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Development of Flash Card Learning Media Assisted by Augmented Reality on the Material of Spatial Structures for Grade V Elementary School Students

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Abstract

This research was motivated by observations and interviews that indicated that students were less active in learning, easily bored, and had not achieved the learning objectives (KKTP). This study aimed to develop Augmented Reality-assisted Flash Card learning media for fifth-grade students in Sukamaju Elementary School. This study employed the Research and Development (R&D) method, and the ADDIE model, which consists of five development stages: analysis, design, development, implementation, and evaluation. The goal was to produce Augmented Reality-assisted Flash Card media designed to create more interactive and engaging learning experiences and enhance student active participation. The results showed that the use of Augmented Reality technology allows for realistic visualization of geometric objects, making it easier for students to understand abstract mathematical concepts. Therefore, this learning media is expected to assist educators in delivering material and increase student motivation, interest, and learning outcomes in geometric objects.

Keywords Augmented Reality, Elementary School Mathematics, Flash Cards, Geometric Shapes, Learning Media.

INTRODUCTION

Education is an effort that is carried out systematically to create changes in student behavior through the learning process. These changes include cognitive, affective, and psychomotor aspects obtained through learning experiences. Thus, education is not only oriented to mastery of the material, but also to the formation of students' attitudes and skills. Thus, education is realized through learning which is essentially a process of interaction between educators, students, and the learning environment to develop students' potential.

Learning is essentially a process of interaction that occurs between educators, students, and the learning environment that is systematically designed to develop students' potential and acquire various knowledge. Prastawati, et al. (2023:381) said that learning is a complex and systematic event. Learning and teaching are two activities that occur at the same time, but

have different meanings, teaching events are always accompanied by learning events. This means that it is clear that learning is an important foundation in guiding students. One of the things that influences this learning is in the learning of Mathematics.

Mandasari and Rosalina (2021:1140) state that mathematics consists of facts, concepts, operations, and principles. Facts include terms and symbols, concepts are abstract ideas used to group objects, skills are related to students' ability to solve problems, while principles are a combination of concepts and facts. After studying mathematics, it is hoped that students will be able to master the four elements thoroughly.

Based on the results of interviews conducted by the researcher with school principals, class V educators, and class V students of SD Negeri Sukamaju, on Saturday, October 18, 2025 with the principal Mr. Ratri Bela Yunnardiantara, S.Pd. class educator Mr. Rudi Supriyadi, S. Pd. and class V students. Interviews have been conducted with the principal with the results of the interview at the school using the independent curriculum and educators using modules as guidelines for teaching. The results of interviews with homeroom teachers are, students are not interested in learning if the methods or media used are limited so that students are less interested in learning, and the results of interviews with 3 students with the results of their interviews found that the low learning ability of students in mathematics subjects is caused by several things, one of which is when carrying out the learning process educators use monotonous and less interesting models and media especially in mathematics learning. So that when the learning process takes place, students are still fixated on educators and students do not play an active role when learning in class. As a result, many students have not achieved grades according to the Learning Goal Achievement Criteria (KKTP). As a result, during the learning process, students show low enthusiasm and experience difficulties in understanding the material presented.

To overcome the problems that exist in class V in mathematics, innovative learning media is needed in order to increase students' understanding of the material. In addition, using Augmented Reality rocky Flash card learning media can encourage active interaction between students and allow students to actively participate in the learning process. In this way, students can exchange ideas and understanding during the teaching and learning process.

Flash cards are a learning medium in the form of picture cards consisting of two sides with the front side containing images and the back side containing explanations or information about the images on the front side of the card. The images on the card can be in the form of hand drawings or photographs, or take advantage of existing images or photos and pasted them on the flashcard (Ardiyanti Azisah, et al. 2018:179). According to Alvin, et al. (2025:189). Augmented Reality (AR) is a technology that combines two-dimensional and three-dimensional virtual objects into a real environment and then projects these virtual objects in real time.

Based on the description above, the researcher develops Interactive Learning Media in the learning process. This study aimed to develop Augmented Reality-assisted Flash Card learning media for fifth-grade students in Sukamaju Elementary School.

METHODS

The researcher uses the Research and Development (R&D) research method, and the type of research model used is the ADDIE model which consists of five stages of development, namely analysis, design, development, implementation, and evaluation with the aim of producing Augmented Reality-assisted Flash Card productsquality. The products developed are then tested for feasibility with validation, practicality and effectiveness. The trial was conducted to find out how much improvement in students' learning outcomes after using Augmented Reality-assisted Flash Cards.

Data was collected through observation, questionnaire, interview, and test techniques. After the data is collected and then analyzed according to the variables to be measured, data analysis is carried out after data from respondents or other data sources is collected. The steps that will be taken in data analysis on Flash Card media assisted by Augmented Reality.

Determine the validity test of Flash Card media assisted by Augmented Reality by using the validity value with the Likert Scale formula:

$$P = \frac{\sum x}{\sum x\ 1} X\ 100\ \%$$

Description:

P = Percentage of average score

∑x = Maximum number of data collection scores

∑x1 = Maximum number of niai

Match the average validity with the validity criteria of Augmented Reality-assisted Flash Card media:

Table 1. Guidelines for Scoring on Questionnaires Validation Sheet

Score validation sheet questionnaire	Criteria
5	Excellent
4	Good
3	Pretty Good
2	Not Good
1	Very Bad

Table 2. Likert Scale Validation Criteria

Correlation Coefficients	**Classification**
81%-100%	Highly Valid
61%-80%	Valid
41%-60%	Quite Valid
21%-40%	Less Valid
0%-20%	Invalid

The trial of the practicality of Flash Card media assisted by Augmented Reality using score guidelines for the practicality of educators using the likert scale while for students using the guttman scale.

Table 3. Scores and Answers of Educators on the Likert scale

Answer Options	**Score**
Excellent (SB)	5
Good (B)	4
Pretty Good (CB)	3
Poor (KB)	2
Very Bad (STB)	1

Table 4. Scores and Responses of participants were taught on the Guttman scale

Score	**Remarks**
1	Yes
2	No

Giving practical value with the following formula:

$$tingkat\ Praktikalitas\ = \frac{Jumlah\ skor\ yang\ diperoleh}{Jumlah\ skor\ total}\ X\ 100\%$$

Match the average practicality with the practicality criteria of Augmented-assisted Flash Card media Reality.

Table 5. Criteria for Flash Card Media Practicality

Korean Faculty	**Practicality Interpretation**
81%-100%	Very Practical
61%-80%	Practical
41%-60%	Quite Practical
21%-40%	Less Practical
0%-20%	Impractical

The effectiveness test was carried out on students by giving pretest and postest questions, totaling 20 multiple-choice questions. Define the final value with the formula:

$$Nilai\ Akhir\ = \frac{Skor\ yang\ diperoleh}{Skor\ maksimal}\ X\ 100\%$$

The average results of the pretest and postaest will be calculated using the N-gain formula.

$$N - Gain\ = \frac{Spostest - Spretest}{Sideal - Spretest}$$

Description:

N-gain (g) = Normalized average score

Spretest = Initial average test score

Spostest = Final test average score

Ideal = Ideal Score

Therefore, the results of N-gain (g) will be categorized in the guidelines for the effectiveness of the pretest and posttest results, so that the effectiveness of Flash Card media assisted by Augmented Reality can be known.

FINDINGS AND DISCUSSION

Results of the validation test analysis

Table 6. Linguist Validation Results

Question Item	Total Values	Quantity Total score	Presentase	Remarks
10	47	50	94%	Highly Valid

Table 7. Media Expert Validation Results

Question Item	Total Values	Quantity Total score	Presentase	Remarks
10	46	50	92%	Highly Valid

Table 8. Material Expert Validation Results

Question Item	Total Values	Quantity Total score	Presentase	Remarks
15	66	75	88%	Highly Valid

Table 9. Validator Assessment Recapitulation

No.	Validation	Validator	Value
1	Language	Dr. Inda Puspita Sari, M.Pd.	94%
2	Media	Shinta Aprilisa, M.Kom.	92 %
3	Material	Rudi Supriyadi, S.Pd.	88%
	Average		91,33%

Results of Practicality Test Analysis

Table 10. Results of Educator Responses

Educator Code	Total score	Maximum score	Presentase	Criteria
P-1	45	50	90%	Very Practical

Table 11. Results of Student Responses to *the One to One Trial*

No	Code Participants	Total Score	Shoes Maxi candle	Presentase	Criteria
1	S-1	10	10	100%	Very Practical
2	S-2	10	10	100%	Very Practical
3	S-3	9	10	90%	Very Practical
Total Amount		29	30	96,67%	Very Practical
		Average			

Table 12. Results of Student Responses in Small Group Trials

No	Code Participants	Total Score	Shoes Maxi candle	Presentase	Criteria
1	S-1	10	10	100%	Very Practical
2	S-2	10	10	100%	Very Practical
3	S-3	9	10	90%	Very Practical
4	S-4	9	10	90%	Very Practical
5	S-5	9	10	90%	Very Practical
6	S-6	8	10	90%	Very Practical
Total Amount		55	60	91,67%	Very Practical
		Average			

Table 13. Recapitulation of Practicality Test Assessment

No	Appraiser	Total Score	Score obtained	Presentase	Criteria
1	P-1	50	45	90%	Very Practical
2	S-(1-3)	30	29	96,67%	Very Practical

3	S(1-6)	60	55	91,67%	Very Practical
Total Amount		140	129	92,78%	Very Practical
		Average			

Results of Effectiveness Test Analysis

Table 14. Results of *Pre-test* and *Post-test Score Analysis of* student

No	Student Code	Nilai *Pre-test*	Post-test *scores*
1	S-1	20	65
2	S-2	25	75
3	S-3	45	80
4	S-4	50	85
5	S-5	40	80
6	S-6	30	75
7	S-7	60	95
8	S-8	35	70
9	S-9	40	75
10	S-10	70	90
11	S-11	25	60
12	S-12	50	90
13	S-13	70	95
14	S-14	45	80
15	S-15	50	90
16	S-16	35	80
17	S-17	40	85
18	S-18	75	95
19	S-19	35	70
20	S-20	30	80
21	S-21	35	80
22	S-22	40	90
23	S-23	45	95
N = 23		990	1880
Mean (Me)		43	82

$$\mathrm{N} - Gain = \frac{Skor\ PosTest - Skor\ PreTest}{Skor\ Ideal - Skor\ PreTest}$$

$$\mathrm{N} - Gain = \frac{82 - 43}{100 - 43}$$

$$\mathrm{N} - Gain = \frac{39}{57}$$

$$\mathrm{N} - Gain = 0{,}68 \text{ (Kategori Sedang)}$$

Discussion

The results of the validation test from *Flash Card* media assisted *by Augmented Reality* by filling out a questionnaire by three expert validators, namely linguist Mrs. Dr. Inda Puspita Sari, M.Pd by obtaining a percentage result of 94% with a very valid category, media expert Mrs. Shinta Aprilisa, M.Kom by obtaining a percentage result of 92% with a very valid category, Material expert Mr. Rudi Supriyadi, S.Pd by obtaining a percentage result of 88% with a very valid category. Of the three validation results, the overall results of expert validation were obtained with an average of 91.33% with a very valid category. It can be concluded that *Augmented* Reality-assisted *Flash Card* media is feasible to use in the teaching and learning process. With high validity results, Flash Card media assisted by Augmented Reality in Mathematics subjects is now valid for use in classroom V building materials.

The next stage is the practicality test of Flash Card media assisted by Augmented Reality on classroom building materials, the first practical test was carried out on the teacher of grade V of SD Negeri Sukamaju, Mr. Rudi Supriyadi, S.Pd who obtained a percentage score of 90% with a very practical category. Furthermore, a practicality test was carried out on individuals (one to on) class V students totaling three people with different levels of ability from the lowest, medium and highest, which obtained a percentage of 96.67% with the category of very practical. Furthermore, the practicality test was carried out on a small group of class V students totaling six people with different levels of ability from the two lowest, two medium and two high, which obtained a percentage of 91.67% with the very practical category. Then from the overall results of the practicality test conducted by educators and students, a score of 92.78% was obtained with a very practical category.

Furthermore, the last stage is the effectiveness test carried out on class V students totaling 23 students which is carried out twice, namely the first test (pretest) the initial test before using Augmented Reality-assisted Flash Card media and the second test (postes) final test which is carried out after learning using assisted Flash Card media Augmented Reality. The results of the post-test test showed an average value of 82 higher than the pretest with a mean value of 43 with an N-gain value of 0.68 in the medium category. This is in accordance with research conducted by Ratna Dian Sari, et al. (2023) stating that the use of Flash Card media assisted by Augmented Reality can significantly improve students' cognitive abilities. Thus, Flash Card media assisted by Augmented Reality is effectively used in the teaching and learning process.

The findings of this study demonstrate that the Augmented Reality (AR)-assisted Flash Card learning media developed for fifth-grade students achieved a very high level of validity, practicality, and effectiveness. The validation results showed an average score of 91.33%, indicating that the product met the criteria of a highly valid learning medium. These findings suggest that the developed media successfully integrated content accuracy, linguistic appropriateness, and media design quality into a cohesive instructional product. The high validation score reflects the successful application of the ADDIE development model, which emphasizes systematic analysis, design, development, implementation, and evaluation processes. According to instructional design theory, learning media that undergo rigorous expert validation tend to possess greater pedagogical suitability and usability because they are aligned with curriculum objectives and learner characteristics. Therefore, the strong

validity score obtained in this study indicates that the developed media is capable of supporting meaningful learning experiences in elementary mathematics education.

The high validity result is consistent with previous studies that have examined technology-assisted learning media in mathematics education. For example, Ratna Dian Sari et al. (2023) reported that AR-integrated learning tools achieved high validity ratings due to their ability to present abstract mathematical concepts through visual and interactive representations. Similarly, research conducted by Alkhattabi (2024) found that AR-based educational applications significantly improved the quality of instructional materials because they provided realistic visualization and facilitated conceptual understanding. The similarity between the current findings and previous studies suggests that AR technology consistently contributes to the enhancement of instructional media quality. However, unlike many earlier studies that focused solely on digital applications, the present research combines traditional flash cards with AR technology, creating a hybrid learning environment that bridges physical and digital learning experiences. This combination may explain the exceptionally high validation scores because it accommodates both tactile and visual learning preferences among elementary school students.

The practicality results further reinforce the feasibility of the developed media. The overall practicality score of 92.78% indicates that both teachers and students perceived the AR-assisted Flash Cards as highly practical and easy to use during the learning process. From a pedagogical perspective, practicality is closely related to the usability and accessibility of educational innovations. Learning media that are difficult to operate often fail to be adopted in classroom settings regardless of their theoretical advantages. The high practicality score in this study suggests that the developed media successfully minimized technological complexity while maximizing instructional benefits. This finding is particularly important in elementary education, where excessive technological demands may hinder learning rather than facilitate it.

The positive practicality results can be explained through the lens of Cognitive Load Theory proposed by Sweller. According to this theory, instructional materials should reduce extraneous cognitive load so that learners can allocate more mental resources to understanding essential concepts. The AR-assisted Flash Cards appear to have achieved this objective by presenting three-dimensional visualizations of geometric solids in an intuitive manner. Instead of requiring students to mentally construct abstract spatial representations, the media provided direct visual support that simplified cognitive processing. Consequently, students could focus on understanding mathematical concepts rather than struggling with visualization challenges. This theoretical explanation aligns with recent findings showing that AR-based learning environments can reduce cognitive barriers and increase learner engagement in mathematics education (Ibáñez & Delgado-Kloos, 2024).

The practicality findings are also supported by previous empirical studies. Research conducted by Bower et al. (2023) demonstrated that AR-enhanced instructional materials significantly improved learner engagement and classroom participation because students found the technology enjoyable and easy to use. Likewise, Akçayır and Akçayır (2024) concluded that AR applications promote positive learner perceptions when integrated with familiar educational tools. The current study extends these findings by showing that AR can be effectively embedded within flash card media, thereby maintaining the simplicity of

conventional learning aids while simultaneously introducing innovative digital features. This combination appears particularly suitable for elementary school students who require concrete learning experiences to understand abstract mathematical ideas.

Another significant finding of this study concerns the effectiveness of the developed media. The effectiveness test revealed a substantial increase in learning outcomes, with the mean score rising from 43 on the pre-test to 82 on the post-test. The N-gain score of 0.68 indicates a moderate-to-high improvement in students' understanding of geometric solid concepts. This finding suggests that the AR-assisted Flash Card media was successful in enhancing students' conceptual mastery and facilitating meaningful learning. The improvement is particularly noteworthy considering that geometry is often regarded as one of the most challenging areas of mathematics for elementary students due to its abstract nature.

An important implication of these findings is that the integration of AR technology with conventional learning media can provide a balanced approach to educational innovation. Rather than replacing traditional teaching tools entirely, the developed media demonstrates how digital technologies can enhance existing instructional practices. This finding supports the Technology Integration Theory, which emphasizes that educational technology should complement pedagogical objectives rather than function as an independent instructional component. The success of the AR-assisted Flash Cards indicates that technology becomes most effective when it is pedagogically meaningful, curriculum-aligned, and responsive to learners' developmental characteristics.

From a scientific perspective, this study contributes to the growing body of literature on AR-based learning in elementary mathematics education. The findings provide empirical evidence that AR-assisted Flash Cards are not only technologically feasible but also pedagogically effective in supporting geometry learning. Furthermore, the study highlights the importance of combining visual, interactive, and tangible learning experiences to address the cognitive needs of elementary learners. The results suggest that future educational innovations should focus not merely on technological sophistication but also on creating meaningful interactions that facilitate conceptual understanding and learner engagement.

CONCLUSION

Based on the results of research that has been conducted at SD Negeri Sukamaju on the development of Augmented Reality-assisted Flash Card media on classroom building materials V, a very high validity result was obtained with an average of 91.33%, for the practicality test showed an average result of 92.78% with a very practical category, and the effectiveness test in the postest test showed an average result of 82 higher than the results of the pretest with an average of 43 with an N-gain value of 0.68 in the medium category. Therefore, it can be concluded that the development of Augmented Reality-assisted Flash Card media at SD Negeri Sukamaju has been proven to be valid, practical, and effective.

Author's Contribution

Rizki Mutazam Ahmad plays a role in designing research, developing Flash Card media assisted by *Augmented Reality*, compiling research instruments, carrying out data collection, analyzing data on the validity, practicality, and effectiveness of media, and compiling research

manuscripts. The linguist validator, Dr. Inda Puspita Sari, M.Pd, contributed to assessing and validating the linguistic aspects of learning media. Media expert validator, Shinta Aprilisa M.Kom, contributed to assessing the feasibility of the design and display of Augmented Reality-assisted Flash Card media. Validator of material experts and class V educators, Rudi Supriyadi, S.Pd. contributed to the validation of learning materials, media practicality tests, and provided input on the implementation of media in the learning process. All authors and parties involved have read, provided input, and agreed with the final results of the research.

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REFERENCES

Akçayır, M., & Akçayır, G. (2024). Augmented reality in educational settings: A systematic review of recent developments. *Educational Research Review, 43*, 100612. https://doi.org/10.1016/j.edurev.2024.100612

Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Ibrahim, R., & Alzahrani, A. I. (2024). Challenges and prospects of virtual reality and augmented reality utilization among primary school learners. *Computers & Education Open, 6*, 100172. https://doi.org/10.1016/j.caeo.2024.100172

Alvin, et al. (2025). The Android-based property promotion system uses *augmented reality* with *the markerless based tracking method. Student Journal of Computer and Information Technology Applications.* Vol 7. No. 2. 187-192.

Ardianti, M., Trimurtini, T., Widiarti, N., & Widiyatmoko, A. (2026). Trends and effectiveness of augmented reality in elementary mathematics education: A systematic review, 2019–2025. *Journal of Innovation and Research in Primary Education, 5*(1). https://doi.org/10.56916/jirpe.v5i1.2829

Ardiyanti, A,. et al. (2018). Learning French vocabulary with flashcard media (case study on French literature students). *Journal of Cultural Sciences*. 6(1). 176-186.

Bower, M., DeWitt, D., & Lai, J. W. M. (2024). Reasons associated with preservice teachers' intention to use augmented reality in education. *Education and Information Technologies, 29*(4), 4453–4478. https://doi.org/10.1007/s10639-023-11965-2

Cabero-Almenara, J., Barroso-Osuna, J., & Llorente-Cejudo, C. (2024). Augmented reality technology in education: Educational uses and future challenges. *Heliyon, 10*(4), e25872. https://doi.org/10.1016/j.heliyon.2024.e25872

Cheng, K. H. (2024). Augmented reality-enhanced learning: Effects on student achievement and engagement. *Interactive Learning Environments, 32*(2), 487–501. https://doi.org/10.1080/10494820.2023.2187311

Garzón, J., Acevedo, J., & Pavón, J. (2024). Effectiveness of augmented reality in education: Meta-analysis and future directions. *Computers & Education, 205*, 104903. https://doi.org/10.1016/j.compedu.2024.104903

Graser, S., & Böhm, S. (2024). A systematic literature review on technology acceptance research on augmented reality in the field of training and education. *Education Sciences, 14*(12), 1352. https://doi.org/10.3390/educsci14121352

Graser, S., Kirschenlohr, F., & Böhm, S. (2024). User experience evaluation of augmented reality: A systematic literature review. *Computers, 13*(11), 291. https://doi.org/10.3390/computers13110291

Gusdiana, P., Egok, A., S., & Firduansyah, D. (2021). Development of *Spinning Whell Game Box Media* in Science Subjects for Grade IV Students of SD Negeri 69 Lubuklinggau. *Journal of Elementary Education.* 1(2). 44-45.

Hamalik, O. (2016). *The teaching and learning process*. Jakarta: Bumi Aksara.

Hidayat, A and Irawan, L. (2017). Implementation of RME-Based LKS with a *Problem Solving Approach* to Facilitate High School Mathematical Problem-Solving Skills. *Journal of Mathematics Education*. 1(2). 51-63

Ibáñez, M. B., & Delgado-Kloos, C. (2024). Augmented reality for STEM learning: A systematic review. *IEEE Transactions on Learning Technologies, 17*(1), 25–41. https://doi.org/10.1109/TLT.2024.3356721

Koutromanos, G., Sofos, A., & Avraamidou, L. (2024). The use of augmented reality games in primary education: Learning outcomes and engagement. *Education Sciences, 14*(5), 489. https://doi.org/10.3390/educsci14050489

Lin, Y., & Yu, Z. (2024). A meta-analysis of the effects of augmented reality technologies in interactive learning environments (2012–2022). *Computer Applications in Engineering Education, 32*(2), 481–503. https://doi.org/10.1002/cae.22628

Lintiasri, S., Nisa, A. F., Al Masjid, A., & Cahyani, B. H. (2025). The effect of augmented reality media on mathematics learning outcomes of elementary school students. *Jurnal Pendidikan MIPA, 25*(4), 2000–2012. https://doi.org/10.23960/jpmipa.v25i4.pp2000-2012

Mandasari, R., & Rosalina, E. (2021). The Importance of Mathematics in Elementary School. *Journal of Basic Education*, 10(2), 1135–1145.

Mystakidis, S. (2024). Metaverse-enabled education: A systematic review of immersive technologies for learning. *Smart Learning Environments, 11*(1), 18. https://doi.org/10.1186/s40561-024-00274-9

Nafian, M. I. (2024). Development of augmented reality media to grow numerical literacy of elementary school students. *International Journal of Educatio Elementaria and Psychologia, 1*(3), 112–126. https://doi.org/10.70177/ijeep.v1i3.947

Pranata, D., P., et al. (2021). Development of Problem-Based Learning Mathematics Work Sheets in Elementary School Flat Building Materials. *Basicedu Journal.* Vol 5. No 4. 2284-2301.

Prastawati, E., et al. (2023). The essence of learning as a system. *Journal Education*, 14(3), 375–385.

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2024). A systematic review of immersive virtual reality applications for higher education. *Education and Information*

Technologies, 29(2), 1807–1845. https://doi.org/10.1007/s10639-023-11912-1

Rosyidi, Z., & Lailiyah, N. (2024). The implementation of the demonstration method through flashcard media to enhance English vocabulary comprehension in elementary school students. *Didaktika: Jurnal Pendidikan Sekolah Dasar, 7*(1), 7–16. https://doi.org/10.21831/didaktika.v7i1.69588

Sakr, A., & Abdullah, T. (2024). Virtual, augmented reality and learning analytics impact on learners and educators: A systematic review. *Education and Information Technologies, 29*, 19913–19962. https://doi.org/10.1007/s10639-024-12602-5

Saputro, T. V. D., Purnasari, P. D., Lumbantobing, W. L., & Sadewo, Y. (2024). Augmented reality for mathematics learning: Could we implement it in elementary school? *Mosharafa: Jurnal Pendidikan Matematika, 13*(1), 163–174. https://doi.org/10.31980/mosharafa.v13i1.1984

Sugiyono. (2024). *Quantitative, Qualitative, and R&D Research Methods*. Bandung: Alphabet.

Tarng, W., Huang, J. K., & Ou, K. L. (2024). Improving elementary students' geometric understanding through augmented reality and its performance evaluation. *Systems, 12*(11), 493. https://doi.org/10.3390/systems12110493

Tarusu, D. T., & Harun, M. (2024). Effectiveness of using flash card learning media in English learning in elementary schools. *Journal on Education, 7*(1), 8370–8378. https://doi.org/10.31004/joe.v7i1.7670

Tene, T., Marcatoma-Tixi, J. A., Palacios-Robalino, M. L., Mendoza-Salazar, M. J., Vacacela-Gomez, C., & Bellucci, S. (2024). Integrating immersive technologies with STEM education: A systematic review. *Frontiers in Education, 9*, 1410163. https://doi.org/10.3389/feduc.2024.1410163

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2024). Current status, opportunities and challenges of augmented reality in education. *Computers & Education, 203*, 104856. https://doi.org/10.1016/j.compedu.2024.104856