

Integration of 3D objects in an augmented reality flashcard game as an innovation in cognitive learning media at Salafiyah Comal Kindergarten

Khusnul Alfiana Azizah¹*, Dicky Anggriawan Nugroho¹, Mohammad Irsyad¹, Lulu Nisaul Wakhidah²

¹ Universitas Islam Negeri K.H. Abdurrahman Wahid Pekalongan, Indonesia.

² Sakarya University, Turkey.

* Corresponding Author. E-mail: khusnulalfiana67@gmail.com

ARTICLE INFO

Article History

Received:

23 January 2026;

Revised:

21 March 2026;

Accepted:

21 March 2026;

Available online:

31 March 2026.

Keywords

Augmented reality;

Cognitive abilities;

Flashcard

ABSTRACT

Learning at Salafiyah Comal Kindergarten is still dominated by conventional media, which provide limited visual stimulation and direct interaction, resulting in suboptimal child engagement. Although augmented reality has the potential to enhance interactivity, the development of AR flashcard media integrated with 3D objects and interactive quizzes for early childhood remains limited. Therefore, this study aims to develop an AR-based flashcard game media with a “transportation” theme and to test its feasibility among children aged 4–5 years. The method used is Research and Development (R&D) following the ADDIE model, involving 16 children. The media was developed using Assembler Edu with the integration of flashcards, 3D objects, and interactive quizzes. Validation results showed the media had an 80% feasibility rating in the “Good” category, and the content received a 95.5% rating in the “Very Good” category. Additionally, the media implementation received a 92.75% response rate in the “Very Good” category. These three assessments indicate that the media possesses a sufficiently high level of feasibility and is suitable for practical use as an interactive learning tool to support children’s engagement in the learning process. The application of AR showed that children were more active, interested, and engaged in the learning process. Therefore, the developed media is suitable for use as an interactive learning medium to support engagement and cognitive stimulation. Further research is recommended to test the media’s effectiveness in enhancing cognitive development using a broader experimental design and a larger sample size.



This is an open access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



How to cite:

Azizah, K. A., et al., (2026). Integration of 3D objects in an augmented reality flashcard game as an innovation in cognitive learning media at Salafiyah Comal Kindergarten. *Jurnal Inovasi Teknologi Pendidikan*, 13(1), 105-116. <https://doi.org/10.21831/jitp.v13i1.93231>

INTRODUCTION

The rapid advancement of technology in today’s digital age has had a significant impact across various fields, including education. Technological developments have driven innovation in the learning process, aiming to improve the quality and effectiveness of learning. One way technology is utilised in education is through digital media, which can create a more engaging, interactive, and enjoyable learning environment for students. One such technology, currently widely adopted in education, is augmented reality. According to [Elvina et al., \(2024\)](#), AR is a technology that combines

elements of the real world with the digital world, thereby enabling the display of objects more realistically. Objects displayed in AR can range from text and animations to 3D models (Amalia et al., 2024). Three-dimensional (3D) representations of objects with length, width, and height convey a sense of real-world space and depth, allowing users to view them from various angles (Wahyudi et al., 2025). With 3D visualisation in AR, this technology can provide a more interactive learning experience and encourage children's active engagement in the learning process, thereby conveying the material more easily.

As educational technology advances, AR is no longer merely a visualisation tool; it has evolved into an interactive learning medium that integrates animations, 3D objects, and assessment tools such as digital quizzes. The existence of such learning media indicates that AR is increasingly used in early childhood education to optimise children's developmental skills, enhance engagement, and support exploration-based learning experiences (Aydoğdu, 2021). Previous research also shows that the use of AR in early childhood education can improve learning engagement and memory retention. Furthermore, the use of game-based AR can boost children's learning motivation (Muti et al., 2024). This indicates that AR is a key innovation in technology-based learning.

In early childhood education, the use of learning materials plays a significant role in supporting children's optimal development. One of the most commonly used tools is the flashcard. A flashcard is a small card containing text, images, symbols, and captions (Hayati, 2022). This tool offers advantages such as ease of use, practicality, and the ability to enhance children's memory (Yusuf et al., 2021). However, conventional flashcards are generally static and do not provide an interactive learning experience. Therefore, the development of augmented reality-based flashcards is an innovation that can provide a more engaging learning experience by displaying three-dimensional objects and enabling direct interaction through digital devices.

In recent developments, AR-based flashcard media has also begun to be developed using a game-based learning approach (Yu et al., 2022), allowing children to interact through quizzes and receive immediate, active feedback. This indicates that the integration of AR and flashcards is increasingly geared toward more participatory learning, focusing not only on concept recognition but also on children's active engagement in the learning process. Such active engagement is crucial, as it is closely linked to children's cognitive development, specifically their ability to think, understand, and solve problems (Ramlah et al., 2022), and it also impacts their lives both now and in the future (Dewi et al., 2023). Therefore, it is necessary to provide appropriate stimulation through meaningful learning tailored to young children's characteristics.

Early childhood, defined as the age range of 0–6 years (Putri & Lili, 2021), is known as the “golden age”, a period marked by rapid development across various aspects (Uswatun & Nur, 2022). During this period, children learn through direct experience, observation, and imitation (Nurfadilah & Miftakhul, 2021), thus requiring learning media that provide concrete, interactive experiences. Theoretically, this can be explained through constructivism, which states that knowledge is actively constructed through experience. Additionally, the “learning by doing” theory emphasises that learning is more effective and the experience is more active and meaningful when children are directly involved in the learning process (Astrachon et al., 2025). In this context, AR becomes relevant because it can provide visual-based learning experiences and direct interaction. According to multimedia learning theory, the combination of text, visuals, and interaction in AR can enhance information processing by providing stimuli through multiple cognitive channels simultaneously. This is further supported by Piaget's cognitive development theory, which explains that young children are in the preoperational stage, a stage requiring concrete media to understand concepts that are still abstract (Anggrian & Saefurahma, 2025). Therefore, integrating AR into flashcards is a solution because it can visualise concepts in a tangible, interactive way.

Based on observations and interviews at Salafiyah Kindergarten, the learning process remains dominated by conventional methods, such as lectures, reading activities, and the use of pictures as learning media. This situation results in children lacking direct and contextual learning experiences (Cahyaningtyas, 2020). Additionally, the use of technology-based learning media remains limited, resulting in suboptimal learning processes and low student engagement (Atikah et al., 2023). Based on previous research, AR has been proven to enhance children's engagement and understanding. However, most studies have focused on visualising 3D objects without integrating evaluative

activities such as interactive quizzes. Furthermore, existing AR-based flashcards still primarily serve as tools for concept introduction and have not yet been fully developed into comprehensive interactive learning media. Research conducted by [Ramlah et al., \(2023\)](#) indicates that young children still face challenges in recognizing letter and number symbols. [Salam & Ramadhan \(2025\)](#) indicate that AR media is more effective than conventional visual media because it presents objects realistically. [Elvina et al., \(2024\)](#) also state that AR-based flashcards are more engaging due to their interactive nature. Based on this synthesis, there remains a gap between the learning needs of young children, which are interactive, concrete, and participatory and the currently available media, which are still limited to visualisation. Therefore, there is a need to develop learning media that integrates 3D objects, active interaction, and learning assessment into a single, comprehensive system.

This study aims to develop an augmented reality-based flashcard game that can interactively display 3D objects and includes a quiz feature for learning assessment. The primary focus of this study is to create interactive, engaging learning media tailored to young children's characteristics to support the development of their cognitive abilities. The contributions of this study encompass both theoretical and practical aspects. Theoretically, this study is expected to expand the body of research on the development of AR-based learning media that integrates visualisation, interactivity, and evaluation into a single medium. Practically, this study is expected to serve as an innovative and meaningful alternative learning medium, capable of optimally enhancing children's engagement and cognitive development.

METHOD

This study employs the Research and Development (R&D) method to develop a new product and validate its effectiveness in the product development process. The development model used in this study is ADDIE; the development process is carried out through several stages: Analysis, Design, Development, Implementation, and Evaluation ([Karmila, 2024](#)). This study uses an R&D design with a descriptive-evaluative approach, namely, product development focused on the validation and feasibility testing of the media, and implementation testing conducted as a one-shot to identify user responses to the developed media ([Adzani & Pramuditya, 2025](#)).

This study involved kindergarten B teachers and students as research subjects, specifically 4 (four) teachers and 16 kindergarten B students at Salafiyah Sidorejo Comal. The subject selection technique used total sampling, in which the entire population served as the research subjects, as the sample size was relatively small and all were involved in the media implementation process ([Hakiki et al., 2022](#)). This study collected qualitative and quantitative data from 16 children in Group B at Salafiyah Sidorejo Comal Kindergarten. The stages of the ADDIE model used in this study are as follows:

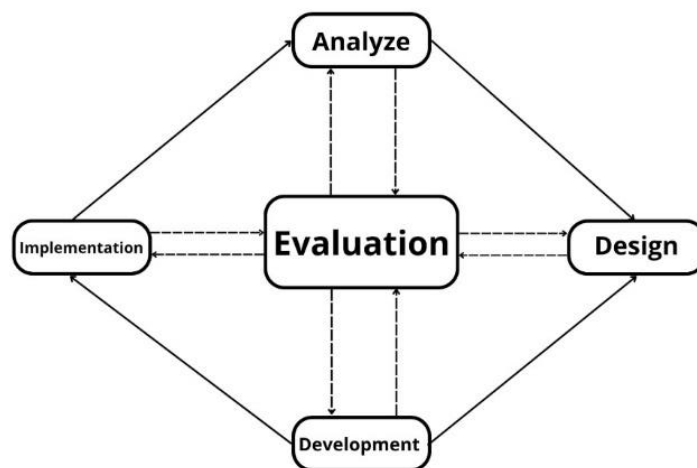


Figure 1. The ADDIE Model

Analysis

The Analysis phase aims to identify the needs and challenges faced by teachers and students at Salafiyah Sidorejo Comal Kindergarten so that the educational media developed can create a more engaging learning experience and support the improvement of young children's cognitive abilities. (Permana et al., 2023). This stage involves observing the learning process, conducting interviews with classroom teachers, and collecting data from the outset (Khoirunnisa et al., 2024) to obtain a comprehensive picture of the challenges faced. The results of this analysis are then used as a foundation for designing teaching materials that align with the needs of young children.

Design

In the Design phase, the researcher developed instructional materials and learning pathways by establishing learning objectives, designing scenarios, conceptualising the product, determining the Augmented Reality (AR) design, and planning the evaluation of the instructional media (Rachma et al., 2023). In this stage, the design of flashcard-based learning media was also carried out using an AR application supported by Sketchfab 3D and Canva for visual processing and customisation. This stage included creating flashcard designs, selecting 3D images as needed, and editing them in Assembler Edu to display the objects in 3D.

In addition, during the research design phase, a questionnaire was developed to facilitate the creation of AR-based flashcard learning materials. This questionnaire served as a tool for collecting data throughout the field research. The questionnaire instruments included evaluation forms for media and subject matter experts, as well as a survey to gather teacher feedback. The feedback provided by these experts was used to ensure that the developed teaching media aligned with the intended instructional objectives.

Instrument validation was conducted to ensure that the questionnaire could measure aspects relevant to the research objectives. Media experts and subject matter experts conducted the validity test. The experts evaluated each statement against the indicators. The results of this evaluation were used as the basis for revising the instrument until it was deemed suitable for use in the research.

Development

In this stage, the researcher develops a prototype or educational media aligned with the initial plan established during the design phase (Wibowo et al., 2022). The development stage is where the researcher creates AR-based flashcards using the Assembler Edu app and other supporting tools, such as Sketchfab 3D and Canva, then prints them for easy implementation. The initial product developed first undergoes validation by experts, such as media specialists and subject matter experts. Next, the feedback from these experts is used to revise the media before it is tested with students. Subsequently, the researcher collects data through a questionnaire to observe the children's responses to the implemented media and the classroom teachers at Salafiyah Sidorejo Comal Kindergarten.

The questionnaire data will be analysed using a Likert scale, as shown in Table 1, with the following categories: invalid, less valid, somewhat valid, valid, and very valid:

Table 1. Likert Scale

No.	Category	Range
1	Invalid	1
2	Less Valid	2
3	Fairly Valid	3
4	Valid	4
5	Very Valid	5

The researchers then conducted a validation test using a questionnaire based on expert validation by media and material experts, as well as post-implementation validation by classroom teachers. Once the scores were obtained, they were calculated using quantitative data to determine a rating scale expressed as a percentage. The calculation used the following Formula 1 (Setiawan & Rahman, 2025).

$$P = \frac{\sum R}{N} \times 100\% \tag{1}$$

Information:

P = Percentage of the score being calculated

$\sum R$ = Total answers provided by the validator

N = Maximum total score obtained

Once the percentage of the score is obtained, it can be converted to enable the researcher to determine whether the learning media is valid. The categories of invalid, less valid, moderately valid, valid, and highly valid can be seen in [Table 2](#) under the score percentage category.

Table 2. Score Categories and Percentage

No.	Category	Score Range
1	Excellent	81% - 100%
2	Good	61% - 80%
3	Fair	41% - 60%
4	Poor	21% - 40%
4	Veri Low	0% - 20%

(Nurhidayah et al., 2024)

Implementation

The next developed product entered the implementation phase. In this phase, the researchers implemented the augmented reality-based flashcard media, which had been revised in accordance with feedback and notes from media experts and subject matter experts (Insani & Firdaus, 2024). Both experts confirmed that the media was suitable for use, enabling the implementation of the flashcard media. This implementation phase involves testing the flashcard product on 16 preschool-aged children at Salafiyah Sidorejo Comal Kindergarten.

Evaluation

The evaluation phase was conducted to assess the suitability of the AR-based flashcard game media developed (Elvina et al., 2024). To determine the effectiveness of the flashcard media, evaluation is necessary, whether formative or summative (Siregar et al., 2022). Formative evaluation is an evaluation conducted throughout the media design and development process. Meanwhile, summative evaluation is conducted after the media has been implemented, specifically through an analysis of teachers' and children's responses to the media (Wardani et al., 2022).

In this analysis plan, the researcher developed a questionnaire for validation by media and subject matter experts. Subsequently, the questionnaire data were analysed to evaluate the quality of each instrument item. In addition, reliability tests were conducted to determine the instrument's consistency in generating data when used repeatedly.

RESULT AND DISCUSSION

Results

This study produced an educational tool in the form of an augmented reality-based flashcard game, developed using quantitative methods involving a questionnaire and a pilot implementation at Salafiyah Sidorejo Comal Kindergarten. The results of the quantitative methods and the stages of development are as follows.

During the analysis phase, the researcher conducted observations and interviews with the teacher of Class B. The results of these observations and interviews indicated that instruction still relied on conventional methods, such as lectures supplemented by books and pictures, leaving children with limited opportunities for direct, interactive learning experiences. Meanwhile, the characteristics of less competitive, highly curious children indicate a need for more interactive media.

These findings reveal a gap between the active and exploratory learning characteristics of young children and a teaching approach that remains largely passive. Therefore, an AR-based flashcard game was developed as an alternative solution to provide students with a more concrete and interactive learning experience.

Next, during the design phase, the educational material was developed as 12 × 8 cm flashcards containing two main activities: introducing modes of transportation through AR-based 3D object visualisation. In this game, children will be introduced to various modes of transportation and their components through 3D AR displays that appear when a barcode is scanned, along with interactive quizzes with immediate feedback. When a child selects an answer, the system provides immediate feedback: a happy icon appears if the answer is correct, and a crying icon appears if it is incorrect. Thus, from a pedagogical perspective, this design serves not only as a medium for delivering content but also as a tool that supports cognitive stimulation by integrating visualisation, interaction, and reinforcement of children’s learning responses.

The learning media developed is an AR-based flashcard game. The flashcard game was created through a combination of manual methods and technology, while the AR was created using the Assembler Edu, Sketchfab, and AR applications. The images used in the flashcard creation process are shown in Figure 1 below. In this digital medium, the researcher used the Assembler Edu app. This app can be downloaded from the Google Play Store and used on smartphones and tablets as needed; it can be seen in Figure 2 below.



Figure 1. Flashcard

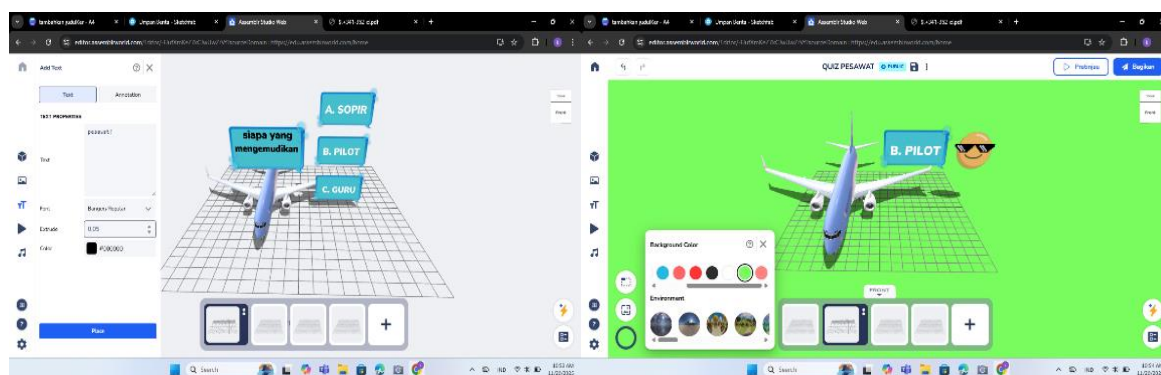


Figure 2. Editing Process with Assembler Edu

After the media was developed, the next step was to conduct validation by media experts and subject matter experts. The validation process was carried out by completing questionnaires and by the experts providing comments and suggestions for improvement. The validation results from the media and subject matter experts are shown in Tables 3 and 4. The following presents the assessment results from both experts.

Table 3. Media Validation Result

No.	Indicator	Percentage
1	Design Aspects	80%
2	Media Feasibility Aspects	73.3%
3	Software Usage Aspects	80%
Total		80%

Table 4. Material Validation Result

No.	Indicator	Percentage
1	Material Feasibility Aspect	96%
2	Presentation Feasibility Aspect	95%
3	Grammar Aspects	86.6%
Total		95.5%

Based on the media expert validation result of 80%, the assessment result for the media falls into the “Good” category. In comparison, the content expert validation achieved 95.5% in the “Very Good” category, indicating that the learning materials align with the needs and characteristics of early childhood. Based on these results, the researcher conducted the learning activity using AR-based flashcards. During the learning phase, children are introduced to various types of transportation through flashcards displaying 3D vehicle images and learn about the parts of the vehicles. This process aims to help children understand the concept of transportation more concretely through interactive digital visualisation. After the children have become familiar with transportation and its parts, the activity continues with an interactive quiz. This quiz appears when scanning the barcode on the flashcard, displaying simple questions appropriate for the children’s abilities. The children are then asked to select the correct answer from the available options. This activity helps children reinforce their understanding of the learned material through an Augmented Reality-based learning experience.



Figure 3. Flashcard Implementation

Table 5. Results of the Flashcard Implementation Questionnaire

No.	Indicator	Percentage
1	Feasibility Aspects	96%
2	Language Feasibility Aspects	85%
3	Grammar Aspects	100%
4	Media Suitability Aspects	90%
Total		92.75%

During the implementation phase, the AR-based flashcard learning media must undergo an evaluation process. The purpose of this evaluation is to improve the quality of the final product by incorporating classroom teachers' comments and suggestions for improvement from the implementation phase in Class B. In this study, the evaluation process was conducted by referring to assessment results and recommendations from media and content experts (validators), which were then conveyed to teachers as feedback on the developed media. These assessments serve as a crucial reference for evaluating and refining the AR-based flashcard game learning media for development in subsequent stages. The survey results from the implementation obtained during the evaluation phase showed a score of 92.75%, which falls into the "Very Good" category. These results indicate that the developed media demonstrates high quality and strong user acceptance and engagement. However, these results primarily reflect users' responses and perceptions of the media, and thus do not directly indicate an improvement in children's cognitive abilities.

Discussion

The development of augmented reality-based flashcard games in this study demonstrates that the presence of technology does not solely determine learning effectiveness, but rather how that technology is integrated into an interactive and meaningful instructional design. This indicates that AR serves as a learning aid. At the same time, the primary factors influencing cognitive improvement are the combination of concrete visualisation, exploratory activities, and the immediate feedback children receive during the learning process.

Stimulating cognitive development in early childhood requires access to interactive learning resources. In this regard, AR-based learning media have the potential to increase children's engagement through their visual and interactive characteristics. This is supported by research conducted by [Amalia et al., \(2024\)](#), which states that the use of AR in early childhood education contributes to the improvement of children's cognitive capacity and intellectual development by presenting more concrete learning experiences, thereby making it easier for children to understand and remember complex concepts. In this context, this study offers an additional contribution by integrating evaluation elements into the medium; thus, the function of flashcards is not limited to serving as a mere introduction to concepts. Rather, they also serve as a tool for reinforcing understanding. Critically, this indicates a shift from using AR as a representational medium to an interactive learning system, enabling a more active and reflective learning process.

Previous research by [Anggreani & Satrio \(2021\)](#) found that using AR flashcards with animal identification concepts helps children recognise objects more accurately. In this context, this study adds value by integrating evaluation elements into the media; it does not merely focus on visualisation but also incorporates interactive evaluation elements, thereby making the learning process more comprehensive. Thus, this educational media is designed with the primary objective of maximising young children's cognitive abilities. The presentation of the material is supplemented with visual support in the form of text and 3D object displays, along with their explanations, as well as simple quizzes designed to assess and reinforce children's understanding of the learned material. This aligns with the view that children's understanding can develop when using learning media that is effectively structured and aligned with children's developmental characteristics ([Atikah et al., 2023](#)).

Learning using Augmented Reality can influence collaborative learning [Kuanbayeva et al., \(2024\)](#) because the learning mechanism in this medium can be observed through the interactions that occur when children use AR flashcards together. When children scan the flashcards and answer interactive quizzes, a "correct" or "incorrect" response appears, which can trigger spontaneous discussions among them, such as asking questions, comparing answers, and helping peers who have not yet grasped the material. In this process, AR flashcards serve as a learning stimulus that encourages social interaction, so that learning does not only occur between the child and the medium but also evolves into a collaborative process among students. Thus, the use of this medium not only enhances individual learning experiences but also strengthens social learning in the classroom.

Faculty members specialising in educational media and materials conducted a validation of the developed product. The validation results showed that the product received a feasibility score of 80% ("Good") and 95.5% ("Very Good"). These results indicate that the developed media meet the

feasibility criteria for implementation in early childhood education. Thus, the development of AR-based learning media is projected to improve children's cognitive abilities through more interactive and engaging learning presentations. Additionally, implementing this media can create a more conducive learning environment and provide enjoyable learning experiences that optimally support children's developmental and growth processes. These findings align with [Nasution et al., \(2022\)](#), which states that AR can help enhance learning by integrating the real and virtual worlds, making the material easier to understand. In this study, AR was used not only to view 3D images but also combined with flashcard quizzes to encourage students to be more active during learning. Furthermore, research conducted by [Elvina et al., \(2024\)](#) indicates that the use of AR can overcome the limitations of the availability of real objects in the learning process. These findings are relevant to the research site, which is still dominated by conventional learning media. However, this study demonstrates that the success of AR is not solely due to its visuals but also because of its usage method, which actively engages children through interaction and quizzes.

To support early childhood development, teaching media that capture attention and provide interactive learning experiences are needed. The Assembler Edu application is one technology that can be utilised to create innovative and engaging teaching tools ([Elvina et al., 2024](#)). Through Assembler Edu, AR-based flashcard games can virtually visualise real-world objects, thereby facilitating teachers in explaining the material. In this study, Assembler Edu was used to develop an AR application that introduces various types of transportation, explains their components, and provides simple quizzes that children can answer through a flashcard game.

This study has several limitations, particularly regarding the sample size, which consisted of students from only one class, and the relatively short duration of the study; consequently, the results obtained may not yet represent broader conditions. Furthermore, this study remains focused on cognitive aspects and has not yet explored the impact of AR-based media on other areas of development. Therefore, further research is needed that involves a broader range of subjects, a longer implementation period, and the use of more comprehensive evaluation indicators to produce findings that are more representative and more accurate.

CONCLUSION

This study aimed to develop an augmented reality-based flashcard learning medium using the ADDIE model for early childhood students at TK Salafiyah Sidorejo Comal. Validation results indicated that the developed medium falls into the "good" category, with 80% from the media expert and 95.5% from the content expert, placing it in the "very good" category. These findings indicate that integrating 3D visualisation via AR can support the recognition of basic concepts, such as letters and numbers, in early childhood learning, particularly by enhancing the appeal of learning media. However, it cannot yet be concluded that the limitations of this study lie in the scope of implementation, which remains limited—both in terms of the number of subjects and the context of use—so the results cannot yet be widely generalised and have not empirically measured the media's impact on aspects of child development. Scientifically, this study contributes to the development of AR-based educational media design by integrating flashcards with 3D visualisation as an interactive media innovation in early childhood education, particularly in educational product development. Therefore, future research is recommended to conduct an effectiveness test using an experimental design with a control group, involving a broader and more diverse range of subjects, and measuring the measurable impact of media use on aspects of child development, such as the ability to recognise letters and numbers, social interaction during learning, and motor skills in the use of augmented reality-based media.

ACKNOWLEDGEMENTS

The author would like to thank his supervisor for his guidance, feedback, and encouragement, which enabled him to complete this journal article.

REFERENCES

- Adzani, R. N., & Pramuditya, S. A. (2025). Pengembangan Media pembelajaran matematika berbasis Google Sites fungsi invers dengan analisis aksesibilitas dan pengalaman pengguna. *Radian Journal: Research and Review*, 4(4), 200–211. <https://doi.org/10.35706/radian.v4i4.13261>
- Amalia, R. R. D., Saman, A., & Herman. (2024). Pengembangan media interaktif augmented reality berbasis smartphone untuk meningkatkan kemampuan literasi anak usia dini. *Didaktika: Jurnal Kependidikan*, 13(2), 1595–1608. <https://doi.org/10.58230/27454312.591>
- Anggreani, C., & Satrio, A. (2021). Pengembangan flashcard berbasis augmented reality untuk anak usia dini. *Jurnal Edukasia*, 3(6), 5126–5135. <https://doi.org/10.60132/edu.v2i1.256>
- Anggrian, M., & Saefurahma, I. M. (2025). Teori perkembangan kognitif piaget dan implementasinya dalam pembelajaran di paud. *Research Early Childhood Qurrota A'yun*, 2(01), 1–11. <https://doi.org/10.64724/y20wk478>
- Astrachon, N., Srikao, S., & Jantharajit, N. (2025). Learning by doing : Enhancing life and social skills in early childhood through an experiential learning management model. *Journal of Education and Training*, 11(4), 172–178. <https://doi.org/10.20448/edu.v11i4.7527>
- Atikah, C., Rusdiyani, I., & Ridela, R. (2023). Pengembangan media pembelajaran berbasis augmented reality pada tema binatang purba untuk meningkatkan kemampuan kognitif anak usia dini Kelompok B (5-6) Tahun di TK Tunas Insan Kamil Kota Serang. *JEA (Jurnal Edukasi AUD)*, 9(2), 89–101. <https://doi.org/10.18592/jea.v9i2.9326>
- Aydoğdu, F. (2021). Augmented reality for preschool children: An experience with educational contents. *British Journal of Education Tecnology*, 53(2), 326–348. <https://doi.org/10.1111/bjet.13168>
- Cahyaningtyas, A. S. (2020). Pembelajaran menggunakan augment reality untuk anak usia dini di Indonesia. *Jurnal Teknologi Pendidikan: Jurnal Penelitian dan Pengembangan Pembelajaran*, 5(1), 20-37. <https://doi.org/10.33394/jtp.v5i1.2850>
- Dewi, E. R. V., Hibana, H., & Ali, M. (2023). Pengaruh penggunaan media loose parts terhadap perkembangan kognitif anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 7(1), 267–282. <https://doi.org/10.31004/obsesi.v7i1.3451>
- Elvina, T., Miranda, D., & Lukmanulhakim. (2024). Pengembangan flashcard tematik berbasis augmented reality anak usia 5-6 tahun. *Jurnal Edukasi*, 2(1), 57–61. <https://doi.org/10.60132/edu.v2i1.256>
- Hakiki, M., Sabir, A., Maryana, A., Muhammadiyah, U., & Bungo, M. (2022). Efektivitas modul digital berbasis e-learning pada mata kuliah pendidikan karakter di STKIP Muhammadiyah Muara Bungo. *Jurnal Muara Pendidikan*, 7(2), 269–233. <https://doi.org/10.52060/mp.v7i2.901>
- Hayati, D. K. (2022). Pengembangan media pembelajaran flashcard pada materi klasifikasi makhluk hidup. *Al Jahiz: Journal of Biology Education Research*, 3(1), 82–93. <https://doi.org/10.32332/al-jahiz.v3i1.4910>
- Insani, Z., & Firdaus, F. M. (2024). Pengembangan aplikasi bangun ruang berbasis augmented reality (AR) untuk meningkatkan kecerdasan spasial dan self-regulated learning. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 8(5), 1185–1196. <https://doi.org/10.31004/obsesi.v8i5.6141>
- Karmila, D. (2024). Pengembangan modul pembelajaran permainan tradisional dalam meningkatkan kemampuan motorik kasar di TK. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 8(6), 1577–1590. <https://doi.org/10.31004/obsesi.v8i6.6068>

- Khoirunnisa, S., Fatih, M., & Wafa, K. (2024). Pengembangan media flashcard berbasis augmented reality pada materi tata surya siswa Kelas V SDN Sumberdiren 01 Garum. *Jurnal Ilmiah Pendidikan Madrasah Ibtidaiyah*, 8(4), 1812–1825. <https://doi.org/10.35931/am.v8i4.4072>
- Kuanbayeva, B., Shazhdekeyeva, N., Zhusupkaliyeva, G., Mukhtarkyzy2, K., & Abildinova, G. (2024). Investigating the Role of augmented reality in supporting collaborative learning in science education: A case study. *Engineering Pedagogi*, 14(1), 149–161. <https://doi.org/10.3991/ijep.v14i1.42391>
- Muti, I., Hasyim, D. M., Ms, S. S. U., & Anwar, S. (2024). Pemanfaatan teknologi pembelajaran berbasis augmented reality sebagai media pembelajaran interaktif era metaverse. *Journal Of Social Science Research*, 4(6), 5463–5474. <https://doi.org/10.31004/innovative.v4i6.17132>
- Nasution, N., Darmayunata, Y., & Wahyuni, S. (2022). Pengembangan media pembelajaran anak usia dini berbasis augmented reality. 6(6), 6462–6468. <https://doi.org/10.31004/obsesi.v6i6.3408>
- Nurfadilah, I., & Miftakhul, F. (2021). Modifikasi perilaku anak usia dini untuk mengatasi temper tantrum pada anak. *Jurnal Pendidikan Anak*, 10(1), 69–76. <https://doi.org/10.21831/jpa.v10i1.28831>
- Nurhidayah, S., Fadhli, M., & Ulfa, S. (2024). Development of “ Tikrar Space ” multimedia based on drill and practice for Arabic vocabulary learning. *Jurnal Inovasi Teknologi Pendidikan*, 11(4), 482–497. <https://doi.org/10.21831/jitp.v11i4.77834>
- Permana, R. A., Husein, H., & Sahara, S. (2023). Kahoot berbasis game based learning terhadap hasil pembelajaran sekolah dasar dengan model ADDIE. *Jurnal Komputer Antartika*, 1(4), 209–213. <https://doi.org/10.70052/jka.v1i4.226>
- Putri, M., & Lili, D. P. (2021). Waspadai dampak penggunaan gadget terhadap perkembangan sosial anak usia dini. *El-Athfal: Jurnal Kajian Ilmu Pendidikan Anak*, 6(01), 46–55. <https://doi.org/10.56872/elathfal.v1i01.273>
- Rachma, A., Tuti Iriani, & Handoyo, S. S. (2023). Penerapan model ADDIE dalam pengembangan media pembelajaran berbasis video simulasi mengajar keterampilan memberikan reinforcement. *Jurnal Pendidikan West Science*, 1(08), 506–516. <https://doi.org/10.58812/jpdws.v1i08.554>
- Ramlah, F., Mukminin, A., & Jannah, R. (2023). Pengaruh penggunaan media flash card terhadap kemampuan berpikir simbolik dan kecerdasan linguistik anak usia 5-6 tahun. *Murhum : Jurnal Pendidikan Anak Usia Dini*, 4(1), 259–271. <https://doi.org/10.37985/murhum.v4i1.202>
- Ramlah, U. T., Riyanto, A. A., & Nuraeni, L. (2022). Media loose parts play dalam merangsang perkembangan kognitif anak usia dini. *Journal Ceria*, 5(3), 293–299. <https://doi.org/10.22460/ceria.v5i3.10521>
- Salam, A., & Ramadhan, S. (2025). Penerapan media pembelajaran pengenalan hewan berbasis augmented reality untuk anak usia dini di TKN 26 Lelamase. *Golden Age and Inclusive Education*, 2(1), 51–65. <https://doi.org/10.61798/galon.v2i1.275>
- Setiawan, A. M., & Rahman, F. N. (2025). Development of digital science literacy based on Articulate Storyline based on objects’ material for class VIII junior high school. *Jurnal Inovasi Teknologi Pendidikan*, 12(2), 132–141. <https://doi.org/10.21831/jitp.v12i2.75435>
- Siregar, E. S., Nasution, A. F., & Siregar, I. (2022). Pengembangan multimedia sebagai perangkat pembelajaran untuk meningkatkan keterampilan membaca pada SD Percobaan Siswa Kelas V. *Jurnal Altifani Penelitian dan Pengabdian Kepada Masyarakat*, 2(1), 85–92. <https://doi.org/10.25008/altifani.v2i1.205>
- Uswatun, H., & Nur, F. (2022). Konsep pendidikan karakter anak usia dini. *Jurnal Inovasi Pendidikan Anak Usia Dini*, 2(2), 116–126. <https://doi.org/10.51878/edukids.v2i2.1775>

- Wahyudi, R., Wahyuni, T. R., & Komalasari, I. (2025). Museum virtual untuk mendukung penyebaran. *Jurnal Dasarupa*, 07(03), 23–32. <https://doi.org/10.52005/dasarrupa.v7i3.428>
- Wardani, H. K., Darusuprapti, F., & Hajaroh, M. (2022). Model-model evaluasi pendidikan dasar (scriven model, tyler model, dan goal free evaluation). *Jurnal Pendidikan: Riset dan Konseptual*, 6(1), 36-49. https://doi.org/10.28926/riset_konseptual.v6i1.446
- Wibowo, V. R., Eka Putri, K., & Amirul Mukmin, B. (2022). Pengembangan media pembelajaran berbasis augmented reality pada materi penggolongan hewan kelas V sekolah dasar. *PTK: Jurnal Tindakan Kelas*, 3(1), 58–69. <https://doi.org/10.53624/ptk.v3i1.119>
- Yu, J., Denham, A. R., & Searight, E. (2022). A systematic review of augmented reality game-based learning in STEM education. *Educational Technology Research and Development*, 70, 1169–1194. <https://doi.org/10.1007/s11423-022-10122-y>
- Yusuf, A., Suardana, I. N., & Selamat, K. (2021). Pengembangan media pembelajaran flashcard IPA SMP materi tata surya. *Jurnal Pendidikan dan Pembelajaran Sains Indonesia (JPPSI)*, 4(1), 69–80. <https://doi.org/10.23887/jppsi.v4i1.33181>