difficulty index before its use in this study.

Two types of data were used in this study: initial data and final data. The initial data were obtained from students' daily assessment scores to determine their prior ability, while the final data were collected through a conceptual understanding test designed to evaluate learning gains after different treatments were administered to each group. Data analysis was carried out using a series of statistical tests, including normality testing, homogeneity testing, and one-way ANOVA. If the analysis revealed significant differences between the control and experimental groups, a post hoc Scheffé test was conducted to more specifically determine differences in conceptual understanding across groups.

Preliminary analysis using one-way ANOVA yielded a significance value of 0.999, which was statistically much higher than the predetermined significance level ($\alpha = 0.05$). Based on this result, it was concluded that the average conceptual understanding of mathematics among the three groups did not differ significantly before treatment. This indicated that the groups were relatively homogeneous or equivalent at the outset, which is important to ensure that any differences found in the final results were attributable to the treatments given rather than to initial group differences.

The learning process was implemented over three sessions. In the first session, the material covered reflection and translation. In Experimental Class 1, learning began with the

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https://doi.org/10.51574/kognitif.v5i3.3639 Volume 5, No 3, Juli - September 2025, pp. 1290– 1302

ARIAS syntax, emphasizing confidence building and connecting material to real-life contexts. Instruction was then delivered using QuizWhizzer, an interactive digital game resembling a board game that also supported the delivery of content. In Experimental Class 2, the ARIAS model was applied without QuizWhizzer. While students still demonstrated active participation, the absence of the media meant that the learning process was limited to the ARIAS structure alone. Meanwhile, in the control class, a conventional learning approach was applied, involving lectures, question-and-answer discussions, and practice exercises.

In the second session, the focus shifted to rotation and dilation. In Experimental Class 1, students were divided into groups and again engaged in educational game-based learning through QuizWhizzer. The competitive atmosphere encouraged greater activity, focus, and engagement in understanding the material. In addition to increasing motivation, the application provided immediate feedback that allowed students to identify errors and make corrections independently, thus strengthening their conceptual understanding more effectively. In Experimental Class 2, learning was carried out through group discussions and individual assignments without QuizWhizzer. Although participation was still visible, student engagement was not as intense as in Experimental Class 1. Meanwhile, the control class continued with the conventional one-way delivery by the teacher, resulting in low student involvement and a passive learning attitude.

In the third session, all students were given a post-test consisting of a set of essay questions. The test instrument had previously undergone validation to ensure that each item was appropriate, clear, and aligned with the objectives of measuring mathematical conceptual understanding. During the learning process, observations were conducted to measure students' level of involvement and responses in each class. The results showed that students in Experimental Classes 1 and 2 exhibited higher participation, stronger learning motivation, and greater enthusiasm than those in the control group. Conversely, many students in the control group continued to struggle with the material and displayed low motivation to learn. This indicates that the ARIAS learning model can create a more engaging and interactive classroom environment.

The calculation and analysis of the final test data are presented in detail in this section to provide a comprehensive overview of the findings that form the basis for drawing conclusions. The prerequisite testing confirmed that all samples came from normally distributed populations and had homogeneous variances. Normality testing was conducted for each sample group to ensure the assumption of normal distribution was met, validating the data for use in subsequent statistical analyses in this mathematics education study (Nurcahya et al., 2023).

Table 6. Summary of the Normality Test of the Mathematical Conceptual Understanding Test Tests of Normality

Class	**Kolmogorov-Smirnov[a]**	**Shapiro-Wilk**
	Statistic	df
ARIAS Learning Model assisted by QuizWhizzer	.123	21
ARIAS Learning Model	.138	21
Conventional Learning Model	.220	22

Based on the results of the Lilliefors normality test in Table 6, the significance values obtained were 0.200 for the ARIAS model assisted by QuizWhizzer, 0.200 for the ARIAS model, and 0.070 for the Conventional model. Since all of these values were greater than $\alpha=0.05$, the data from the three groups were normally distributed and met the assumption of normality. To further ensure that the analyzed data also met the homogeneity assumption, a prerequisite test was conducted using Bartlett's test. This test is applied to examine the uniformity of variances when comparing more than two groups (Usmadi, 2020).

Table 7. Summary of the Homogeneity Test of the Mathematical Conceptual Understanding Test

Test of Homogeneity of Variances			
Value			
Levene Statistic	df1	df2	Sig.
.809	2	61	.450

Based on the results of the Levene test presented in Table 7, the significance value was greater than $\alpha = 0.05$, indicating that the variances among the groups met the assumption of homogeneity. With all prerequisite assumptions satisfied, the next step was hypothesis testing using the one-way Analysis of Variance (ANOVA) method. A summary of the results of the mean difference test among the three classes, at the 5% significance level, is presented in Table 8.

Table 8. Summary of the Final Data Mean Difference Test

ANOVA					
Value					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2813.312	2	1406.656	10.178	.000
Within Groups	8430.626	61	138.207		
Total	11243.937	63			

Referring to the results in Table 8, it was found that there were significant differences among the group means. Therefore, it was necessary to conduct a post hoc test using Scheffé's method. This test allows for pairwise comparisons of group means, thereby supporting the achievement of the research objectives.

Table 9. Summary of the Post Hoc Test of Students' Mathematical Conceptual Understanding

Multiple Comparisons

Dependent Variable: Value
Scheffe

					95% Confidence Interval	
(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
ARIAS + QuizWhizzer	ARIAS	4.524	3.628	.464	-4.58	13.63
	Conventional	15.677*	3.587	.000	6.68	24.68
ARIAS	ARIAS + QuizWhizzer	-4.524	3.628	.464	-13.63	4.58
	Conventional	11.154*	3.587	.011	2.15	20.15
Conventional	ARIAS + QuizWhizzer	-15.677*	3.587	.000	-24.68	-6.68
	ARIAS	-11.154*	3.587	.011	-20.15	-2.15

*. The mean difference is significant at the 0.05 level.

Based on Table 9, the summary of the post hoc test using Scheffé's method revealed significant differences between the ARIAS learning model assisted by QuizWhizzer and the Conventional model, as well as between the ARIAS model and the Conventional model. However, no significant difference was found between the ARIAS model assisted by QuizWhizzer and the ARIAS model alone. These findings will be further analyzed in the discussion section.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v5i3.3639 Volume 5, No 3, Juli - September 2025, pp. 1290– 1302

Discussion

The ARIAS Learning Model Compared to the Conventional Learning Model on Students' Mathematical Conceptual Understanding

Based on the data analysis findings, the implementation of the ARIAS learning model demonstrated a significant difference compared to the conventional learning model. Students who were taught using the ARIAS model showed stronger mastery of mathematical concepts than those who received conventional instruction. This finding indicates that the ARIAS model has a higher level of effectiveness compared to teacher-centered approaches. The superiority of the ARIAS model can be explained by its characteristics, which position students as active participants in the learning process. Through its five stages (Assurance, Relevance, Interest, Assessment, and Satisfaction) the model encourages students to construct understanding independently, connect the material to real-life contexts, and remain motivated to achieve better outcomes (Kurniawati et al., 2017; Mayun et al., 2016). In contrast, conventional approaches, which remain teacher-centered, tend to position students as passive recipients of information, thereby limiting opportunities for developing conceptual understanding (Asmedy, 2021; Azzahra et al., 2021). This finding is consistent with previous studies showing that the ARIAS model produces higher learning outcomes compared to conventional models (Swandewi, 2016). Thus, it can be concluded that student-centered approaches such as ARIAS are more effective in supporting the achievement of mathematical conceptual understanding.

The ARIAS Learning Model Assisted by QuizWhizzer Compared to the Conventional Learning Model on Students' Mathematical Conceptual Understanding

The findings also revealed that students taught with the ARIAS learning model assisted by QuizWhizzer experienced significant improvements in mathematical conceptual understanding, achieving more optimal results compared to those in conventional learning. This confirms that the integration of a structured learning model with interactive digital media can create a more effective, engaging, and meaningful learning process. QuizWhizzer contributed significantly by presenting material in the form of educational games, which not only enhanced students' learning motivation but also promoted active engagement and group collaboration (Isnaini et al., 2025). The competitive elements and instant feedback offered by this platform reinforced the formative assessment aspect of the ARIAS model, thereby accelerating students' reflection and understanding of the material (Hermawan & Suharto, 2025). These results support the theory that motivation-based learning integrated with interactive digital media can improve student learning outcomes, particularly in conceptual understanding (Larasti et al., 2025; Hasibuan et al., 2016). Therefore, the application of the ARIAS model assisted by QuizWhizzer was effective in creating meaningful, systematic learning that directly impacted students' conceptual understanding. The integration of ARIAS and the interactive features of QuizWhizzer created learning experiences that stimulated active participation, thereby enhancing conceptual understanding through adaptive and contextual approaches.

The ARIAS Learning Model Compared to the ARIAS Learning Model Assisted by QuizWhizzer on Students' Mathematical Conceptual Understanding

Although the initial hypothesis suggested that ARIAS assisted by QuizWhizzer would yield higher outcomes than the ARIAS model alone, the analysis showed that the difference between the two was not statistically significant. In other words, the use of QuizWhizzer did not produce a meaningful increase in students' mathematical conceptual understanding compared to the independent application of the ARIAS model. This finding suggests that the main strength in enhancing conceptual understanding lies in the ARIAS structure itself. Its five stages already encompass motivational elements, active involvement, and continuous assessment, which are collectively effective in facilitating conceptual learning (Wiyanoto et al., 2022). Therefore, while the use of digital media such as QuizWhizzer may enrich the learning experience, its contribution is more complementary rather than a decisive factor in conceptual understanding. In conclusion, these findings emphasize that the success of learning is determined more by the strength of pedagogical design than by the use of technology alone. Interactive media still holds value in terms of motivation and visualization, but its long-term effectiveness depends on the robustness of the instructional framework implemented by the teacher.

Conclusion

Based on the findings, it can be concluded that the ARIAS learning model demonstrated higher effectiveness than the conventional learning model in improving students' mathematical conceptual understanding, whether implemented with the interactive media QuizWhizzer or without it. This suggests that active, structured, and motivational approaches such as ARIAS can more optimally enhance concept-based mathematics learning. However, the difference between the application of ARIAS assisted by QuizWhizzer and ARIAS without media was not significant. In other words, the use of QuizWhizzer did not provide a statistically meaningful additional effect on improving conceptual understanding. Thus, the main strength in supporting students' conceptual understanding lies in the structure and stages of the ARIAS model itself, while interactive media such as QuizWhizzer serve more as a complement to create a more engaging and varied learning atmosphere. This study has several limitations, including the short implementation period, the limited scope of material restricted to a specific topic, and the use of a post-test only design, which reduces the generalizability of the findings. Therefore, mathematics teachers are encouraged to maximize ARIAS as a primary strategy for teaching mathematical concepts, while future research is recommended to cover broader topics, longer durations, and deeper integration of learning technologies to comprehensively increase the effectiveness of the model.

Conflict of Interest

The authors declare that there is no conflict of interest.

Authors' Contributions

The first author, D.S.E., was responsible for developing the research instruments, designing and conducting the study, collecting data, processing and analyzing the data, preparing the results, and revising the content of the manuscript. The second author, M.N., contributed to the application of theory in the study and to revising the manuscript content. The percentage contributions of the authors to the conceptualization, preparation, and editing of this article are as follows: D.S.E.: 60%, and M.N.: 40%.

Data Availability Statement

The authors declare that the data supporting the findings of this study will be made available by the corresponding author, [D.S.E], upon reasonable request.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v5i3.3639 Volume 5, No 3, Juli - September 2025, pp. 1290– 1302

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