

Virtual Reality-Based Learning about "Animals Recognition" and Its Influence on Students' Understanding

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Received : June 12, 2023

Revised : July 18, 2023

Accepted : July 23, 2023

Abstract

The development of Educational technology has experienced a rapid increase which has consciously contributed positively to the motivation for learning achievement, as well as virtual reality media which can bring reality into learning activities. The aim of this research is to produce virtual reality media for learning to know animal' diversity. This research type is Research and Development with the ADDIE' developing model which consists 5 steps : 1. Analysis, 2. Design, 3. Development, 4. Impelmentation, 5. Evaluation. The research subject consists of media experts, material experts, teachers, and 27 elementary school second-grade students. Data collection techniques consist of tests and non-tests, with interview guidelines, questionnaires, and test instruments for data analysis tailored to each instrument using average, descriptive, and n-gain. Research results show that Virtual Reality products are declared suitable for use as learning media and are effective in increasing students' understanding of animal introduction for elementary school students. The results of assessments by media experts, material experts, and teachers also showed that these media belong to the category of "appropriate" to be used as learning media. In addition, the media is also included in the "effective" category to help students understand material about animal recognition based on n-gain analysis.

Keywords:

virtual reality, learning media, animal recognition, ADDIE

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How to Cite: Sukmawati, F., Santosa, E. B., & Rejekiningsih, T. (2023). Virtual Reality-Based Learning about "Animals Recognition" and Its Influence on Students' Understanding. *JTP - Jurnal Teknologi Pendidikan*, 25(2), 269-284. <https://doi.org/10.21009/jtp.v25i2.36106>

INTRODUCTION

The rapid development of technology today has affected various fields of human life, including politics, economics, society, culture, art, and even education. In the field of education, technology has an important influence on science, where students are taught about natural phenomena and facts, and with this technology, humans use technology to apply this knowledge (Rahardian in Maritsa et al., 2021). Developments in education can be seen in changes in components such as the quality of educators, curriculum, learning processes, learning facilities and infrastructure, learning resources, and others (Supriadi & Hignasari, 2019).

The 21st century's tremendous advancements in science, technology, information, and communication have posed new challenges for human life. In order to survive the challenges that are quite complicated in the 21st century, Wagner argues that there are seven competencies and skills that are important to master in the 21st century (Mutarom, 2020), namely: (1) think critically in solving a problem; (2) have a spirit of leadership and collaboration; (3) be easily adaptable

and very agile; (4) have a spirit of initiative and entrepreneurship; (5) have effective oral and written communication techniques; (6) know all information and analyze it; and (7) have curiosity.

Learning in this very sophisticated century prioritizes students actively looking for learning resources to add insight into the material being studied. So that the knowledge gained will become the basis of a strong learning experience for students. The use of appropriate technology and active learning will enable students to learn meaningfully and enthusiastically through various activities (Khlaisang & Songkram, 2017). Education at the elementary school level has a very important role in shaping students' basic understanding and knowledge. At the elementary school level, with an age range of 7–12 years, children's reasoning is still limited; although they can reason logically and understand causal relationships, they are not yet able to do hypothetical or abstract reasoning.

To teach most effectively, teachers must have clear goals about the skills students want to master. Bloom's Taxonomy divides thinking or cognitive (cognitive) abilities into six levels, namely C1 Remembering, C2 Understanding, C3 Applying, C4 Analyzing, C5 Evaluating, C6 Creating (Churches, 2008). One of the lessons that elementary school students need to understand is about animal diversity and how the environment influences them. In learning to know animals, students are directed to be able to understand animals well, which means that the learning objectives are at the cognitive level of C2 (Understanding).

However, several problems were encountered by teachers and students in the learning process. Based on the results of observations and initial interviews found at Laweyan Public Elementary School, the delivery of learning materials about animal introduction to students was carried out orally by the teacher and only used textbooks to see pictures of animals, so students lacked direct experience and gained in-depth knowledge about animals. In addition, the lack of use of media in learning activities in the classroom, especially media that is integrated with technology, is due to the incomplete facilities and infrastructure owned by schools, such as LCDs and projectors. Furthermore, the school has problems carrying out direct learning such as visiting the zoo due to accommodation problems, and the distance is quite far, so it will take a lot of time to prepare. Therefore, the learning process related to animal recognition that has been going on so far is monotonous and less interesting.

Pre-Research Results of Students' Understanding of Animals

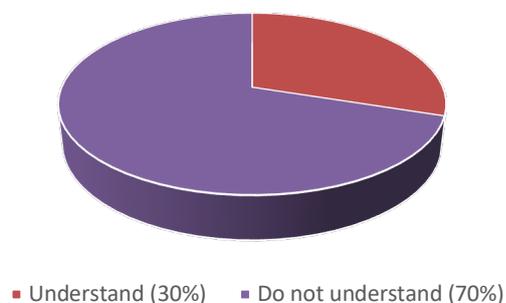


Figure 1. Pre-Research Results on Students' Understanding of Animals

Students' knowledge of animals has different levels. In Figures 1 and 2, the results of preliminary research regarding students' understanding of animals and students' interest in learning about animals through virtual reality are presented for elementary school second-grade students at Laweyan Public Elementary School. Data collection was carried out by researchers through observation.

Student Learning Interest in Getting to Know Animals Through Virtual Reality

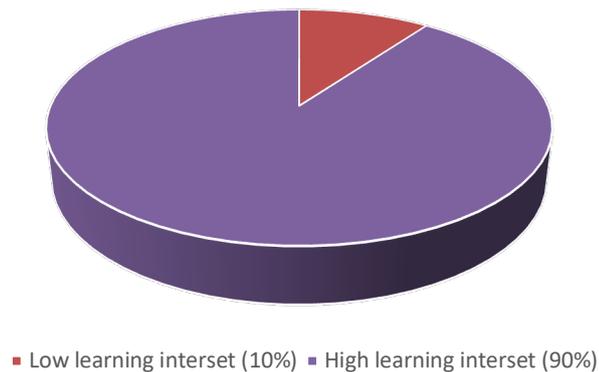


Figure 2. Students' Interest in Getting to Know Animals Through Virtual Reality

The next step is to see students' responses when studying animals through conventional media (2D images) and through Virtual Reality media. The results of the study are presented with a diagram in Figure 3 which illustrates that by using virtual reality to study animal material, students show a high interest in learning and understanding more quickly (63%) compared to using conventional media where students find it difficult to understand (37%).

Differences in Students' Understanding of Animals with Conventional Media and Virtual Reality

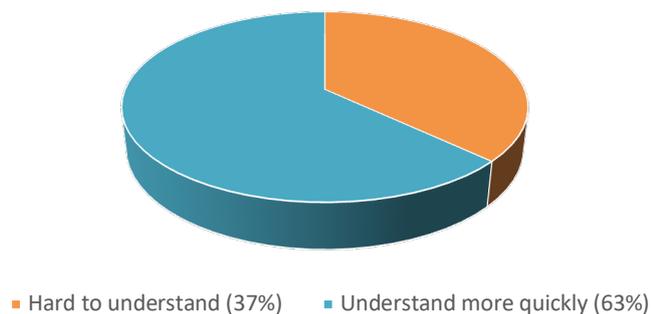


Figure 3. Differences in Students' Understanding of Animals

In learning activities, the role of the media cannot be separated, because the media can assist educators in conveying learning material to students to achieve learning objectives. Learning media is anything that can be used by teachers or can assist teachers in delivering learning material to their students (Supriadi & Hignasari, 2019). One of the demands of 21st-century learning is the integration of

technology as a learning medium to develop learning skills. The needs of the 21st century, as it is today, do require in-depth (cognitive) knowledge skills in the context of life regarding a problem, event, or event (Rahayu, Iskandar, & Abidin, 2022; Fitria, 2023; Asisdiq et al., 2017).

In recent years, Virtual Reality (VR) has increased rapidly, showing its characteristics and applications in areas such as education, health, and entertainment (Alfalah, 2018; Lv, Li, & W. Li, 2017). However, VR is still widely used for entertainment. Although VR is not widely used in Education. It has great potential in educational applications (Elmqaddem, 2019). VR allows students to simulate experiences and practice processes to help increase understanding (Durukan et al., 2020; Supriadi & Hignasari, 2019); Supriadi & Hignasari, 2019). Some of the advantages of using virtual reality for students include being able to provide a fun learning experience, increase understanding, self-motivation, satisfaction, engagement and attract their attention because VR provides tools that can visualize objects so that users can interact with them (Pramesti, Sitompul, & Sofia, 2022). Judging from the advantages and capabilities that virtual reality can carry out, virtual reality has the potential to be utilized as a learning medium (Saidin et al, 2015; Albus et al, 2021). This is because using virtual reality learning is felt to be more efficient than theoretical explanations because there is direct visualization. The use of virtual world can also be used as a practicum medium to a certain extent, Zulherman* et al., 2021).

For this reason, it is necessary to have media to modify conventional learning and provide direct, real-life experiences to students with animal virtualization so that students in elementary schools can interact directly with animals in the virtual world. Forms of virtual interaction can be created with a virtualization process (Carter et al, 2020; Lugosi & Lee, 2021). Thus, this study aims to develop virtual reality to facilitate elementary school students to get to know animals. It is hoped that this virtual reality can provide a meaningful, interactive, fun, and effective learning experience for students and they can explore the world of animals directly in virtual form.

METHODS

The methodology used in this research is research and development (R&D), adopting the ADDIE model (Nichols, Hess, & Greer, 2016). The purpose of this research is to produce virtual reality learning media to facilitate elementary school students' getting to know animal' diversity. The population in this study were second-grade students at Laweyan Public elementary school.

The test subjects used in this study involved three experts, consisting of material experts, media experts, and linguists experts. Individual trials were carried out involving three of second-grade students at SD Negeri Laweyan. Small-group trials were conducted in small groups in this study, small group trials consisted of nine of second-grade students at Laweyan public elementary school. The large group test was carried out on all subjects in class, namely 27 of second-grade students at Laweyan public elementary school (Salim, 2019).

Data collection techniques were carried out through interviews, questionnaires, and observation. Interviews were conducted with Laweyan Public Elementary School teachers, whose aim was to conduct a needs analysis related to the needs and use of instructional media. The interview guide contains aspects of teacher knowledge related to learning media, the use of media in the implementation of learning, learning materials, and media needed in learning. The interview guide was validated by experts before being used (Arikunto, 2010).

In order to validate and verify the feasibility of the media design developed in this study, validation was carried out with material experts and media experts through a questionnaire. Furthermore, the observation sheet is used to see the use of media in the implementation of learning and to see students' abilities regarding the introduction of animal material.

The data analysis techniques used in this development research are qualitative and quantitative descriptive techniques. Qualitative analysis techniques were used to analyze data in the form of input and suggestions obtained from the results of distributing evaluation questionnaires to material and media experts (Silalahi, 2015). While for the quantitative technique used to analyze the results of the questionnaire given to material experts with the assessment categories shown in table 1 (Fahmi et al., 2021; Rejekiningsih et al., 2021).

Table 1. Validation Score Conversion

Average Score	Category	Conversion
$X > 4,2$	Fine	
$3,4 < X \leq 4,2$	Good	Feasible
$2,6 < X \leq 3,4$	Enough	
$1,8 < X \leq 2,6$	Less	
$X \leq 1,8$	Very Less	Not Feasilbe

The qualitative data in the form of inputs and suggestions is also grouped and analyzed, the results of which are used in product development revisions. Furthermore, to find out the effectiveness of virtual reality media, it was carried out by testing the ability to recognize animals through observation sheets, comparing the pretest and posttest values of the experimental group and the control group, and then looking for the n-gain from both of them with the category of interpretation of the effectiveness of n-gain based on table 2 (Novitra et al., 2021).

Table 2. Criteria of Interpreting the Effectiveness of n-gain

Presentase (%)	Eligibility Level
<40	Ineffective
40 – 55	Less Effective
56 – 75	Effective Enough
>76	Effective

The procedure for the ADDIE development research model (analysis, design, development, implementation, and evaluation) adopted in this research will work as follows:

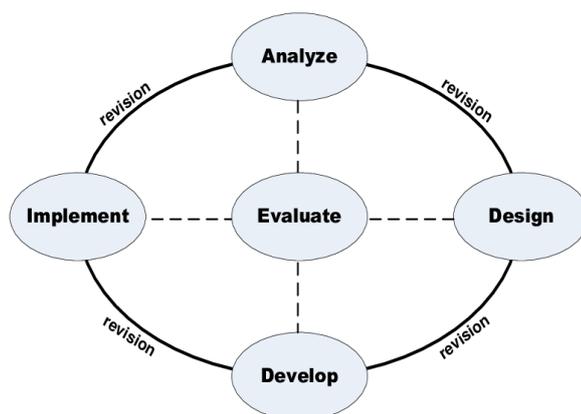


Figure 4. ADDIE Development Model

The initial stage is to analyze. At this stage, analyze the characteristics of students, and identify learning objectives. The second stage is design. At this stage, the design of virtual reality media is carried out, which can make students more interested and experience a direct virtual experience during the learning process. The third stage is the development stage. At this stage, virtual reality media development is carried out for various objects to be developed, and then testing is carried out to test whether objects adapted to this virtual reality format can operate or not. The fourth stage is implementation. The last stage is evaluation. At this stage, it is carried out to find out the effectiveness of using virtual reality media.

RESULTS & DISCUSSION

In order to facilitate the process of data collection, the results of this research will be divided into several stages, namely the stages of needs analysis, product development, and testing, each of which will contain the stages of the ADDIE development model.

Result of Need Analysis Stage (Analysis dan Design)

This analysis was carried out on the technology-based facilities and infrastructure available at Laweyan Public Elementary School and the teachers' skills in using them. The aspects that are analyzed include the availability of digital technology, references to digital learning materials, and skills in using technology. The following are the results of observations made at Laweyan Public Elementary School related to technology-based facilities and infrastructure in Table 3:

Table 3. Analysis of Technology-Based Facilities at Laweyan Public Elementary School

Aspects	Indicators	Responses (%)
Availability of Digital Technology	Availability of internet network	50%
	Availability of devices to support the digital learning process	25%
	Adequate availability of interactive learning multimedia	25%

Technological Process	Teachers have good technology use skills	50%
	Teachers are able to utilize digital technology in learning	43,8%
	Teachers are able to maintain technology devices	43,8%
Access to Digital Reference	Access the digital learning resources	62,5%
	Manage material and implement it into the learning process	62,5%

The data above shows that the availability of an adequate internet network at Laweyan Public Elementary School is only 50%. In addition, only 25% of schools have digital-based interactive multimedia and computer labs. This means that Laweyan Public Elementary School lacks facilities for the digital learning process. This is also exacerbated by the teacher's low digital literacy skills. Even the accessibility of digital references still shows unsatisfactory numbers.

Besides that, the analysis of users, namely second-grade students at Laweyan Public Elementary School, showed that the majority of students had a visual learning style with a percentage of 58.82% and the others, namely auditory learning styles, 16.57% and 24.71% kinesthetic. The openness of students towards the media shows a positive percentage. 81.13% of all students can operate smartphones and computers well, but only 45.28% personally own these devices. 94.45% of Grade 2 students at Laweyan Public Elementary School are interested in using digital media in the learning process in class. It can be seen that the visual learning style dominates among the students. Almost all students are interested in using digital-based media, whether they are proficient or not in using digital devices. So it can be concluded that it is very appropriate to develop interactive multimedia for Grade 2 students at Laweyan Public Elementary School, who tend to have a visual and open learning style with digital learning media. In addition, the use of communicative and friendly dubbing narratives can adapt to the language and cognitive development of students.

The results of the needs analysis were also carried out through the results of interviews with the teacher, who then obtained information that the teacher really understood the concept of animals and their types, but the teacher experienced difficulties in determining suitable learning media and models to be used in achieving learning objectives. On the other hand, the teacher really understands the characteristics of his students.

Difficulties in the digital-based learning process to introduce various types of animals occur due to limited facilities and habitats where animals live in zoos. Of course, not all animals can be presented at the zoo for certain reasons. On the other hand, this causes a lack of knowledge of the diversity of animals that should be known.

Based on the results of the analysis of teachers at Laweyan Public Elementary School, it shows that there are problems that occur in the process of learning to know animals and their habitats. The problem is caused by the non-optimal learning process, which has an impact on the low numeracy scores of the second grade students at Laweyan Public Elementary School. The causative factor

is that the learning process is packaged less attractively and does not use interactive digital learning media. Thus, motivation and learning participation are low.

The next stage is the design process (figure 5 and figure 6). Based on the results of the needs analysis, it shows that the opportunities for developing virtual reality media are very large so that they can become innovations in learning to introduce animals to students.

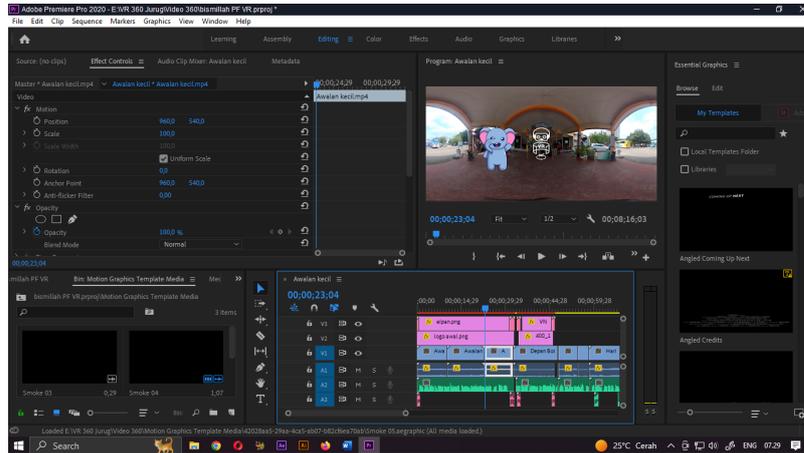


Figure 5. Virtual Reality Design Process Introduction Animal (1)



Figure 6. Virtual Reality Design Process Introduction Animal (2)

Results of the product development stage (Development & Implementation)

In this section, there is a process of validation by experts at the development stage and a feasibility assessment by the teacher as a practitioner at the implementation stage. The results of media assessment or validation by experts will be presented below.

Table 4. Media Expert Validation Results

No	Aspect	Experts	
		1	2
1	Media display and User Friendly	40	39
2	Programs and Interactivity	30	30
Total Score		70	69
Average Score		5	4,9

Overall validation from media expert I that the media is included in the "Very Good" category with an average score of 5. Meanwhile from media expert II that the media is included in the "Very Good" category with an average score of 4.9 to Table 2. Information that the product The virtual reality diversity of animals that has been developed has the quality of display design, use of audio, and video quality which is classified as 'very good'. The results of the assessment on the display aspect and the programming aspect get an average score of 5 and 4.9 for each validator. So the total score for all aspects and media experts is 4.95 which is included in the 'very good' qualification. In addition, qualitatively the media validators I and II provided input in efforts to improve the display and navigation quality of virtual reality products.

Furthermore, the material expert validation is carried out by the validator with the criteria; 1) Educators at least hold a master's degree, in the field of elementary school education/biology education. 2) have teaching experience in the field of education in the field of elementary school education/biology education for at least four years. The results of the validation of material experts I and material experts II are presented in Table 5.

Table 5. Material Expert Validation Results

No	Aspect	Experts	
		1	2
1	Learning and Illustration	39	39
2	Quality of Material / Information	19	20
Total Score		58	59
Average Score		4,8	4,9

Through Table 5, information is obtained that the VR products developed have learning qualities which include components of competence, introduction, learning process, and evaluation which are included in the 'very good' qualification. This is shown through the results of the assessment which received a score from the first material expert that the material in the media is included in the "Very Good" category with an average score of 4.8. Meanwhile, from the second media expert, the material in the media is included in the "Very Good" category with an average score of 4.9. The total average score of the two experts is 4.85 which indicates the "Very Good" category.

From each assessment, it shows that the virtual reality media developed is included in the 'proper' category, referring to the conversion score validation table, as a medium for introducing various types of animals, and is feasible for trials to the next stage.

The next media test or assessment will be carried out by the teacher as a learning practitioner, the following (Table 6) is the acquisition of an assessment score from the practitioner.

Table 6. Practitioner (Teacher) Validation Results

No.	Aspect	Expert 1	Expert 2
1.	Display/visual	18	19
2.	Interactivity	15	15
3.	Learning	14	14

4. Language and Material	15	15
Total Score	62	63
Average Score	4,7	4,8

Overall validation from the first expert practitioner that the media & materials are included in the "Very Good" category with a score of 4.7. Meanwhile, experts from the second practitioner stated that the media and materials were included in the "Very Good" category with a score of 4.8.

Product effectiveness test results (Evaluation)

The results of this test were carried out by giving pre-tests and post-tests regarding students' understanding of types of animals and animal concepts both before using virtual reality media, and after using virtual reality media which was divided into an experimental class and a control class. Before carrying out a test on the level of influence of the use of virtual reality media on students' understanding of animal introduction material, they must go through several pre-requisite test stages such as homogeneity tests and normality tests. Each - each analysis results for the homogeneity test and normality test are presented in the following Table 7.

Table 7. Results of Normality Test Data on Product Test Results

	Experimental class			Control class	
	n	Statc	Sig.	Statistic	Sig.
<i>Pre-Test</i>	30	0,947	0,141	0,98	0,825
<i>Post-Test</i>	30	0,941	0,096	0,964	0,396

The table above shows that the resulting pre-test and post-test values have a significance above 0.05. This means that all data is normally distributed. In addition to the normality test, the data obtained must go through a homogeneity test. The aim is to find out between the control class and the experimental class that comes from various schools and has the same homogeneous data. The data is said to be homogeneous if the significance value is more than 0.05. Following are the results of the homogeneity test on the post-test data for the experimental class and the control class are presented in the following Table 8:

Table 8. Homogeneity Test Results Data Product Test Results

	<i>Levene Statistic</i>	Sig.
Homogeneity Test Results	0,435	0,512

Based on the data table above, shows a significance value of 0.512 which means more than 0.05. So it can be concluded that the test results or post-test scores in the experimental class and control class are homogeneous. Data that has been declared normally distributed and homogeneous can be analyzed using statistical parametric methods, including the N-Gain Score Test and the Independent Sample T-Test.

Testing the Independent Sample T-Test is a test on the post-test data of the experimental class and the control class. The purpose of this test is to find out the comparisons and differences in the mean of the two data. Independent sample t-test is carried out on unpaired data such as post-test data in the experimental class and post-test data in the control class which are not carried out by the same sample. The

data is stated to have an average difference if the 2-tailed significance value is less than 0.05. The following are the results of the Independent Sample T-Test on the experimental class and control class post-test data are presented in the following Table 9:

Table 9. Independent Sample T-Test Results

<i>Independent Sample T-Test</i>				
<i>Equal Var</i>	<i>df</i>	<i>Sig. (2-Tailed)</i>	<i>Mean Dif</i>	<i>Std. Dif</i>
<i>Assumed</i>	58	0,000	12,866	2,002
<i>Not- Assumed</i>	57,123	0,000	12,866	2,002
<i>Descriptive Statistics</i>				
<i>Class</i>	<i>Mean</i>	<i>Std. Dev</i>	<i>Std. Mean</i>	
experimental class	87,7	8,221	1,501	
control class	74.83	7,259	1,325	
difference	12,87 (17,1%)			

The data above shows that the 2-tailed significance value in the equal variance is assumed to be 0.000 or less than 0.05. So, between the post-test average data of the experimental class has a difference in numbers from the average post-test data of the control class. The results of the descriptive analysis on the independent sample t-test showed that between the average post-test scores of the experimental class and the control class, there was a difference expressed by a difference of 12.87 or a difference of 17.1%. So it can be concluded that virtual reality media products are effective in increasing students' understanding of animals compared to comparative products with a difference in the value of 12.87.

Besides being tested using the Independent Sample T-Test, the data above was also tested using the N-Gain Score Test. The purpose of this test is to determine the effectiveness of the product by comparing the value obtained with the maximum value. So, with this test, it will show the level of effectiveness of virtual reality media products used in the experimental class. Following are the results of the N-Gain Score Test Table 10:

Table 10. N-Gain Score Test Results

Category	Results
<i>Mean</i>	62,316
<i>Min</i>	0,00
<i>Max</i>	100,00

The table above shows the results of the N-Gain Score value which is in the mean or average part. The results of the N-Gain Score analysis in the post-test experimental class show the number 62,316 which is included in the quite effective category. So it can be concluded that the product in the form of virtual reality media was stated to be quite effective in achieving maximum scores on the numeracy literacy test for second-grade students in elementary school Laweyan.

So, it can be concluded that based on the 2 analytical methods above, virtual reality media developed for learning to know animals is effective in increasing students' understanding of the types of animals at Laweyan Public Elementary School.

Discussion

The virtual reality media developed has gone through several feasibility tests so it can be said that the developed media is feasible and effective for learning about animals for second-grade students at Laweyan Public Elementary School. Whether the media is effective or not is identified because this virtual reality media is to the needs of students so that they can absorb information more effectively. In addition, the use of language terms that have been adapted to student characteristics is also a determining factor for whether or not the media is effective in influencing students' abilities (Rosidah et al., 2021) (Mayorga et al., 2020).

The results showed that the media developed in the Virtual Reality (VR) format were considered feasible to be used as learning media, of course, could not be separated from the adjustment of the components in the media to the characteristics of students during the design stage (Yung & Khoo-Lattimore, 2019)(Perdana et al., 2021). The average score of the assessment results of media experts, material experts, and practitioners who have successfully demonstrated the feasibility level of the developed media cannot be separated from the identification of the feasibility theory.

Learning with the help of virtual reality can impress students, facilitate students in the learning process, and increase students' willingness to learn (Mulders et al., 2020) (Carter et al., 2020). Therefore, the assessment of the effect of the product developed shows that virtual reality media is included in the effective category in helping students understand the materials (Styowati & Utami, 2022)(Zahabi & Abdul Razak, 2020). Interesting learning media in general will be able to increase students' curiosity about the material to be studied (Munawaroh et al., 2022).

The presence of virtual reality media products is one of the learning media innovations that is appropriate and is based on student needs. Therefore, the statement that the diversity of virtual reality products developed has quality display design, audio usage, and video quality that fall into the 'very good' qualification as evidenced by the validation results of media experts with a score of 4.95, the validation results of material experts with value of 4.85 and the validation results of media and material practitioners 4.75. With the results of the validation test, it is stated that virtual reality products are **very good** for development.

The results of this research are in line with research conducted by (Kamińska et al., 2019) that the use of virtual reality media has succeeded in having a significant impact on the progress of education in general because the application of this technology can already be applied to various levels of education. Research conducted by (Al-Gindy et al., 2020), the ICT-based learning paradigm relies on high-level media such as virtual reality can have an impact on science learning. Therefore, now many teachers and students have started to be open to the presence of technology in learning activities such as virtual reality media (Jang et al., 2021)

Therefore, according to the research results obtained in this study, the product in the form of virtual reality media is quite effective by achieving maximum scores on the numeracy literacy ability test for students in grade 2 SD Negeri Laweyan as evidenced by the N-Gain result of 62,316. With several stages of effectiveness testing that have been carried out, the development of virtual reality media for learning about animals is declared **effective** in increasing students' understanding

of the types of animals at SD Negeri Laweyan.

In addition, virtual reality media can also increase students' willingness to learn because by utilizing virtual reality media students can feel the habitat environment of the animals in the development. This research will provide practical and theoretical benefits for readers, especially teachers, so that they can carry out comprehensive implementation steps regarding innovation in their learning activities, especially in terms of ICT-based learning media innovation with virtual reality (VR).

CONCLUSION

The teacher's challenge in providing innovation for the learning process can be overcome through the application and integration of ICT into the learning process, one of which is discussed in this research, namely the development and application of high-level learning media products, namely virtual reality. The results of this study are by the research objectives where results of this study indicate that Virtual Reality products are declared suitable for use as learning media and are effective in increasing students' understanding of animal introduction for elementary school students. In the future, this research can be used as a basis for teachers and other researchers to implement and test the effectiveness of other variables that are considered important and needed.

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