



Bridging Nature and Technology: The Impact of Environment-Based Augmented Reality Digital Books on Elementary Students' Science Interest and Achievement

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Abstract: This study aims to develop a digital book design equipped with environment-based Augmented Reality (AR) features and to examine its validity, practicality, and effectiveness in improving students' interest and achievement in science learning. This study employed the ADDIE model, consisting of five stages: Analyze, Design, Development, Implementation, and Evaluation. The research was conducted with fifth-grade students at SD No. 3 Kedonganan, Bali Province. The effectiveness test involved 54 students from two classes, consisting of 27 students in the experimental class and 27 students in the control class. The practicality test involved five teachers and 25 fifth-grade students selected for the product trial. Data were collected through validated questionnaires and multiple-choice tests. The validity of the digital book was assessed using a modified Learning Object Review Instrument (LORI) and BSNP assessment instruments. The developed digital book integrates 3D visualization and AR features. The validity test results showed that the digital book achieved an average score of 0.92, indicating a very valid category. The practicality results showed that teacher responses reached an average score of 95.16%, while student responses reached 92.53%, both categorized as very practical. The hypothesis testing results using one-way MANOVA showed a significance value of $p < 0.001$, indicating a statistically significant effect of implementing the environment-based AR digital book on students' interest and achievement in science learning. These findings indicate that the developed digital book with environment-based AR features is a valid, practical, and effective learning medium for enhancing science learning outcomes and interest among fifth-grade elementary school students.

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Introduction

Technology-oriented learning makes it more possible to implement student-centered learning strategies and encourages a creative and independent learning process to face global competition (Rosnaeni, 2021; Handini, 2023). In the learning process, providing interesting and enjoyable environment-based learning experiences is more commonly found in Science learning (Andriani, 2020; Afriyadi, 2023). However, most students consider Science learning to be a boring and difficult subject because the material provided is very complex, thus making students feel burdened in their learning (Raharjo, 2019; Anderson, 2020). The causes of low Science learning achievement are 58.33% originating from the students themselves who consider Science material difficult, 45.83% of students have difficulty concentrating at school, 37.50% of students have difficulty understanding the material presented by the teacher, and 37.50% of students often delay assignments (Zannah, 2022).



Based on the results of interviews conducted in June 2025 with a fifth-grade homeroom teacher at SD No. 3 Kedonganan, Bali, several issues were identified in the Science learning process. The problems encountered include: 1) teaching materials only use conventional printed books, 2) the use of media and teaching materials is not yet in line with current technological developments, 3) the delivery of material mostly uses the lecture method which provides less direct experience (especially in ecosystem material), making it less engaging and innovative, which affects the lack of student interest in understanding the material or answering questions.

Based on the results of classroom observations conducted in May 2025, student interest in science learning was still lacking, as seen from the classroom atmosphere, where most students were less enthusiastic and tended to remain silent during the lessons. Several students did not focus on the teacher's explanations and were less interested when asked to read the textbook. During the learning process, it was observed that the teacher only used videos taken from YouTube, and the reference sources used were still limited to conventional textbooks, namely the main course books. Based on the evaluation results, the average Science learning achievement for fifth-grade elementary school students was 61.48%, indicating that the minimum mastery requirement of 70% according to the Learning Objective Achievement Criteria has not been met.

Currently, several research studies on the development of digital books have begun to make them more attractive (Wonda, 2022; Paing, 2024). In one article on developing digital books as a medium to increase learning motivation, it is explained that digital books are equipped with animations, videos, and allow for audio recordings so that students can also learn independently and have an equal learning experience (Wastanimpuna, 2021; Yasa, 2022).

The development of more interactive digital books, where one innovation is the use of Augmented Reality (AR), allows learning materials to be presented in the form of interactive three-dimensional visuals (Efendi, 2016; Qumillaila, 2017). Currently, few elementary schools use AR as a learning medium because generally they still adopt the old method of using books or 2D images as learning media. This AR can enrich the learning experience through 3D visualization, animation, and direct interaction, which can make abstract concepts easier to understand and increase students' creativity and information retention (Ziden, 2022; Wibowo, 2023; Saumarwah, 2025).

Several other studies have utilized AR as a means to improve students' comprehension skills (Ruddamayanti, 2019; Abdullah, 2022; Fajriati, 2023; Mahrawi, 2023; Wahyuni, 2024). However, these studies have not yet integrated environmental and ecosystem values into the AR media, so students only gain a technological experience, not a contextual experience that builds interest, understanding, and environmental awareness.

This study aims to develop and describe the validity, practicality, and effectiveness of an environment-based Augmented Reality (AR) digital book in enhancing interest and learning achievement in Science and Social Studies among fifth-grade elementary school students. This study contributes to elementary Science learning by providing an interactive digital book model that integrates environmental context with AR features to help students understand ecosystem concepts more concretely. In addition, this study offers an innovative learning media alternative that can increase students' interest and learning achievement through 3D visualization and contextual learning experiences.



Research Method

This research uses the Research and Development (R&D) method. In this development research, the author uses the ADDIE development model (Analyze, Design, Development, Implementation, Evaluation) (Adeoye et al., 2024).

The subjects for the product validity test involved 3 experts, namely a material expert, a language expert, and a media expert, all of whom are lecturers from the Basic Education Master's Degree Program at Ganesha University of Education. The research subjects for the practicality test involved 5 teachers from Cluster IV Kuta. Each teacher guided 5 students in their respective classes, so the total number of students involved was 25. The subjects for the product effectiveness test involved 54 fifth-grade students from two classes.

Data collection in this study used non-test and test methods. The non-test method was carried out using questionnaires to assess product validity, practicality, and students' learning interest. The validity of the digital book was assessed by experts using a modified Learning Object Review Instrument (LORI) and BSNP-based assessment indicators, covering material, media, and language aspects. Meanwhile, the practicality of the product was measured using the User Experience Questionnaire (UEQ), which was completed by teachers and students to assess attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. The test method was used to measure students' learning achievement through multiple-choice questions administered before and after the implementation of the environment-based Augmented Reality (AR) digital book.

The data analysis technique uses validity testing through judge testing, small group testing, practicality testing, and effectiveness analysis. Product validity was analyzed based on expert judgment scores and converted into validity criteria using a quantitative descriptive approach. The validity score was calculated by comparing the obtained score with the maximum score, then converting it into a percentage using the formula:

$$\text{Percentage} = \frac{(\text{Actual Score})}{(\text{Maximum Score})} \times 100$$

The results were interpreted using validity criteria, namely 81%–100% = very valid, 61%–80% = valid, 41%–60% = fairly valid, 21%–40% = less valid, and 0%–20% = invalid. The product was considered feasible if it reached at least the valid category (Adi et al., 2023). Practicality data obtained from the UEQ questionnaire were also analyzed using a percentage with the same formula as the validity testing. The percentage results were then interpreted into practicality criteria, namely 81%–100% = very practical, 61%–80% = practical, 41%–60% = fairly practical, 21%–40% = less practical, and 0%–20% = impractical. The digital book was considered practical if the responses from teachers and students reached at least the practical category (Darma et al., 2021).

The effectiveness of the environment-based Augmented Reality (AR) digital book was analyzed using a one-way MANOVA test to determine the simultaneous effect of the product on students' learning interest and learning achievement. Before conducting the MANOVA test, prerequisite tests were carried out, including the normality test, the homogeneity test, and the multicollinearity test. The hypothesis testing criterion was determined based on the significance value. If the significance value was less than 0.05, then H_0 was rejected, and H_1 was accepted.

Results and Discussion

Based on the results of the student potential analysis, the majority of fifth-grade students are able to operate technological devices such as mobile phones and are accustomed to using them in daily life. The product designed in this development research is a digital book utilizing Augmented Reality (AR) features and is environment-based to improve student achievement and interest in learning Science and Social Studies on ecosystem material.

The development of the product design for the digital book with environment-based AR features was prepared by creating flowcharts to illustrate the product.

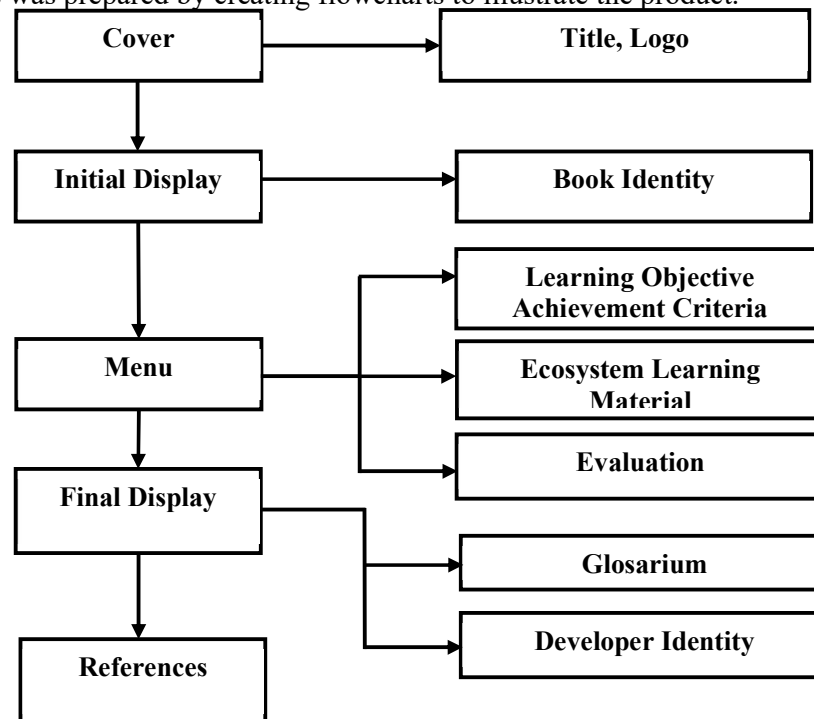


Figure 1. Flowchart of Digital Book Design

The menu structure in the environment-based AR digital book was designed by considering the characteristics of elementary school students who need concrete, visual, and interactive learning experiences to understand Science concepts more easily (Rosnaeni, 2021; Wibowo, 2023). Therefore, the digital book provides several main menus, including learning objectives, ecosystem learning materials, AR-based visualization, glossary, evaluation, references, and developer identity, to support systematic and student-centered learning (Handini et al., 2023; Yasa et al., 2022). The learning objectives menu helps students understand the competencies that must be achieved before learning, so the learning process becomes more directed and meaningful (Rosnaeni, 2021). The ecosystem material menu presents concepts gradually from simple explanations to more complex environmental interactions, which is suitable for elementary students' cognitive development and contextual Science learning needs (Zannah & Zulfadewina, 2022; Afriyadi et al., 2023). The AR visualization menu is provided to help students observe ecosystem components in three-dimensional forms, making abstract concepts easier to understand through concrete visual representation (Abdullah et al., 2022; Ziden et al., 2022). The glossary menu supports students in understanding important scientific terms, while the evaluation menu allows

students to measure their comprehension independently after using the digital book (Wonda et al., 2022; Yasa et al., 2022). Thus, the arrangement of these menus is not only intended to organize the content, but also to strengthen meaningful, interactive, and contextual Science learning in elementary schools.

Development of a Digital Book with Environment-Based AR Features

At the development stage, this digital book was created in a web format equipped with AR features that can be viewed in 3D or displayed in a room. There are three display options to choose from for viewing the AR feature: view in 3D, scan marker, and place in room. The display of the digital book product with environment-based AR features can be seen in the following table.

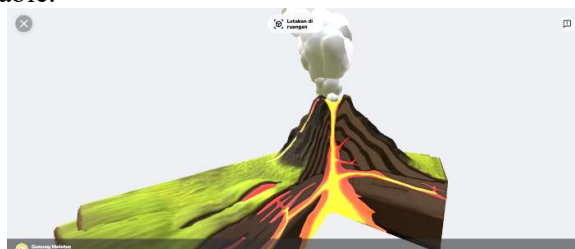


Figure 2. 3D Display

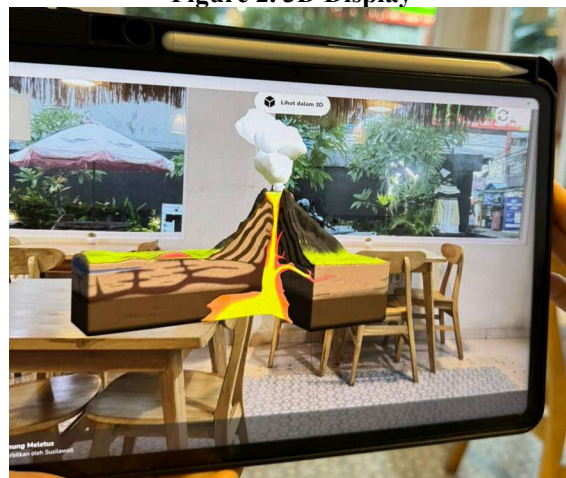


Figure 3. Augmented Reality Display



Figure 4. Interactive Evaluation

Test Results of the Digital Book with Environment-Based AR Features

Material validity testing was conducted by 3 academics/lecturers who have expertise in the field of instructional technology and natural science. The results of the product validity test assessment for the material aspect are presented in the following table.

**Table 1. Results of the Learning Material Expert Assessment**

	Score	Criteria
Mean	0,93	Very High

Based on the results of the material validity test from three experts, the average validity score for the material of the digital book with environment-based AR features was 0.93. When converted into the criteria table, the score assessment indicates that the material of the digital book with environment-based AR features has very valid criteria. Media validity testing was conducted by 3 academics/lecturers who have expertise in the field of instructional technology and natural science. The results of the product validity test by media experts are presented in the following table.

Table 2. Results of the Learning Media Expert Assessment

	Score	Criteria
Mean	0,93	Very High

Based on the recapitulated results, the average validity score for the developed media was 0.93, falling within the very high criteria. This indicates that the digital book media with environment-based AR features has very valid criteria. Language validity testing was conducted by 3 academics/lecturers who have expertise in the field of instructional technology and natural science. The results of the expert assessment on the linguistic aspects of the developed product are presented in the following table.

Table 3. Results of the Language Expert Assessment

	Score	Criteria
Mean	0,92	Very High

Based on the results of the language assessment, the average language validity score for the developed digital book was 0.92, falling within the very high criteria. This indicates that the language of the digital book with environment-based AR features is very valid. In the small group testing, the environment-based AR digital book was trialed with 15 fifth-grade elementary school students with the aim of determining whether the environment-based AR digital book could be tested in the classroom. The assessment used the Benchmark Reference Assessment method by comparing the actual score to the ideal maximum score, which is the number of respondents multiplied by the number of items (26) and the highest score (7).

$$\text{Percentage} = \frac{(\text{Actual Score})}{(\text{Maximum Score})} \times 100$$

$$\text{Percentage} = \frac{2524 \times 100}{2.730}$$

$$\text{Percentage} = 92,45$$

The results of the Benchmark Reference Assessment method by the small group had a total average score of 92.45%, with a very practical category. The practicality test of the environment-based AR digital book was conducted through the analysis of response questionnaires from 5 elementary school teachers and 25 fifth-grade elementary school students using the User Experience Questionnaire (UEQ) method. To calculate the percentage of the practicality test using the Benchmark Reference Assessment approach, the following formula was used.

$$\text{Percentage} = \frac{(\text{Actual Score})}{(\text{Maximum Score})} \times 100$$

$$\text{Percentage} = \frac{866 \times 100}{910}$$

$$\text{Percentage} = 95,16$$



The results of the UEQ questionnaire by teachers had a total average score of 95.16% with a very practical category. The results of the UEQ questionnaire by students using the Benchmark Reference Assessment approach used the following formula.

$$\text{Percentage} = \frac{(\text{Actual Score})}{(\text{Maximum Score})} \times 100$$

$$\text{Percentage} = \frac{4210 \times 100}{4.550}$$

$$\text{Percentage} = 92,53$$

The results of the UEQ questionnaire by students had a total average score of 92.53% with a very practical category.

The research data is presented as learning interest questionnaire data for the control and experimental classes, as well as Science learning achievement test data for the control and experimental classes. The number of respondents in both the control and experimental classes was 27 each. The following is a summary of the interest questionnaire data and learning achievement test data for the control class and the experimental class.

Table 4. Summary of Interest Questionnaire and Learning Achievement Results

Respondent	X1		X2	
	Y1	Y2	Y1	Y2
1	68	60	89	84
2	82	64	82	88
3	79	72	75	80
4	83	68	70	88
5	75	64	81	80
6	70	68	72	80
7	80	76	88	80
8	83	72	97	92
9	82	68	72	72
10	70	72	92	84
11	83	80	89	88
12	70	76	82	84
13	79	80	84	88
14	87	76	90	84
15	91	68	87	92
16	69	80	91	88
17	83	72	75	80
18	87	64	72	88
19	69	76	85	84
20	81	72	84	80
21	70	72	80	80
22	86	68	84	84
23	78	76	98	92
24	74	68	86	76
25	87	76	86	84
26	77	76	91	84
27	92	72	72	76
Mean	79,07	71,70	83,48	83,70

Information:

X1 = Control Class



X2 = Experimental Class

Y1 = Learning Interest

Y2 = Learning Achievement

The first prerequisite test in a multivariate analysis of variance (MANOVA) test is the multivariate normality test. This test was conducted using SPSS Statistics 26. The normality test data are presented in the following table.

Table 5. Data of Multivariate Normality Test

Tests of Normality							
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Learning Interest	Media Learning						
	Konvensional book	0,157	27	0,087	0,938	27	0,107
	Digital Book with Environment-Based AR Features	0,119	27	0,200*	0,949	27	0,204
Learning Achievement	Konvensional book	0,161	27	0,070	0,939	27	0,114
	Digital Book with Environment-Based AR Features	0,153	27	0,106	0,940	27	0,121
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Based on Table 5, both in the Kolmogorov-Smirnov and Shapiro-Wilk columns, it shows that the data on the learning interest and learning achievement variables, whether using the digital book with environment-based AR features or conventional books, have a significance value > 0.05 , which means the data is normally distributed. The second prerequisite test in Multivariate Analysis of Variance (MANOVA) is the homogeneity test of the variance-covariance matrix.

Table 6. Box's M Test

Box's Test of Equality of Covariance Matrices ^a	
Box's M	5,017
F	1,603
df1	3
df2	486720,000
Sig.	0,186
Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.	
a. Design: Intercept + Media_Pembelajaran	

Based on the Table 6 shows that the results of the homogeneity test of the variance-covariance matrix have a Sig. value is $0.186 > 0.05$, thus the data indicates homogeneity.

The third prerequisite test in Multivariate Analysis of Variance (MANOVA) is the multicollinearity test between dependent variables.

Table 7. MANOVA Test

Correlations			
		Learning Interest	Learning Achievement
Learning Interest	Pearson Correlation	1	0,367**
	Sig. (2-tailed)		0,006
	N	54	54
Learning Achievement	Pearson Correlation	0,367**	1
	Sig. (2-tailed)	0,006	



	N	54	54
**. Correlation is significant at the 0.01 level (2-tailed).			

In the results table, we see that the correlation between learning interest and learning achievement is 0.367 based on the data above. The limit for correlation is 0.8. As long as the correlation is less than 0.8, there is no multicollinearity, so MANOVA can proceed. In order to test the effectiveness of the product in this study, it was analyzed simultaneously using the MANOVA test. The following are the results of the multivariate test.

Table 8. Multivariate Test

Multivariate Tests ^a							
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0,997	7387,626 _b	2,000	51,000	< 0,001	0,997
	Wilks' Lambda	0,003	7387,626 _b	2,000	51,000	< 0,001	0,997
	Hotelling's Trace	289,711	7387,626 _b	2,000	51,000	< 0,001	0,997
	Roy's Largest Root	289,711	7387,626 _b	2,000	51,000	< 0,001	0,997
Media Learning	Pillai's Trace	0,581	35,333 ^b	2,000	51,000	< 0,001	0,581
	Wilks' Lambda	0,419	35,333 ^b	2,000	51,000	< 0,001	0,581
	Hotelling's Trace	1,386	35,333 ^b	2,000	51,000	< 0,001	0,581
	Roy's Largest Root	1,386	35,333 ^b	2,000	51,000	< 0,001	0,581
a. Design: Intercept + Media Learning							
b. Exact statistic							

Based on the results of the MANOVA analysis with SPSS, it was found that the significance value for Wilk's Lambda was < 0.001. This indicates that the sig value is < 0.05, thus according to the decision-making criteria, H0 is rejected and H1 is accepted. Therefore, it can be concluded that there is a simultaneous influence from the implementation of the digital book with environment-based AR features in increasing the interest and learning achievement in Science and Social Studies for fifth-grade elementary school students. The next step is to calculate the effect size to measure the magnitude of the influence from the treatment (the digital book with environment-based AR features).

$$ES = \sqrt{F} \times \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \quad (\text{Modification from: Dantes, 2017})$$

$$ES = \sqrt{35,333} \times \sqrt{\frac{1}{27} + \frac{1}{27}}$$

$$ES = 5,94 \times \sqrt{\frac{2}{27}}$$

$$ES = 5,94 \times 0,272$$

$$ES = 1,62$$



Based on the results of the effect size calculation to measure the magnitude of the influence from the treatment (the digital book with environment-based AR features), a result of 1.62 was obtained. With an $ES > 0.8$, it can be concluded that the implementation of the digital book with environment-based AR features has high effectiveness.

The evaluation of the results of this development research indicates that the alternative hypothesis (H_1) is accepted, meaning there is a simultaneous influence from the implementation of the digital book with environment-based Augmented Reality (AR) features on increasing the interest and learning achievement in Science and Social Studies for fifth-grade elementary school students. Furthermore, the results of the effectiveness analysis show that the use of the digital book with environment-based AR features falls into the high effectiveness category. This indicates that this digital book is able to significantly improve the quality of learning. Therefore, the digital book with environment-based AR features is deemed effective and feasible for use as a science learning medium in elementary schools.

The significant MANOVA results indicate that the environment-based Augmented Reality (AR) digital book has a simultaneous effect on students' learning interest and Science learning achievement because AR enables learning materials to be presented through concrete, interactive, and visual experiences that are more appropriate for elementary school students (Abdullah et al., 2022; Ziden et al., 2022). Compared to conventional books, the use of 3D visualization helps students observe ecosystem components more clearly, so abstract concepts such as interactions between living things and their environment become easier to understand (Mahrawi et al., 2023; Wibowo, 2023). The integration of environmental contexts in the digital book also makes Science learning more meaningful because students are not only introduced to concepts theoretically, but are also connected to phenomena found in their surrounding environment (Afriyadi et al., 2023; Handini et al., 2023). This contextual and visual learning experience can increase students' attention, curiosity, and motivation because the learning process becomes more engaging than the use of printed textbooks alone (Wonda et al., 2022; Yasa et al., 2022). In addition, AR-based learning media can provide opportunities for students to explore objects independently, repeat observations, and interact with learning materials, which supports better conceptual understanding and knowledge retention (Abdullah et al., 2022; Ziden et al., 2022). Therefore, the increase in students' learning interest and achievement in this study can be theoretically explained by the ability of environment-based AR digital books to combine visualization, interactivity, contextual learning, and independent exploration in elementary Science learning (Mahrawi et al., 2023; Wahyuni et al., 2024).

Conclusion

This study successfully developed and evaluated an environmentally-based digital book design featuring Augmented Reality (AR) through the ADDIE framework. The empirical findings confirm that the developed media possesses high content validity and exceptional practicality for elementary science instruction. Rather than merely acting as an alternative reading text, the integration of eco-themed 3D visualizations effectively bridges the gap between abstract environmental concepts and students' cognitive comprehension, leading to a simultaneous increase in learning interest and academic achievement. Although technical challenges such as device hardware variance and ambient lighting conditions pose minor constraints during implementation, this interactive digital book provides a scalable model for immersive, tech-driven primary science education.



Recommendation

To school principals, it is recommended that they promote the use of the digital book with environment-based Augmented Reality features as a learning medium and can organize training for teachers to enhance their competence in utilizing technology, especially in developing and using digital books with Augmented Reality features. To teachers, it is recommended that they use the digital book with environment-based Augmented Reality features as an alternative medium to support the learning process in the classroom, so that the implementation of learning becomes more innovative and engaging, thereby being able to improve student learning achievement. To other researchers who wish to conduct similar research on different materials, it is recommended to focus more on the activities of the subjects to be studied and this can also be used as a comparison with the results of other studies.

References

- Abdullah, N., Baskaran, V. L., Mustafa, Z., Ali, S. R., & Zaini, S. H. (2022). Augmented Reality: The Effect in Students' Achievement, Satisfaction and Interest in Science Education. *International Journal of Learning, Teaching and Educational Research*, 21(5), 326–350.
- Adeoye, M. A., Wirawan, K. A. S. I., Pradnyani, M. S. S., & Septiarini, N. I. (2024). Revolutionizing education: Unleashing the power of the ADDIE model for effective teaching and learning. *JPI (Jurnal Pendidikan Indonesia)*, 13(1), 202-209.
- Adi, S., Nurharsono, T., Billiandri, B., & Soenyoto, T. (2023, November). Validity and reliability of instruments in physical education learning multimedia. In *Proceedings of International Conference on Physical Education, Health, and Sports* (Vol. 3, pp. 1-13).
- Afriyadi, H., Hayati, N., Laila, S. N., Prakasa, Y. F., Hasibuan, R. P. A., & Asyhar, A. D. A. (2023). *Media Pembelajaran Berbasis Digital (Teori & Praktik)*. Jambi: PT. Sonpedia Publishing Indonesia.
<https://doi.org/https://books.google.co.id/books?id=luKwEAAAQBAJ>
- Anderson, L. W. (2020). *Taxonomies of Educational Objectives as Bases for Curriculum Planning*. In: Oxford Research Encyclopedia of Education
- Andriani, T. (2020). Sistem Pembelajaran Berbasis Teknologi Informasi dan Komunikasi. *Sosial Budaya: Media Komunikasi Ilmu-Ilmu Sosial Dan Budaya*, 12(1), 1–17.
- Darma, I. K., Karma, I. G. M., & Santiana, I. M. A. (2021). Validity and practicality test of applied mathematics digital teaching materials for blended learning for polytechnic students. *Soshum: Jurnal Sosial Dan Humaniora*, 11(1), 44-53.
- Efendi, Y., Wira H, T., & Khoirunnisa, E. (2016). Penerapan Teknologi AR (Augmented Reality) pada Pembelajaran Energi Angin Kelas IV SD di Rumah Pintar Al-Barokah. *Studia Informatika: Jurnal Sistem Informasi*, 9(1), 29–47.
- Fajriati, R. (2023). Penggunaan Buku Aktivitas Anak Berbasis Augmented Reality (AR) pada Buku Digital Cerdas Indonesia 2. *Keagamaan: Jurnal Pengabdian Masyarakat*, 4(2), 60–63.
- Handini, O., Rizkasari, E., Suryanti, H. H. S., Prihastari, E. B., Handayani, D. S., Prakoso, M. R. N., Sufa, F. F., Daryono, & Sutikno, A. (2023). *Inovasi Dalam Pembelajaran Abad 21*. Surakarta: Unisri Press.
- Mahrawi, M., Marianingsih, P., Artdhita, A., Saputro, N. P., Pardede, P. I., Cahyani, A. R., & Chaerunisa, R. (2023). Pengembangan Bio-Meta: Buku Digital Terintegrasi dengan



- Augmented Reality dan Virtual Reality. *Jurnal Ilmiah Wahana Pendidikan*, Februari, 9(3), 317–329.
- Paing, I. W., Margunayasa, I. G., & Arnyana, I. B. P. (2024). Pengembangan Buku Cerita Digital Bermuatan Tri Hita Karana pada Subtema Globalisasi di Sekitarku. *PENDASI Jurnal Pendidikan Dasar Indonesia*, 8(1), 14–24.
- Qumillaila, Q., Susanti, B. H., & Zulfiani, Z. (2017). Pengembangan Augmented Reality Versi Android Sebagai Media Pembelajaran Sistem Ekskresi Manusia. *Cakrawala Pendidikan*, 1, 57–69.
- Raharjo, W. T., & Kristin, F. (2019). Peningkatan Hasil Belajar IPA Peserta Didik Menggunakan Model Pembelajaran Make A Match pada Kelas 4 SD. *Satya Widya*, 35(2), 168–175.
- Rosnaeni, R. (2021). Karakteristik dan Asesmen Pembelajaran Abad 21. *Jurnal Basicedu*, 5(5), 4341–4350.
- Ruddamayanti. (2019). Pemanfaatan Buku Digital dalam Meningkatkan Minat Baca. *Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang*, 2(1), 1193–1202.
- Saumarwah, N., Riyadi, A. R., & Kurniawan, H. (2025). Penerapan Metode Demonstrasi untuk Meningkatkan Hasil Belajar Peserta Didik Kelas 2 SD pada Pelajaran Matematika Materi Pengukuran. *Jurnal Ilmu Pendidikan (JIP)*, 3(4), 174–182.
- Wahyuni, M. L., Sohiburoyyan, R., & Yani, M. (2024). Aplikasi Buku Digital berbasis Augmented Reality Sebagai Sarana Pengenalan Warisan Budaya Tak-Benda Kabupaten Indramayu. *Jurnal Pengabdian Kepada Masyarakat Bidang Ilmu Komputer (ABDIKOM)*, 3(1), 15–21.
- Wastunimpuna, B. Y. A., & Purwanto, L. M. F. (2021). Augmented Reality dalam Proses Desain Arsitek Masa Depan. *JoDA Journal of Digital Architecture*, 1(1), 19.
- Wibowo, H. S. (2023). *Pengembangan Teknologi Media Pembelajaran: Merancang Pengalaman Pembelajaran yang Inovatif dan Efektif*. Jakarta: Tiram Media
- Wonda, H., Kota, M. K., & Arianti, C. D. (2022b). Pengembangan Buku Digital Sebagai Media untuk Meningkatkan Motivasi Belajar Siswa Kelas IV. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 11(6), 1751–1762.
- Yasa, A. D., Kumala, F. N., Pandak, A. S. bin, & Raharja, A. S. (2022). Pengembangan Buku Digital Berbasis Inkuiri pada Muatan IPA Materi Listrik di SDN Kota Malang. *Jurnal Jendela Pendidikan*, 2(04), 510–518.
- Zannah, S. R., & Zulfadewina, Z. (2022). Faktor Penyebab Menurunnya Hasil Belajar IPA Siswa Kelas IV pada Masa Pembelajaran Tatap Muka Terbatas. *Jurnal Educatio FKIP UNMA*, 8(3), 981–991.
- Ziden, A. A., Ziden, A. A. A., & Ifedayo, A. E. (2022). Effectiveness of Augmented Reality (AR) on Students' Achievement and Motivation in Learning Science. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(4).