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The Effectiveness of Virtual Reality Media on Primary School Students' Learning Outcomes

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A B S T R A K

Perkembangan teknologi saat ini belum sepenuhnya diikuti oleh berbagai bidang kehidupan manusia, salah satunya dunia Pendidikan. Masih terdapat permasalahan yang dihadapi seperti hasil belajar siswa yang rendah, faktor ini disebabkan sebagian guru belum sepenuhnya memanfaatkan teknologi dalam proses pembelajaran. Penelitian ini bertujuan untuk mengetahui efektivitas media virtual reality terhadap hasil belajar siswa sekolah dasar. Jenis penelitian yang digunakan dalam penelitian ini adalah kuantitatif dengan metode eksperimen. Jenis penelitian eksperimen yang digunakan dalam penelitian ini adalah pre-experimental design dengan tipe One-Group Pretest-Post-test. Teknik pengumpulan data yang digunakan ialah observasi, tes dan dokumentasi. Teknik analisis data yang digunakan yaitu analisis deskriptif dan uji prasyarat analisis. Hasil dari penelitian ini diperoleh nilai Pretest dengan skor rata-rata sebesar 65,07. Kemudian diperoleh rata-rata Post-test sebesar 86,03. Dari hasil uji T-test yang dilakukan diperoleh hasil yang signifikan. Hal ini dibuktikan dengan nilai Sig. (2- tailed) sebesar 0,000 yang mana nilai Sig. tersebut < 0,05 maka H_a diterima dan H_0 ditolak. Berdasarkan hasil yang diperoleh dapat disimpulkan bahwa media virtual reality efektif terhadap hasil belajar siswa.

A B S T R A C T

The development of technology today has not been fully followed by various fields of human life, one of which is the world of education. There are still problems faced such as low student learning outcomes, this factor is due to some teachers not fully utilizing technology in the learning process. This study aims to analyze the effectiveness of virtual reality media on the learning outcomes of elementary school students. The type of research used in this study is quantitative with experimental methods. The type of experimental research used in this research is a Pre-Experimental Design with One-Group Pretest-Post-test type. The data collection techniques used were observation, tests, and documentation. The data analysis technique used was descriptive analysis and prerequisite test analysis. The results of this study obtained Pretest scores with an average score of 65.07. Then obtained an average Post-test of 86.03. From the results of the T-test conducted, significant results were obtained. This is evidenced by the Sig. (2- 2-tailed) of 0.000, where the Sig. value is <0.05, so Ha is accepted and Ho is rejected Based on the results obtained, it can be concluded that virtual reality media is effective on student learning outcomes.

1. INTRODUCTION

Current technology plays a significant role in various aspects of human life. One aspect or field that is not exempt from the current technological advancements is the realm of education. The rapid development of technology brings about changes in communication and information patterns, including in the realm of education (Ramli et al., 2016; Silaban et al., 2022). Education is a pivotal determinant of a nation's progress. An advanced education system will also impact the advancement of the country (Boholano, 2017; Faiz et al., 2022). By the National Education Law No. 20 of 2003, Article 2 states that National Education is education based on Pancasila and the 1945 Constitution of the Republic of Indonesia, rooted in the values of religion, Indonesian national culture, and responsive to the demands of changing times. From this law, one of the meanings contained within is the challenge posed by the demands of changing times. Education today must be able to adapt to technological advancements and reflect the four elements of 21st-century learning: communication, collaboration, critical thinking, and problem-solving, as well as creativity and innovation (Garba et al., 2015; Suniasih, 2021). Therefore, schools, teachers, and relevant stakeholders must swiftly transform themselves to accommodate students according to the competencies required in the digital era. The government has taken a positive step in the realm of education in Indonesia by launching a new curriculum known as the 'independent learning' curriculum. The concept of Merdeka Belajar is to return a national education system to the essence of the law to give schools the freedom to interpret the basic competencies of the curriculum into their assessment (Aan et al., 2021;

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Mustaghfiroh, 2020). However, this curriculum has not yet been fully implemented in all schools in Indonesia, resulting in some schools still adhering to the 2013 curriculum. The 2013 curriculum redesigned the learning approach, where each subject that used to be taught separately was transformed into thematic learning. Thematic learning is learning based on a theme that is used to link several subject concepts (Dewi, 2021; Pohan & Dafit, 2021). In addition, thematic learning is an approach in learning that integrates various Basic Competencies (KD) and several subjects into a single unit arranged into a theme. In line with this, thematic learning also trains students to gain a separate understanding of a concept and improve students' cognitive abilities and skills (Nayoga Yuswantoro & Adi, 2022; Sari et al., 2018) .

Teachers must be capable of developing engaging learning strategies for their students. One of the things that teachers can do nowadays is to provide innovative and captivating teaching methods for students. The success of the learning process is heavily influenced by the teacher's willingness to innovate, starting from innovative preparations for teaching, implementation of teaching, and assessment of learning (Nessipbayeva, 2019; Yantoro et al., 2021). This innovation can be achieved by incorporating media into the teaching process. Learning media encompass both physical and technical elements that assist teachers in the teaching process, making it easier to convey subject matter to students (Candrasa & Cen, 2023; Firmadani, 2020). The use of media in the teaching process has a significant positive impact, as it contributes to improved student achievement.

Based on observations conducted at Muhammadiyah Ngadiwinatan Elementary School, it was found that the understanding of 3rd-grade students regarding the characteristics of living beings was still challenging. From field observations, several issues were identified, particularly in the 3rd-grade class regarding the topic of characteristics of living beings. One of the issues was the lack of diverse teaching innovation by the teachers, meaning they hadn't fully utilized instructional media as tools in the teaching process. This was evident during classroom observations in the 3rd-grade class, where the teacher solely relied on textbooks as the source of learning. Consequently, students struggled to comprehend the material presented by the teacher, lacked motivation, and showed low engagement in the learning process. This was also apparent in the limited participation of students in Q&A sessions and their overall disinterest in the lessons. These issues had an impact on the students, leading to learning outcomes falling below the minimum passing grade (MPG) of 75. Therefore, a solution is needed for these challenges, which involves utilizing engaging instructional media tailored to the student's needs.

An ideal medium to implement at present combines print technology and computer technology. One such medium that integrates print and computer technology is virtual reality (VR). Virtual reality is a current choice in interacting, because it is quite easy to use. However, in the world of education, virtual reality technology has not been widely known, so virtual reality is currently being promoted as a promising tool (Mulders et al., 2020; Saurik et al., 2019). Survey data from 2019 regarding the development of virtual reality technology indicates that before 2025, this technology is predicted to become a common technology used by society, similar to how smartphones are widely used today. Virtual reality is the fusion of print and computer media that presents real-world data adjusted to match the actual environment (Halili, 2019; Rahmawati et al., 2021). In addition, virtual reality is a 3-dimensional media generated from computers to view the surrounding environment interactively. Virtual reality serves as an interface between human applications and computerization based on a real-time, three-dimensional graphical world (Kamińska et al., 2021; Wijayanto et al., 2023).

In the field of education, the use of virtual reality technology has positive impacts, especially in aiding the learning process. The essence of this virtual reality technology is very helpful for humans to feel like they are in a certain place (Ariatama et al., 2021; Sinambela et al., 2018). The sensation is like real with the overall display and makes it easy to know what kinds of objects exist clearly and clearly. In addition, the advantages of using virtual reality, which provides experiences that are not available in real circumstances and controls the complexity of learning situations for instructional purposes. Virtual reality also has several advantages in learning, such as learning that can be more accurate in describing some processes than other media (Dharma et al., 2018; Sinambela et al., 2018). The use of virtual reality media will also make children get direct experience without having to go to the observed object.

Based on the explained, the researcher aimed to conduct a study at Muhammadiyah Ngadiwinatan Elementary School, where it was identified that the learning outcomes in the 3rd-grade class during the subtheme of characteristics of living beings did not meet the minimum passing criteria. Therefore, efforts are needed to address this issue. The endeavor involves utilizing virtual reality media in the teaching process, with the hope that the learning outcomes of the 3rd-grade students can meet the designated criteria for passing grades. In addition, this study contributes to the literature on learning through virtual reality media by showing higher learning improvement than learning using books or conventional learning.

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2. METHOD

The type of research used in this study is quantitative with an experimental method. The experimental research design employed in this study is a Pre-Experimental Design with the One-Group Pretest-Post-test type (Shi et al., 2021). This research was conducted at SD Muhammadiyah Ngadiwinatan Yogyakarta, in the third grade of the second semester of the 2022/2023 academic year. The population for this study was taken from the students of SD Muhammadiyah Ngadiwinatan. The sampling technique employed was a saturated sampling technique, where all members of the population are used as the sample. This is often done when the population size is relatively small, fewer than 30 individuals. In this study, the sample used was the third-grade class of SD Muhammadiyah Ngadiwinatan Yogyakarta for the academic year 2022/2023, consisting of 21 students. This research utilizes several techniques, such as observation, testing, and documentation. The observation conducted by the researcher involves observing the teaching and learning process in the third-grade classroom before and after using virtual reality media. In this study, testing is employed to determine the initial level of student ability and learning outcomes in Theme 1, Subtheme 1: Characteristics of Living Things, for the third-grade class, focusing on the cognitive aspect. Documentation is gathered in the form of photographs capturing learning activities in the classroom, particularly for the third-grade class.

The instruments used in this study include observation sheets, test sheets related to the subject matter of the characteristics of living things, and documentation. In the observation sheets, the researcher observes the teaching and learning process in the third-grade classroom before and after using virtual reality media. The criteria for the test sheet consist of the learning process from the beginning, core, and end of the lesson, student conditions, and the use of media in the teaching process. Regarding the test sheet, the researcher created two types of questions: a pretest and a post-test. Each type of test contains 15 items. The questions are in the form of multiple-choice objective tests with three answer alternatives: a, b, and c, with only one correct answer. The correct answer is assigned a value of 1, while incorrect answers are assigned a value of 0. The instructional objectives for the cognitive aspect being assessed include the aspects of analyzing (C4), evaluating (C5), and creating (C6). The instrument lattice is presented in Table 1.

Table 1. Lattice of Pretest and Posttest Questions

No	Basic Competence	Question Indicator	Level of Cognition	Problem Shape	Question Item	Number of Items
1	3.4 Look at vocabulary in texts about the concept of characteristics, needs (food and place of life), growth, and development of living things that exist in the local environment local environment presented in oral, written, visual.	Presented with a song lyric song, students can analyse the characteristics of the animal mentioned in the song.	C4	Multiple Choices	1	1
		Presented with a problem students can categorise animals based on their characteristics	C6		2,3	2
		Presented with a picture, students are able to compare several types of animals based on characteristics	C5		4,5	2
2	3.1 Explain the properties of arithmetic operations on numbers.	Presented with a problem, students are able to Analyse and categorise the numbers in a number	C4		6,7,8	2
		Presented with a problem, students are able to decompose say from smallest or largest and add up numbers	C4		9,10	2
3	3.2 Know the forms and variations of rhythmic patterns ins songs	Presented with a problem, students are able to Analyse the types of patterns patterns and tempo in songs	C4		11,12,13, 14,15	5

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Before conducting data analysis, the researcher conducted validity and reliability tests. In this study, content validity was used to determine the extent to which students could grasp the subject matter and the changes in cognitive learning outcomes. To assess the instrument's reliability, the researcher employed the internal consistency test technique. Subsequently, the researcher performed data analysis. There are two types of data analysis used: descriptive data analysis and prerequisite analysis tests. Descriptive data analysis was conducted by observing the teaching and learning process. For the prerequisite analysis, the researcher conducted two types of tests: normality test and hypothesis test.

3. RESULT AND DISCUSSION

Result

The comparison of pretest scores is presented in tabular form. The results of the pretest are presented in Table 2.

Table 2. Pretest Score Results

Pre-test	N		Mean	Median	Mode	Std. Deviation	Variance	Rangen	Minimum	Maximum
	Valid	Missing								
	21	0	65.0790	66.6700	73.33	10.52025	110.676	33.33	46.67	80.00

Based on Table 2 show the pretest results from 21 respondents, it was found that the minimum learning outcome score before implementing the treatment was 46.67, with a maximum score of 80.00. The obtained average score was 65.07, with a standard deviation of 10.520. The median score was 66.67, and the mode was 73.33. The post-test results are presented in Table 3.

Table 3. Post-test Score Results

Post-test	N		Mean	Median	Mode	Std. Deviation	Variance	Rangen	Minimum	Maximum
	Valid	Missing								
	21	0	86.0324	86.6700	80.00	6.63441	44.015	0.00	80.00	100.00

Based on Table 3 show the post-test results from 21 respondents, it was found that the minimum learning outcome score after implementing the treatment was 80.00, with a maximum score of 100.00. The obtained average score was 86.03, with a standard deviation of 6.634. The median score was 86.67, and the mode was 80.00. Then comparison of pretest and post-test scores is presented in diagram form as follows. The results of the comparison of pretest and post-test values are presented in Figure 1.
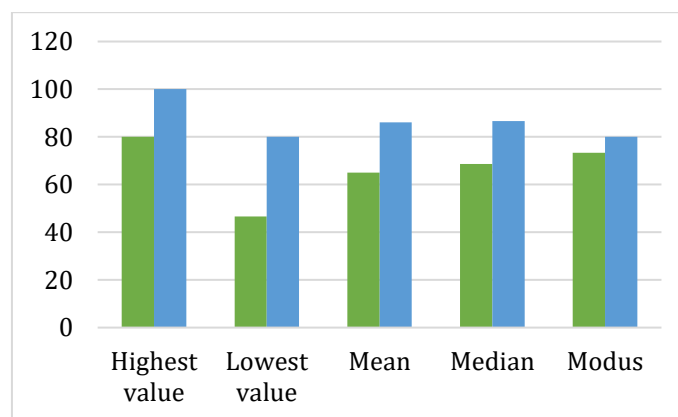

Figure 1. Comparison of Pretest and Post-test Score

Based on Figure 1 show the pretest-posttest results, a significant difference is observed. The pretest mean score is 65.07, while the post-test mean score is 86.03. Furthermore, the experimental group's post-test mean score is 29.48. This demonstrates a notable difference, where the post-test scores are higher than the pretest scores. Consequently, it can be concluded that virtual reality media is effective in improving the learning outcomes of third-grade students in thematic learning, Theme 1, Subtheme 1: Characteristics of Living Things, at SD Muhammadiyah Ngadiwinatan. The results of the normality tests are presented in tabular form as follows. The results of the t-test are presented in Table 4.

Table 4. Normality Test Result

Paired Samples Test			df	Sig.(2-tailed)
Pair1	Posttest – Pretest	12.050	20	0.000

Based on Table 4 show result of normality tests, it is revealed that the pretest data exhibits a normal distribution, as indicated by the significance value of 0.621. This value is greater than > 0.05. Thus, it can be inferred that the pretest data follows a normal distribution, given that the significance value of 0.621 > 0.05. Similarly, the results of the normality test on the post-test data show a significance value of 0.154, which is also greater than > 0.05. This suggests that the post-test data conforms to a normal distribution, as the significance value of 0.154 > 0.05.

Discussion

It should be recognized that education is a system, within which various components are interconnected in pursuit of a common goal. Several components of instruction are involved, such as objectives, learning materials, methods, media, and assessment (Magdalena et al., 2021; Wang et al., 2022). Since education functions as a system, the success of the learning process significantly relies on how effectively these components interact with one another. The utilization and selection of these instructional components can influence students' learning outcomes. Hence, teachers can adapt their approach to suit the characteristics of each student. Some students might grasp concepts by simply listening to the teacher, while others absorb the material more effectively when accompanied by instructional media, be it images or videos (Maziyah et al., 2022; Putri Ningrat et al., 2018; Torres-Gastelú & Kiss, 2016). Some students need to participate actively, engaging directly with the learning process, which can accelerate their understanding of the subject matter.

In connection to the effectiveness of using media in the learning process, the Department of Education and Culture emphasizes that incorporating media into teaching can spark students' interest and motivation to learn, mitigate or prevent verbalism, stimulate orderly and systematic reasoning, and foster understanding while cultivating values within students (Annisa et al., 2023; Magdalena et al., 2021). The use of media can be one of the benchmarks in the effectiveness of the learning process. Consequently, it is anticipated that the effectiveness of utilizing instructional media can influence students' learning outcomes. One of the methods that teachers can currently employ is the utilization of virtual reality media.

Virtual reality media is a technology that can immerse its users into experiencing specific environments as if they were physically present. The advancement of virtual reality technology is growing in terms of its functionality and feasibility (Al-Gindy et al., 2020; Durukan et al., 2020). Nowadays, the utilization of virtual reality has expanded due to its advantages that are not attainable through conventional teaching methods. In addition, reality is one of the promising technology-based learning media for today's learning process. Through this media, students will get the latest experience during learning (Martono et al., 2020; Wijayanti & Indriyanti, 2017). Through learning by using virtual reality, it gives students direct experience of environments or situations that are difficult to replicate. Such as being able to present phenomena that students may not encounter in everyday life. For example, students in the tropics can make observations of animals that live in polar regions.

Based on the results of the conducted research, it can be understood that virtual reality has an impact on students' learning outcomes. This can be observed from the pretest and post-test scores obtained by the researcher. From the pretest results, an average score of 65.07 was obtained, with a standard deviation of 10.520. From the post-test results, an average score of 86.03 was obtained, with a standard deviation of 6.634. Furthermore, the results of the conducted T-test yielded significant outcomes. This is evident from the obtained significance value (2-tailed) of 0.000, which is smaller than 0.05. Consequently, Ha is accepted, and Ho is rejected. This indicates that the hypothesis suggesting a difference in test results before and after the implementation of virtual reality media is supported. In other words, the calculated t-value is greater than the critical t-value, meaning Ha is accepted and Ho is rejected.

The above analysis results indicate the influence of using virtual reality media on students' learning outcomes in thematic education for Grade III, Theme 1, Subtheme 1: Characteristics of Living Things. This is consistent with the observations made regarding the student's activities during the research process. Based on these observations, there were noticeable changes among the students. At the beginning of the learning activities, several students were less engaged, not paying attention to the lesson, and some were hesitant to answer the teacher's questions. However, after the utilization of virtual reality media, changes

were observed. Students became more active in their learning, and they started to gain the confidence to answer the teacher's questions.

Previous study state that virtual reality has an impact on students' learning outcomes as it helps them to understand subject concepts better (Yudintseva, 2023). In addition, the application of learning media in the form of virtual reality technology aims to increase students' absorption of information. The use of virtual reality technology in education is intended to improve learning outcomes and student motivation. Therefore, as a technology development tool, virtual reality has found a useful role in the classroom learning process (Aprilinda et al., 2020; McGovern et al., 2020).

During the research, the researcher allowed each student only one trial (5 minutes) with the virtual reality experience. From the observations made by the researcher, there were expressions from some students indicating a sense of dissatisfaction and a desire to try using virtual reality again. They felt that their initial experience was not sufficient, and they wanted to explore all the animals within the virtual environment once more. This can be concluded as an indication that students are becoming more interested in virtual reality media. In the learning process involving virtual reality media, it will bring positive perspectives from both teachers and students (Meletiou-Mavrotheris et al., 2020; Rong et al., 2022). This was reflected in terms of improved mastery of the subject matter and enhanced student competence and thinking skills. Additionally, virtual reality also fostered deeper understanding, higher motivation, and improved thinking skills. Virtual reality technology can also enhance students' broader abilities and gain experience in learning (McGovern et al., 2020).

The Researchers also asked students about the operation of virtual reality media. All students stated that virtual reality media is very easy to use or operate, making it suitable for elementary school students who are very fond of new technology. Previous study state the use of virtual reality is very suitable for use in the learning process because it makes learning more meaningful (Serin, 2020). Considering that students today are digital natives, they are more interested in learning how to use technological media rather than traditional media. This leads to students finding the presented material easier to grasp, and the classroom learning process becomes less boring. In line with result of other study found the use of virtual reality also allows the role of the teacher who only becomes a facilitator in the classroom (Yildirim et al., 2020). Virtual reality is utilized as a supporting medium for the learning process, with the hope that it will help students become more active during lessons and achieve optimal learning outcomes.

The results of this research can encourage further development in educational technology, especially in the use of virtual reality as a learning tool. This could open up opportunities for the development of VR applications and platforms that are better and more integrated with elementary school curricula. If research finds a significant impact of VR use on learning outcomes, this may trigger adjustments in educational curricula to integrate more VR technology in the learning process. However, this research has limitations related to the availability and accessibility of VR technology which may be a limitation. Schools that do not have access to VR devices may not be able to practically apply the findings of this research.

4. CONCLUSION

This research contributes to the literature on learning through virtual reality media by showing a higher learning improvement than learning using books or conventional learning. The process of learning activities using virtual reality media obtained the results that there is an increase in student learning outcomes after using virtual reality media as a tool in the learning process. This can be seen from the activeness of students in the learning process. In addition, based on the results of the pretest and posttest conducted, the results are very significant so it is concluded that the use of virtual reality media is effective on student learning outcomes.

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