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Development of Virtual Reality (VR)-Based "Jelajah Geometri" Animation Media to Improve Critical Thinking Skills of Grade IV Elementary School Students

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Abstrak

Penelitian ini bertujuan untuk mengetahui proses pengembangan media animasi "Jelajah Geometri" berbasisi *Virtual Reality* (VR) untuk meningkatkan kemampuan berpikir kritis pada siswa kelas IV SD, serta untuk mengetahui respon siswa setelah menggunakan media animasi "Jelajah Geometri" berbasisi *Virtual Reality* (VR) untuk meningkatkan kemampuan berpikir kritis siswa kelas IV SD pada materi komposisi dan dekomposisi bangun datar. penelitian ini dilaksanakan di SDN Penggung I dengan melibatkan 20 siswa kelas IV sebagai responden. Metode yang digunakan dalam penelitian ini adalah *Research and Development* (RnD) dengan mengacu pada model pengembangan ADDIE, yang terdiri dari lima tahapan utama, yaitu 1) Analisis, 2) perancangan, 3) pengembangan, 4) implementasi, 5) evaluasi. Berdasarkan hasil validasi dari tim ahli, diperoleh hasil tingkat kelayakan media sebagai berikut; ahli media sebesar 96%, ahli bahasa 100%, dan ahli materi 95% yang seluruhnya masuk dalam kategori sangat valid, Setelah dilakukan revisi terhadap media dan materi sesuai dengan saran dari para validator, peneliti melanjutkan ke tahap implementasi atau uji coba kepada 20 siswa kelas IV. Hasil implementasi menunjukkan bahwa media memperoleh skor sebesar 76%, yang termasuk dalam kategori "baik".

Keywords
Virtual Reality;
Animation Media;
Critical Thinking

Abstract

This research aims to understand the development process of the "Jelajah Geometri" animation media based on virtual reality (VR) to enhance critical thinking skills in fourth-grade elementary school students, as well as to determine the students' responses after using the "Jelajah Geometri" animation media based on virtual reality (VR) to improve critical thinking skills in fourth-grade elementary school students on the topic of composition and decomposition of flat shapes. This research was conducted at SDN Penggung I, involving 20 fourth-grade students as respondents. The method used in this research is Research and Development (R&D) based on the ADDIE development model, which consists of five main stages: 1) Analysis, 2) Design, 3) Development, 4) implementation, and 5) Evaluation. Based on the validation results from the expert team, the media feasibility levels are as follows: media expert 96%, language expert 100%, and material expert 95%, all of which fall into the very valid category. After revisions were made to the media and materials according to the suggestions from the validators, the researcher proceeded to the implementation stage, or trial, with 20 fourth-grade students. The implementation results indicate that the media received a score of 76%, which falls into the "good" category.

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Introduction

The advancement of digital technology has had a significant impact on the world of education. Putra & Pratama (2023) stated that the application of attractively designed digital media and technology has the potential to increase students' interest in learning and create a more interactive learning atmosphere. The use of digital technology in mathematics learning at the elementary school level is very

beneficial because it can facilitate students' understanding of abstract mathematical concepts through a visual and interactive approach that is easier to understand. This is also in accordance with research by Azkia et al. (2023), which revealed that digital media is a useful tool to assist the learning process, especially in areas that require visualization and real representation. Because mathematics is a discipline that focuses on abstract concepts and ideas, it plays a significant role in developing human cognitive abilities (Rizki, P et al., 2021). In addition, mathematics learning has an important role in shaping critical thinking patterns of students, especially at the elementary school level (Fauziyah & Priyambodho, 2022). As one of the basic subjects, mathematics teaches students to solve problems systematically and logically (Hadiawati, 2020; Sofiyati et al., 2024).

Mathematical critical thinking skills play an important role in improving students' mathematical skills (Kurniawan et al., 2023). According to Hikmah & Kartika (2022), critical thinking and mathematics are interrelated and inseparable elements. Understanding of mathematical concepts is formed through the process of critical thinking, while critical thinking skills themselves can be honed through a challenging and meaningful learning process (Kurniawati & Ekayanti, 2020). Based on research findings conducted by Amalia et al. (2020), elementary school students are still lacking in mathematical critical thinking. This is because some students are not used to systematic thinking; they tend to prioritize the use of formulas without providing in-depth reasons in solving problems. Based on the results of Arifudin's research (2024), it was revealed that the mathematical critical thinking skills of elementary school students are still relatively low and need to be improved. The results of Handayani's research (2020) also stated that the mathematical critical thinking skills of students, especially elementary school students, are still low because critical thinking skills in mathematics are not developed enough in the learning process.

This is also in line with the results of direct observations in the field and interviews conducted by researchers with teachers at SDN Penggung I, which show that there are still some students who need to improve their mathematical critical thinking skills. This situation is caused by the difficulty of students in understanding the material, especially in mathematics. In addition, the lack of focus when studying also causes them to experience obstacles in absorbing the material presented by the teacher.

In the context of learning, teachers have an important role in providing learning media that can help improve students' critical thinking skills. One of the learning media that can be used to improve mathematical critical thinking skills is digital media. This is also in accordance with the results of research conducted by Fadiyah et al. (2024) which revealed that the use of innovative digital media in the learning process has the ability to improve students' thinking skills at the elementary school level. One of the learning media that can be developed to improve critical thinking skills in elementary school students is animation media. Animation media is a medium consisting of a series of images designed to produce movement effects, with interesting sounds, and containing educational values (Riyanti & Jarmita, 2021). The learning material that is visualized in the form of animated images becomes more meaningful and interesting so that it is easy to accept and understand, and is able to improve the critical thinking skills of elementary school students (Rochmania & Restian, 2022). Therefore, researchers are trying to develop animation media that help elementary school students improve their critical thinking skills.

In developing this animation media, researchers developed virtual reality (VR)-based animation media. Virtual reality is an environment produced through computer technology where the objects displayed look very realistic. This technology creates an immersive experience for its users, as if they were in the environment, while allowing interaction and manipulation of existing virtual objects (Saparuddin et al. 2024). Various studies have discussed the development of mathematics learning media, especially those based on virtual reality. The novelty of this research lies in the development of virtual

Reality (VR) animation-based learning media specifically designed for geometry material at the elementary school level, with the main aim of improving students' critical mathematical thinking skills. This approach is different from previous studies, such as the study of Susilawati et al. (2021) which focused on students' understanding abilities, or the research of Darojat et al. (2022) which emphasized increasing learning motivation. The focus of this research material, namely geometry material for grade IV elementary school students, also differentiates it from previous research, such as the study by Lestari et al. (2022), which discussed the solar system for grade VI students, or the study by Saparuddin et al, (2024), which discussed disaster mitigation for high school students.

Based on the background above, the researcher is interested in conducting research and development focused on the topic "Development of Virtual Reality (VR)-Based Animated Learning Media "Jelajah Geometri" to Improve Critical Mathematical Thinking Skills of Grade IV Elementary School Students."

Method

In this study, the researcher employed the Research and Development (R&D) method. This method is an approach used to create a specific product and test its effectiveness (Sati et al., 2023; Sugiyono, 2019). The study adopts the ADDIE model, introduced by Dick and Carey, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. However, this research focuses solely on determining the validity and practicality of the developed media.

Analysis Stage: In this stage, the researcher analyzes the needs to be addressed and assesses the urgency of developing the intended product. **Design Stage:** At this stage, the researcher designs the product to be developed. The product design remains conceptual and serves as the foundation for the subsequent development stage. **Development Stage:** During this stage, the conceptual framework designed in the previous stage is transformed into a tangible product ready for implementation. Additionally, validation data are analyzed to assess the validity of the developed learning media. **Implementation Stage:** In this phase, the developed product is applied in an actual learning environment, namely the classroom. However, full implementation is not conducted in this study, as the media trial is limited to assessing the practicality of the developed learning media. **Evaluation Stage:** This final stage involves evaluating the implementation phase to determine the feasibility of the media development. It should be noted that this evaluation does not assess the effectiveness of the developed media.

This study was conducted with 20 fourth-grade students from SDN Penggung I as research subjects. The data collection technique employed in this study was a questionnaire, which was used to measure both the media needs of teachers and students, as well as the validity and practicality levels of the animated media *Jelajah Geometry* based on Virtual Reality (VR). The data analysis techniques used in this study included validity and practicality tests. To determine whether the VR-based animated media *Jelajah Geometry* meets the criteria for validity and practicality, the researcher applied the following formula:

$$\text{Validity Value} = \frac{\text{Total of all scores}}{\text{highest score}} \text{ x } 100\ \%$$

$$\text{Practical Value} = \frac{\text{Total of all scores}}{\text{highest score}} \text{ x } 100\ \%$$

Results and Discussion

Result

The results of this development research, which was conducted using the ADDIE model consisting of five stages—Analysis, Design, Development, Implementation, and Evaluation—led to the creation of an animated media product titled *Geometry Exploration* based on Virtual Reality (VR). This media was designed to enhance critical thinking skills among fourth-grade elementary school students in the topic of composition and decomposition of flat shapes. The development procedure carried out by the researcher followed the five stages of the ADDIE model, as outlined below:

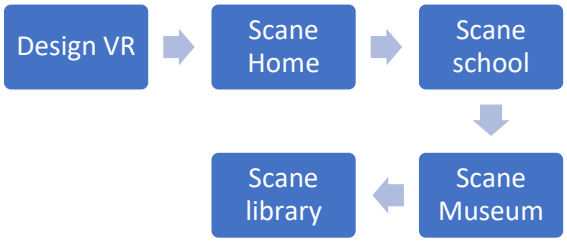
1. *Analysis*

In the analysis stage, the researcher distributed questionnaires to teachers and students in grade IV to identify the need for learning media that support the development of students' critical thinking skills. Based on the questionnaire distributed to 40 grade IV students, the results showed that 40 students showed low interest in participating in mathematics learning and had difficulty in understanding the material, especially on questions that require critical thinking skills. In addition, other factors that also influenced the learning method tended to be monotonous and less enjoyable, causing students to feel bored. The results of the questionnaire also showed that students had a high interest in technology-based learning media, especially those that display visual, interactive, and interesting characteristics such as virtual reality (VR). However, the majority of students had never used VR media in the learning process, especially mathematics. Meanwhile, based on the needs analysis questionnaire distributed to 2 grade IV teachers, it was found that teachers were aware of the importance of critical thinking skills in mathematics learning. However, some teachers admitted that they had difficulty in choosing and developing effective learning media to encourage the development of these abilities. In addition, the use of learning media in the classroom is still not optimal, and technology-based media such as Virtual Reality (VR) has never been applied in the learning process.

From the results of the needs analysis, it can be concluded that students need virtual reality (VR) media to improve their critical thinking skills. Therefore, in this study, the researcher developed a virtual reality (VR)-based "geometry exploration" animation media, which was designed to meet students' needs in improving their critical thinking skills.

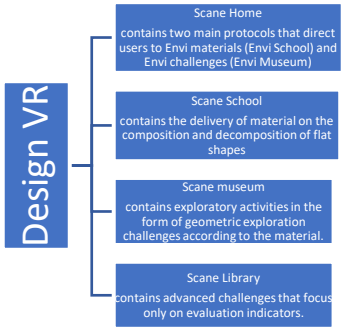
2. *Design*

At the design stage, the researcher compiled a product design framework with the theme of composition and decomposition of flat shapes to help develop students' critical thinking skills. This design includes 4 main scenes in the animated media "geometry exploration" based on virtual reality (VR). The compilation of these four scenes aims to ensure that media development runs in a structured manner and in accordance with learning needs.



Picture 1. Design VR

Then each scane is designed with several activity components that support the learning process in stages. The stages of the learning process chosen are the result of adjustments to the needs required. Here are some designs of the stages of the learning process that are designed and will be developed in the next stage.



Picture 2. Stages VR

3. *Development*

In the process of developing the animated media "Jelajah Geometri" based on virtual reality (VR), researchers use the Millealab editor application as a tool. Before being used in learning, the animated media "EJelajah Geometri" based on virtual reality (VR), was validated by media, language, and material experts to ensure feasibility and make revisions before field trials.

a. Media Expert Validation Test

Media expert validation was carried out by one validator who is a lecturer in the Elementary Madrasah Teacher Education study program, namely Mr. Heru Mudiyanti, M.Pd. The following are the results of the media expert validation test.

Tabel 1. Media Expert Validation Results

Aspect	Score	Score Max	Percentage	% Average	Category of each aspect
Graphic Eligibility	5	5	96%	96%	Very Valid
	4	5			
	5	5			
	5	5			
	5	5			
Media Eligibility	4	5	96%		
	5	5			
	5	5			
	5	5			
	5	5			

Based on the table above, it was obtained that the graphic feasibility aspect reached a percentage of 96%, as well as the media feasibility aspect, which also obtained a value of 96%. After the two aspects were accumulated, a total percentage of 96% was obtained, which was included in the very valid or very feasible category..

b. Language Expert Validation Test

The validation of the language expert was carried out by one Language expert validator who is a lecturer in the Indonesian language Education Study Program, namely Mrs. Venni Nurfadilah, M.Pd. The results of the language expert validation test are as follows.

Table 2. Language Expert Validation Test

Aspect	Score	Score Max	Total Score	Percentage	% Average	Category of each aspect
Straightforwardness	5	5	10	100%	100%	Very Valid
	5	5				
Communicative	5	5	15	100%		
	5	5				
	5	5				
Language Compatibility	5	5	10	100%		
	5	5				

Based on the table above, it is obtained that the aspect of straightforwardness reaches a percentage of 100%, the communicative aspect obtains a percentage of 100%, as well as the aspect of language appropriateness, which also shows a percentage of 100%, which, if accumulated as a whole, is included in the very valid category.

c. Material Expert Validation Test

The validation of the material expert was carried out by Mrs. Ati Rohayati, S.Pd, as a mathematics subject teacher at SDN Penggung I. The following are the results of the validation test of the material expert.

Table 3. Material Expert Validation Results

Aspect	Score	Score Max	Total Score	Persentage	% Average	Category of each aspect k
Content Eligibility	5	5	36	90%	95%	Very Valid
	5	5				
	4	5				
	4	5				
	4	5				
	4	5				
	5	5				
	5	5				
Contextual assessment	5	5	5	100%		

Based on the table above, it is obtained that the aspect of content feasibility reaches a percentage of 90%, while the aspect of media feasibility also gets a value of 100%. After both aspects are accumulated, a total percentage of 95% is obtained.

4. *Implementation*

After the development product has been successfully validated and improved according to the suggestions given by the validator. Furthermore, the development product will be tested or implemented on 20 fourth-grade elementary school students. The purpose of this trial is to determine the practicality of the Virtual Reality (VR)-based "Jelajah Geometry" learning media. The trial was conducted on May 6, 2025, on 20 fourth-grade students of SDN Penggung I. At this stage, the implementation began by asking students to explore the virtual reality (VR) media that had been developed. Furthermore, students were

given questions to measure their critical thinking skills. After this activity, students were asked to provide an assessment of the practicality of the product developed by filling out a student response questionnaire. The results of student responses as users are as follows:

Table 4. Student Response Results (Users)

Number of Respondents	Total	Score Max	Average %	Criteria
20 Student	1525	2000	76%	Practical

Based on the table above, it shows the results of student responses in the field trial of the animated media "Geometry Exploration" based on Virtual Reality (VR), obtaining an average percentage of 76%, including in the practical category.

5. ***Evaluation***

The final stage in this research process is evaluation. At this stage, the researcher assesses the entire series of stages that have been implemented in the development of the "Jelajah Geometry" learning media based on Virtual Reality (VR). This study uses formative evaluation because its main focus is to assess the feasibility of the "Jelajah Geometry" animation learning media based on Virtual Reality (VR), not to measure the effectiveness of the product or media in question. This evaluation process is carried out at the validation stage by expert media validators, language experts, and material experts, with the aim of obtaining input and comments in order to revise the media developed so that it is worthy of being tested on students.

Discussion

The feasibility of the "Jelajah Geometry" animation media based on virtual reality in improving students' critical thinking skills in the composition and decomposition of flat shapes in grade IV of SDN Penggung I is shown through the validation results from various aspects, namely media, language, and materials by a team of experts, as well as responses from students. The results of the media validation obtained an average score of 96% with a very feasible category, language validation reached 100% with a very valid category, and material validation obtained an average of 95%, which was also included in the very valid category. Based on the results of the three validation aspects, it can be concluded that the "Jelajah Geometry" animation media based on virtual reality is very feasible to be tested in the learning process. This finding is in line with the results of research conducted by Febriana et al. (2023), which states that virtual reality-based learning media in mathematics subjects is considered very feasible for use in learning practices in the field. This is because the use of VR in the world of education, especially at the elementary school level, can facilitate students' understanding of complex concepts through a more visual and interactive approach (Styadi et al., 2024). In addition to making it easier for students to understand difficult concepts, based on research conducted by Zulfikri (2023), VR-based learning has also been proven to be able to improve the critical thinking skills of elementary school students.

After implementing the media on grade IV students of SDN Penggung I, the results obtained were 76%, which were included in the practical or good category. This means that the animated media "Jelajah Geometry" has proven to be practical and feasible to use and has a positive contribution in improving students' critical thinking skills in the composition and decomposition of flat shapes in mathematics. This is also in line with the results of research conducted by Putra (2024), which states that the use of Virtual Reality (VR) in the context of education can increase learning motivation, conceptual understanding, and critical thinking skills of elementary school students, especially in mathematics. Findings from Setyawan's research (2023) also state that Virtual Reality technology has great potential in stimulating and developing students' critical mathematical thinking skills. In addition, the results of research conducted by Oktarizka & Abidin (2024) also show that the use of virtual reality (VR) media can

significantly improve students' critical mathematical thinking skills at the elementary school level. In addition to providing a more concrete learning experience, the use of this media also gets a positive response from students to Virtual Reality-based learning. This is because Virtual Reality (VR) Media provides opportunities for users to do things that are impossible in the real world and allows active participation in the virtual environment. In Indonesian, virtual reality, or virtual reality, is a technology that allows users to experience interactions with the virtual world as if they were in real conditions (Wulandari et al., 2022).

Based on the overall results of the discussion, it can be concluded that the animated media "Jelajah Geometri" based on virtual reality is very feasible to be used in the field. This is supported by the validation results from experts and positive responses from students, which indicate that the media meets the practical and effective categories in supporting the improvement of critical thinking skills of elementary school students.

Conclusion

The learning media developed in this study is the animated media "Jelajah Geometry" based on Virtual Reality (VR), which is designed to improve the critical thinking skills of fourth-grade students of SDN Penggung I on the composition and decomposition of flat shapes, with 20 respondents. This study was conducted using the ADDIE model (analysis, design, development, implementation, and evaluation). This learning media has passed a series of validation tests involving media experts, language experts, and material experts. The assessment results from the validator showed that the media obtained a percentage of 96% from media experts, which is categorized as very valid. Validation by language experts reached a percentage of 100% with a very valid category, while the assessment from material experts obtained a score of 95%, which is also included in the very valid category. In addition, the response from students to the animated media "Jelajah Geometry" based on Virtual Reality (VR) to improve critical thinking skills showed a percentage of 76%, which is categorized as practical.

Reference

Amalia, N. F., Aini, L. N., & Makmun, S. (2020). Analisis Tingkat Kemampuan Berpikir Kritis Siswa Sekolah Dasar Ditinjau Dari Tingkat Kemamampuan Matematika. *Jurnal IKA PGSD (Ikatan Alumni PGSD) UNARS*, *8*(1), 97. https://doi.org/10.36841/pgsdunars.v8i1.587

Arifuddin, A. (2024). Perolehan Dan Peningkatan Kemampuan Berpikir Kritis Dan Kreatif Matematis Siswa Sekolah Dasar Melalui Pembelajaran Saintifik Berbantuan Augmented Reality Ditinjau Dari Level Disposisi Matematis Siswa. *(Doctoral Dissertation, Universitas Pendidikan Indonesia).*

Azkia, N. F., Muin, A., & Dimyati, A. (2023). Pengaruh media pembelajaran digital terhadap hasil belajar matematika: meta analisis. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *6*(5), 1873–1886. https://doi.org/10.22460/jpmi.v6i5.18629

Darojat, M. A., Ulfa, S., & Wedi, A. (2022). Pengembangan Virtual Reality Sebagai Media Pembelajaran Sistem Tata Surya. *JKTP: Jurnal Kajian Teknologi Pendidikan*, *5*(1), 91–99. https://doi.org/10.17977/um038v5i12022p091

Fadiyah, H., Kurnianti, E., & Hasanah, U. (2024). Studi Literatur: Peningkatan Kemampuan Berpikir Kritis Siswa Sekolah Dasar Melalui Media Digital. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang, 10(2), 211 - 224.* https://doi.org/https://doi.org/10.36989/didaktik.v10i2.2968

Fauziyah, N., & Priyambodho, B. . (2022). *Universitas Muhammadiyah Surakarta , Surakarta , Indonesia Abstrak PENDAHULUAN Matematika merupakan salah satu ilmu yang berperan penting dalam perkembangan dunia Matematika adalah ilmu yang berhubungan dengan ide dan konsep abstrak yang dapat membantu me*. *11*(4), 2823–2835.

Febriana, D., Asih, I., & Pamungkas, A. S. (2023). Pengembangan Media Pembelajaran Virtual Reality berbantu Millea Lab pada Mata Pelajaran Matematika di Sekolah Dasar. *Jurnal Pendidikan Dasar*, *11*(2), 329–340. https://doi.org/10.46368/jpd.v11i2.926

Hadiawati, H. (2020). Penerapan Strategi Pemecahan Masalah Sistematis (Systematic Approach to Problem Solving) untuk Meningkatkan Hasil Belajar Matematika Kelas XI IPS 2 SMA Negeri 1 Kerinci Tahun Pelajaran 2019/2020. *Jurnal Ilmiah Universitas Batanghari Jambi*, *20*(3), 784. https://doi.org/10.33087/jiubj.v20i3.1061

Handayani, H. (2020). Pengaruh Implementasi Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Berpikir Kritis Matematis Siswa Sekolah Dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *Vol 5 No 1 June 2020*. https://doi.org/10.23969/jp.v5i1.1944

Kurniawati, D., & Ekayanti, A. (2020). Pentingnya Berpikir Kritis Dalam Pembelajaran Matematika. *PeTeKa (Jurnal Penelitian Tindakan Kelas Dan Pengembangan Pembelajaran)*.

Lestari, D. D., Sulistyawati, I., & Wardani, I. S. (2022). Pemanfaatan Media Video Animasi Terhadap Hasil Belajar Sistem Pencernaan Manusia Sekolah Dasar. *JISPENDIORA : Jurnal Ilmu Sosial, Pendidikan Dan Humaniora*, *1*(2), 01–05. https://doi.org/10.56910/jispendiora.v1i2.27

Oktarizka, D. A., & Abidin, Y. (2024). Analisis Kebutuhan Pengembangan Media Virtual Reality Sistem Pencernaan untuk Meningkatkan Berpikir Kritis Kelas V SD. *Jurnal Elementaria Edukasia*, *7*(1), 2225–2235. https://doi.org/10.31949/jee.v7i1.8819

Putra, L. D., & Pratama, S. Z. A. (2023). PEMANFATAN MEDIA DAN TEKNOLOGI DIGITAL DALAM MENGATASI MASALAH PEMBELAJARAN. *Journal Transformation of Mandalika.*, *. Vol. 4,*.

Putra, L. D., Shiddiq, A. J., Khafi, I., & Nugroho, B. (2024). Integrasi Teknologi Immersive learning Dalam Pembelajaran Sekolah Dasar. *Jurnal Riset Madrasah Ibtidaiyah (JURMIA)*, *4*(2), 218–230. https://doi.org/10.32665/jurmia.v4i2.3349

Riyanti, M., & Jarmita, N. (2021). Pengembangan Media Animasi Pembelajaran Berbasis Powtoon pada Materi Unsur-Unsur Bangun Datar. *Jurnal Keilmuan Dan Kependidikan Dasar*, *13*(01), 73–88. http://jurnal.uinbanten.ac.id/index.php/primary/article/view/4698

Rizki, P, A., Ponoharjo, & Rokhman, M, S. (2021). Keefektifan Metode Pembelajaran Resitasi Terhadap Minat Dan Prestasi Belajar Matematika. *Integral : Jurnal Penelitian Pendidikan Matematik*. https://doi.org/https://doi.org/10.24905/jppm.v4i1.73

Rochmania, D. D., & Restian, A. (2022). Pengaruh Penggunaan Media Belajar Video Animasi Terhadap Proses Berfikir Kreatif Siswa Sekolah Dasar. *Jurnal Basicedu*, *6*(3), 3435–3444. https://doi.org/10.31004/basicedu.v6i3.2578

Saparuddin, M. I., Astutik, S., Pangastuti, E. I., Apriyanto, B., & Susiati, A. (2024). Pengembangan Media Pembelajaran Geografi Virtual Reality Berbasis Millealab Pada Materi Mitigasi Bencana Siswa SMA. *Majalah Pembelajaran Geografi*, *7*(1), 93–103.

Sati, A. T., Aditya, D. T., Azzahra, N. L., & Djutalov, R. (2023). Perancangan Sistem Informasi Keuangan Orens Peninggaran Raya (OPERA) Berbasis Dekstop Dengan Java Se & MYSQL Menggunakan Metode Reseach And Development (RND). *Journal of Research and Publication Innovation, 1(2), 196-200.*

Setyawan, M. D., El Hakim, L., & Aziz, T. A. (2023). Kajian Peran Virtual Reality (VR) Untuk Membangun Kemampuan Dialogis Siswa Dalam Pembelajaran Matematika. *Jurnal Pendidikan Indonesia*, *4*(02), 122–131. https://doi.org/10.59141/japendi.v4i02.1592

Sofiyati, A. A., Arifuddin, A., & Andini, W. (2024). Game Development"GEMAS(Modified Divisiem Engklekgame)" To Improve Understanding Of Conceptisin Class II Elementary School Students. *AL-Mudarris : Journal Of Education*, *7*(2), 189–204. https://doi.org/https://doi.org/10.32478/bdv9nd09

Styadi, A., Istiyowti, L. S., Kampus, A., Business, S., Gading, J., Boulevard, S., Tower, N., Dua, K. K., & Tangerang, K. (2024). *Implementasi Virtual Reality dalam Kegiatan Pembelajaran di Sekolah Dasar Universitas Pradita , Indonesia lembaga pendidikan sebagai sarana pendukung dalam pembelajaran , baik*

sebagai sarana dalam. *2*(1), 21–27.

Sugiono. (2019). *Metode Penelitian dan Pengembangan (R&D).* Alfabeta.

Susilawati, F., Munzir Umran, & Galang Pandu Pratama. (2021). Rancang Bangun Aplikasi Virtual Reality (Vr) Sistem Tata Surya Sebagai Media Pembelajaran Sains. *J-Innovation*, *10*(2), 63–68. https://doi.org/10.55600/jipa.v10i2.94

Wulandari, T. D., Widiyatmoko, A., & Pamelasari, S. D. (2022). Keefektifan Pembelajaran Ipa Berbantuan Virtual Reality Untuk Meningkatkan Kemampuan Kognitif Siswa SMP Di Abad 21: Review Artikel. *Proceeding Seminar Nasional IPA XII*, 106–115. https://proceeding.unnes.ac.id/index.php/snipa/article/view/1343%0Ahttps://proceeding.unnes.ac.id/index.php/snipa/article/download/1343/855

Zulfikri, A. (2023). Dampak Implementasi Teknologi Virtual Reality dalam Pembelajaran Matematika pada Siswa Sekolah Dasar di Kabupaten Sukabumi. *Jurnal Pendidikan West Science*, *01*(06), 258–265.