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THE EFFECT OF INTERACTIVE MULTIMEDIA-ASSISTED CONTEXTUAL LEARNING MODELS ON STUDENTS' MATHEMATICS LEARNING OUTCOMES ON CUBE AND BLOCK MATERIALS

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DOI: 10.5281/zenodo.11076998

Abstract

The objective of this study was to examine the effect of interactive multimedia-assisted contextual learning models on the learning outcomes of fifth-grade elementary school students on the topic of cubes and blocks. The research employed quantitative methods with an experimental approach. The study employed a True Experiment design utilizing the Posttest-Only Control design. This study used a simple random sample as its sampling technique. The participants in this study consisted of fifth-grade students from elementary school. A total of 23 students participated in the instrument test, whereas 57 students were included as subjects who either received treatment or did not receive treatment. The analysis in this study employed a T-independent test using SPSS to examine the hypothesis. The statistical analysis yielded a Sig. (2-tailed) value of 0.027 at a significance level of 0.05. Given that the significance level is 0.027, which is less than 0.05, it can be concluded that the alternative hypothesis (H1) is accepted, and the null hypothesis (H0) is rejected. Therefore, the contextual learning model, aided by interactive multimedia, has a significant effect on the learning outcomes of fifth-grade students in the subject of materials of cubes and blocks.

Keywords: Interactive Multimedia-Assisted, Contextual Learning, Outcomes on Cube and Block Materials.

INTRODUCTION

Mathematics is a subject that is taught at all levels of education, including elementary school (SD), junior high school (SMP), high school (SMA), and college (Chusna, 2016; Ernawati, 2017; Pebriana, 2017; Sari, 2017; Yuliana et al., 2022). Mathematics is not only significant in the realm of education but also highly interconnected with everyday life, making it crucial to acquire knowledge in this subject (Pebriana, 2017).

Mathematics is strongly connected to our everyday lives. Alongside the utilization of learning media, learning models are an essential aspect of learning innovation that must be developed. Student-centered learning is essential for enhancing students' understanding of mathematics since it promotes active student engagement and encourages teachers to adapt their teaching methods.

According to the constructivist philosophy, contextualization is an approach to learning that emphasizes the value of knowledge that is directly applicable to real-life situations and meaningful for students (Choi & Johnson, 2010; Driver et al., 1994). Contextualization emphasizes the application of concepts and process skills in a practical and meaningful context that is useful to students from various backgrounds.

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This approach motivates students to create connections between knowledge and its practical use in their roles as family members, citizens, and workers. It also promotes active participation in the demanding process of learning (Sears & Hersh, 2000, p. 4). Subsequently, students derive significance from the process of acquiring knowledge. While pursuing their learning goals, students draw on previous experiences and capitalize on the advantages of their existing knowledge. By engaging in an integrated and multidisciplinary approach to studying subjects, individuals can acquire the necessary knowledge in the applicable context.

Technological advancements have a significant impact on many fields, including education (Abduvakhidov et al., 2021; Martinez, 2018). Technological advancements have a direct or indirect positive impact on our lives (Raja & Nagasubramani, 2018). Technology is expected to enhance the quality of education, especially as a method and medium in the process of learning. Utilizing technology in education has the potential to solve a variety of challenges that hinder the educational process (Hutchison, 2019; Saptono et al., 2021; Wiradimadja et al., 2021). Technological advancements have the potential to enhance the effectiveness of teaching and foster better teacher-student interactions (Senen et al., 2021).

The rapid advancement of technology has significantly impacted various aspects of life, including the way learning activities are conducted. Teachers are now able to enhance their teaching methods by utilizing technology as a means of interaction with students. This situation has led to the creation of digital platforms that facilitate social connections and enable the delivery of meaningful lessons. The advancement of technology will reveal that individual interaction is not limited to one-way communication but can also occur in a two-way way, including multiple actors from different directions. Incorporating interactive multimedia into the learning process is one example.

Multimedia refers to the simultaneous presentation of information across multiple mediums. Its composition includes certain elements, which may not include all, such as text, fixed graphic images, motion graphics, animation, hypermedia, photography, video, and audio (e.g., voice, music, and narration) (Nusir et al., 2013). Multimedia encompasses more than just animation, pictures, and video-related products. It involves the integration of programming and other methods to create portals or apps that combine data, videos, and images (Nusir et al., 2013).

Augmented reality (AR) is a technology that merges the physical world with the virtual world by overlaying virtual things onto the real environment using three-dimensional imagery, which is achieved by the use of a smartphone's digital camera, which shows the combined view in real-time (Anggraeni et al., 2019). For the creation of applications, researchers opted for the *Unity* program (Liu1 et al., 2018) and the *Vuforia* program as the chosen tools for AR applications. The rationale behind selecting these software tools is that *Unity* facilitates the construction of both two-dimensional and three-dimensional images and is compatible with multiple platforms. On the other hand, *Vuforia* (Liu1 et al., 2018) is a software program specifically designed to aid in the development of AR technology and can be seamlessly integrated with *Unity*.

Interactive multimedia refers to media that is utilized as an educational tool, utilizing computers or smartphones to enhance the learning experience. Multimedia can present a combination of text, images, audio, and video.

The presence of this interactive multimedia could help students understand abstract concepts easily and concretely. There are various types of building spaces. Hardianti et al. (2017) proposed that building space can be categorized into two distinct types: flat-sided space and curved-sided space. Flat-sided geometric shapes that fall under the category of flat-sided spaces include cubes, blocks, prisms, and pyramids. The curved side space comprises three geometric shapes: a tube, a cone, and a ball.

When it comes to teaching about building spaces like cubes and blocks, teachers tend to rely on the traditional lecture method and use concrete media. The premise is that students benefit from the lecture style, and the use of concrete media enhances their understanding of the subject matter. The reason for this is that teachers still lack the ability to generate, utilize, and implement technology-based media in the process of learning. Additionally, many teachers lack the necessary expertise to effectively incorporate technology into their teaching practices. However, the benefits of contextualized learning models are inspiring. They enable students to simulate the studied environment, develop their understanding, explore, and examine, either independently or collaboratively. According to Selvianiresa and Prabawanto (2017), contextualization has offered numerous benefits for achievement. Contextualized learning models facilitate the connection between information and its practical applications in students' lives (Date et al., 1996); and learning by doing (Mazzeo et al., 2003). Ambrose et al. (2013) assert that placing new material in a context that enables students to comprehend its significance and practicality enhances their motivation to learn it. The incorporation of interactive multimedia will enhance the enjoyment of this activity. Thus, the process of acquiring knowledge becomes enjoyable and may be focused on the student, with the teacher assuming the role of a facilitator who guides and helps students in their learning. Furthermore, it has the potential to enhance student learning outcomes. The incorporation of multimedia in the learning process is widely acknowledged to have a positive impact on the effectiveness of learning (Nusir et al., 2013).

This research is unique in its ability to merge concepts and materials from the fields of education and technology. It underscores the use of technology to enhance the educational experience of elementary school students (ali et al., 2024; Delyana et al., 2024). This involves incorporating interactive multimedia and contextual learning methods that align with the specific characteristics and needs of these students. The study specifically examined the role of interactive multimedia in contextual learning models, with a focus on students' concept-understanding abilities, the connection between concepts and students' real lives, student motivation and involvement, and the impact of interactive multimedia on learning outcomes. The research findings will provide a comprehensive understanding of how interactive multimedia can enhance the contextual-based learning process in elementary schools, thereby enhancing our understanding of its importance. To utilize this interactive learning medium that is based on context, a laptop or smartphone is necessary, depending on the specific requirements. Learning can be conducted at any location and at any time.

The use of a contextual learning model, aided by interactive multimedia, enhances the learning experience for students. By engaging in group activities, students are able to comprehend the material effectively. The purpose of this study was to investigate the impact of interactive multimedia-assisted contextual learning models on student learning outcomes in cube and block spaces.

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OBJECTIVES AND HYPOTHESES

Objects

This study, with a clear and focused purpose, aimed to examine the effect of employing a contextual learning model aided by interactive multimedia on cubes and blocks, in comparison to conventional learning. It was carried out in the Padang City, located in the West Sumatra Province of Indonesia. The participants were fifth-grade elementary school students. A total of 23 students participated in the instrument test, whereas 57 students were selected as subjects who received treatment and did not get treatment. With the utmost fairness, 57 students were divided into two groups using a stratified random sampling technique. This technique, known for its unbiased nature, ensured that each student had an equal chance of being assigned to either group. The class for the study was selected by drawing, a method described by Fraenkel, Wallen, and Hyun (2012). The analysis of the draws revealed two distinct groups: the experimental group, which received treatment, and the control group, which did not receive any treatment.

METHOD

The research employed is quantitative and utilizes experimental research methods. Sugiyono (2015: 107) defines experimental research as a research methodology employed to investigate the impact of specific treatments on others within controlled conditions. The experimental research would employ the true experiment design, specifically the posttest-only control design. Table 1 presents the research design.

Table 1: Posttest-Only Control Research Design

Class	Treatment	Final Test
Experimental	X	O2
Control	-	O4

Source: Sugiyono (2015:112)

Notes

X = Learning using contextual learning models aided by interactive multimedia

O2 = Final Test of Experimental Class

O4 = Final Test of Control Class

Data collection was conducted by implementing a learning approach in two separate groups, namely the experimental group and the control group. The treatment administered involves the implementation of a contextual learning model, supported by interactive multimedia, for teaching the materials of cube and block spaces to fifth-grade elementary school students. Prior to use, the test items underwent preliminary testing (including validity, reliability, discriminating power, and difficulty level) to ensure their appropriateness for this study (Budiyono, 2015). The process of identifying appropriate test items was meticulous and thorough. Each item was carefully evaluated based on its validity, reliability, discriminating power, and difficulty level. Validity is the primary criterion that assesses the instrument's ability to measure what it is intended to measure accurately. On the other hand, the reliability test evaluates the instrument's consistency in producing reliable results over time (Aliotta, 2003). A power-discrimination test was administered to assess the varying skills of students, enabling the identification of those with high abilities and those with low

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abilities. Furthermore, the purpose of the specified items' difficulty test is to assess the proficiency level of students in completing the test, determining whether the item is categorized as easy, moderate, or difficult. The pilot test was administered in the fifth grade of SD Negeri 54 Anak Air Padang. The analysis was conducted using SPSS 17.0, which assessed the validity, reliability, discriminatory power, and difficulty level. The results indicated that out of the 30 items, 10 were deemed appropriate for use in the study.

RESULTS AND DISCUSSION

Data Analysis

Test data analysis was conducted using the independent sample t-test method, with the assistance of SPSS 17.0. The data analysis was conducted to assess the effectiveness of employing contextual learning models with the aid of interactive multimedia, focusing on the examination of significant values. If the significance value (Sig) is greater than 0.05, it indicates that the null hypothesis (H0) is accepted. If the resulting significance value is less than 0.05 (Sig < 0.05), the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. The decision-making requirements are:

The research hypotheses are as follows:

H0: There is no difference in learning outcomes between the experimental and control groups.

H1 : There is a difference in learning outcomes between the experimental and control groups.

This study was carried out by subjecting both the experimental and control groups to testing. The trial was carried out in two classes, with class VA serving as the experimental group and class VB serving as the control group. Each group received different treatments. The experimental group received treatment in the form of a contextual learning model with the aid of interactive multimedia. In contrast, the control group did not receive any significant treatment and followed conventional learning methods. The control group engaged in learning activities through the provision of materials, specifically in the form of conventional lectures. The control group underwent the learning process without the implementation of the contextual learning model, which was supported by interactive multimedia.

Teaching and learning in both groups were carried out throughout four sessions, with each session lasting 75 minutes. A post-test was administered at the end of the meeting. The test was administered to evaluate student performance throughout their learning processes. Prior to evaluating the effectiveness of the product, it is imperative to assess the preliminary analysis of student learning outcomes data. The following are the results of the prerequisite analysis and testing conducted to evaluate the product's effectiveness:

Normality Test

This test was conducted to determine whether the sample data used came from a normally distributed population or not. The statistical test used is the Shapiro-Wilk test with SPSS 17.0, and the significance level is $\alpha = 0.05$.

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The decision-making requirements are:

H0: the sample is normally distributed

H1: the sample is not normally distributed

The criterion for accepting H1 and rejecting H0 is when the significance value exceeds 0.05 (Sig > 0.05). On the other hand, if the probability value or significance value is less than 0.05 (Sig < 0.05), then H1 is rejected, and H0 is approved. The table below presents the results of the normality test on the post-test data from both the experimental and control groups.

Table 2: Sample Class Final Test Normality Test Results

One-Sample Kolmogorov-Smirnov Test

			eksperimen	kontrol
N			29	28
Normal Parameters[a,b]	Mean		81.72	72.50
	Std. Deviation		12.837	15.546
Most Extreme Differences	Absolute		.189	.185
	Positive		.122	.146
	Negative		-.189	-.185
Test Statistic			.189	.185
Asymp. Sig. (2-tailed)			.010[c]	.015[c]
Monte Carlo Sig. (2-tailed)	Sig.		.225[d]	.260[d]
	99% Confidence Interval	Lower Bound	.214	.249
		Upper Bound	.236	.272

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. Based on 10000 sampled tables with starting seed 2000000.

According to the table provided, the significance value obtained from the experimental group is 0.010, whereas the control group has a significance value of 0.015. The results indicate that the singularity value of the post-test data for each group is greater than α (sig > 0.05), suggesting that H0 is accepted and the data accurately represent samples that follow a normal distribution.

Homogeneity Test

A homogeneity test was performed to ascertain whether the sample was from a homogeneous population or not. Statistical tests were conducted using the Levene statistic in SPSS 17.0. The requirements for drawing hypotheses are:

H0: the data is not homogeneous

H1: the data is homogeneous

The homogeneity of the data is apparent from the homogenous test results, indicating a clear pattern in decision-making. H1 is accepted if the significance value is greater than 0.05 (Sig. > 0.05). The data is not homogeneous when H0 is accepted and H1 is rejected, i.e., if the significance value is less than 0.05, and otherwise, H0 is rejected. The following table presents the results of the homogeneity test.

Table 3: Homogeneity Test Results of Sample Classes

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Hasil	Based on Mean	1.123	1	55	.294
	Based on Median	1.187	1	55	.281
	Based on Median and with adjusted df	1.187	1	53.860	.281
	Based on trimmed mean	1.072	1	55	.305

Source: Primary Data, March 2024

According to the table above, the homogeneity test conducted using the SPSS computer series shows that the Based on Mean has a significance of 0.294. Since the significance level of 0.294 is greater than 0.05, it may be concluded that the two sample classes have homogenous variances, meaning that the variances of the two groups are similar and do not significantly differ.

The prerequisite statistical tests conducted met the criteria that the sample data follows a normal distribution and is homogeneous. Subsequently, the t-test could be utilized to analyze the research data. An independent sample t-test was conducted in this study to compare two distinct groups: the experimental group and the control group. Furthermore, the two groups were compared in order to determine the mean difference prior to and following the treatment. Here are the results of the independent sample t-test conducted on the post-test data from both groups:

The figure below displays the mean scores of the post-test data for both the experimental and control groups.

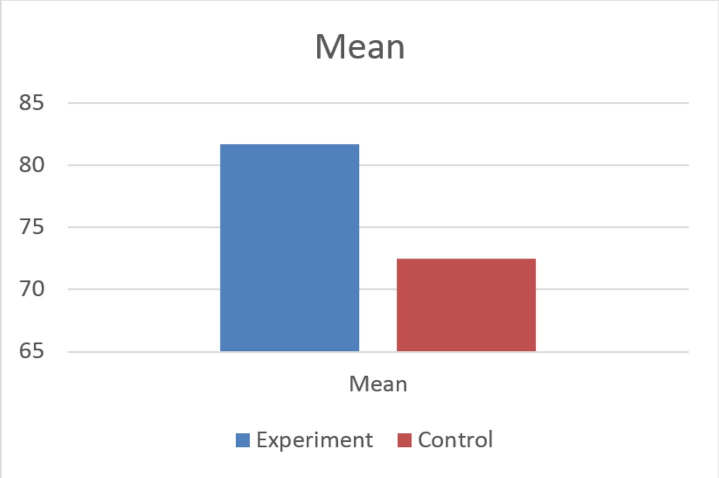

Figure 1: Mean Scores from Post-Test Data

According to Figure 2, both groups exhibit the same mean difference. The experimental group had a mean score of 26.67, while the control group achieved a mean score of 27.22. This is demonstrated by conducting the independent T-sample test on the pre-test data using the following hypothesis:

H0: There is no significant difference in the mean between the experimental group and the control group.

H1: There is a significant difference in the mean between the experimental group and the control group.

The following is a description of the post-test result data with SPSS 17.0:

Table 4: Hypothesis Test Results of Sample Classes with T-Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	eksperimen - kontrol	8.571	19.382	3.663	1.056	16.087	2.340	27	.027

According to the provided table, there are 29 students in the experimental class and 28 students in the control class. The results obtained indicate a significance level of 0.027 using a two-tailed test. If the significance value is 0.027, which is less than the significance level of 0.05, it indicates a statistically significant difference or influence. Therefore, the alternative hypothesis (H1) is accepted, while the null hypothesis (H0) is rejected.

The Merdeka Curriculum is an independent learning curriculum that allows both teachers and students the autonomy to experiment, learn independently, and foster creativity in the teaching and learning process. By using a collaborative learning model, it is possible to introduce innovation in every course through the adaptation of the learning material. Muslich (2007) defines *contextual learning* as a learning concept that not only integrates learning materials with students' real-life experiences but also inspires them to see the practical application of their knowledge in their everyday lives. The underlying philosophical principle of CTL is constructivism.

Constructivism is an educational philosophy that emphasizes the idea that learning is not just about memorization but rather about the active construction of new knowledge and abilities based on real-life experiences and factual information. Hence, the integration of learning models with interactive media enables students to engage in active learning, both individually and collaboratively.

The contextual approach is a pedagogical idea that enables teachers to effectively educate and connect the acquired information to students' real-life situations. It encourages students to establish links between their existing knowledge and its practical application in their roles as family and community members. This approach is anticipated to result in more significant learning outcomes for students. The learning process unfolds organically through student activities and work experience, rather than relying solely on the transmission of knowledge from teacher to student. The learning strategy holds greater significance than the final outcome. Contextual learning, similar to other strategies for learning, is designed to enhance productivity and meaning (Ekowati et al., 2015). Furthermore, the use of interactive multimedia in education makes the learning process more enjoyable and prevents monotony.

Utilizing interactive multimedia enhances the innovativeness and interactivity of the learning process. Interactivity in multimedia enhances learning by facilitating a deeper comprehension of the presented material. Students actively engage in the learning process (Evans & Gibbons, 2007; Vrtačnik et al., 2000). Furthermore, it can integrate text, images, audio, music, animated visuals, or videos into a cohesive entity that works together to accomplish objectives for learning (Leow & Neo, 2014). This tool has the transformative potential to alter students' perspectives on challenging learning materials, fostering their happiness and motivation to engage in the learning process (Ampa, 2015). Interactive multimedia can cater to the needs of students with varied learning styles, foster a more authentic learning environment, and generate animations or other captivating visuals to stimulate student engagement and motivation. Utilizing methods for learning that incorporate interactive multimedia enhances the effectiveness of learning (Rachmadtullah et al., 2018).

According to the analysis, the experimental class had a maximum score of 100 and a minimum score of 50. The control class achieved a maximum score of 100 and a minimum score of 30. The mean score for the class was 72.5. The obtained hypothesis yields a t-count value of 0.027. If the significance value is 0.027, which is less than the significance level of 0.05, it can be concluded that there is a statistically significant difference or influence. Therefore, the alternative hypothesis (H1) is accepted, and the null hypothesis (H0) is rejected. Given the significance value of Sig. 2-tailed < 0.05, these results suggest that student achievement in mathematics when using a 'contextual learning model' that emphasizes real-world applications of mathematical concepts, with 'interactive multimedia' such as educational videos and interactive quizzes, is higher than achievement when using conventional models or lecture methods. The disparity in learning outcomes between the experimental and control classes can be attributed to the implementation of the contextual learning model, aided by interactive multimedia, in the experimental class.

A contextual learning model aided by multimedia not only enhances the learning experience for students but also holds immense potential for educators and researchers. By promoting collaboration in groups and fostering active participation, this model leads to improved knowledge. In contrast, the control group relied on a traditional model, delivering instruction through lectures, Q&A sessions, and assignments, and instructing students to attentively listen to the teacher's explanations. The results were not as promising, with only a few students able to provide accurate answers and others engaging in distractions. This underscores the need for a shift towards interactive multimedia and contextual learning models, which can assist teachers in effectively delivering learning materials and ultimately leading to the attainment of learning objectives (Pellas, 2018).

CONCLUSIONS

The results of this study indicated that the utilization of contextual learning models, aided by interactive multimedia, had a significant impact on students' learning outcomes in the subject matter, namely in the concepts of cubes and blocks. Compared to conventional models, the use of interactive multimedia in contextual learning models resulted in significantly higher student learning results in mathematics. The experimental class achieved a maximum score of 100 and a minimum score of 50. The mean score in the class was 81.7. The control class recorded a maximum score of 100 and a minimum score of 30. The students in this class achieved a mean score of 72.5. The hypothesis yielded a t-count value of 0.027. If the significant value is less than 0.05, which indicates a significance level of 0.027, it can be concluded that there is a significant difference or influence. In this case, the alternative hypothesis (H1) is accepted, and the null hypothesis (H0) is rejected. Given that the significant value is less than 0.05, the statistical significance is determined. Teachers, practitioners, and researchers can utilize and adapt contextual learning models with the aid of interactive multimedia in order to enhance classroom learning and make it enjoyable for students.

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