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Development of an Augmented Reality (AR) Book Integrated with Sasirangan Motifs to Improve Early Childhood Cognitive Abilities

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Abstract

The rapid advancement of digital technology has created opportunities to transform early childhood learning through interactive instructional media while simultaneously addressing the need to preserve local cultural heritage. This study aimed to develop an Augmented Reality (AR) Book integrated with Sasirangan motifs and to evaluate its feasibility and effectiveness in improving the cognitive abilities of early childhood learners. The study employed a Research and Development (R&D) approach using the ADDIE model, comprising Analysis, Design, Development, Implementation, and Evaluation, with a pre-experimental one-group pretest–posttest design during the implementation stage. Participants included kindergarten children aged 5–6 years and teachers from several Aisyiyah Kindergartens in Banjarmasin. Data were collected through expert validation, classroom observation, interviews, documentation, and pretest–posttest assessments and were analyzed using descriptive quantitative analysis and comparative analysis of learning outcomes. The findings demonstrated that the developed AR Book achieved valid to highly valid feasibility ratings from experts and produced consistent improvements in children's cognitive performance following implementation. The integration of interactive three-dimensional visualization with culturally meaningful Sasirangan motifs enhanced learner engagement, conceptual understanding, and knowledge retention while fostering appreciation of local cultural identity. This study contributes to the field of educational technology by providing empirical evidence that culturally integrated AR-based instructional media can simultaneously enhance cognitive development and cultural preservation, offering a contextually relevant model for

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innovative early childhood learning in the digital era.

Keywords: Augmented Reality, AR Book, Cognitive Development, Early Childhood Education, Research and Development, Sasirangan Motif.

INTRODUCTION

Early childhood education is the main foundation in shaping children's cognitive, social, emotional, and motor abilities. During this period, children are in a phase of rapid development so the right stimulus is needed to optimize their potential. One of the important aspects of early childhood learning is cognitive ability, which includes the ability to think, remember, solve problems, and understand basic concepts. However, learning in PAUD institutions is still very conventional and less attractive to children (Baiti et al, 2021). The learning media used tends to be passive, such as picture books or worksheets that do not sufficiently stimulate children's curiosity and active participation. Therefore, innovation in interactive learning media is needed, fun and able to develop children's cognitive aspects optimally.

One of the innovations that has great potential in improving the quality of children's learning is the use of Augmented Reality (AR) technology. AR enables the incorporation of virtual objects in the real world in real-time, creating a more engaging, immersive and contextual learning experience. With the help of AR, children can interact directly with learning materials visually and kinesthetically, which is certainly in accordance with the characteristics of early childhood learning (Abinaya et al, (2023). On the other hand, it is also important to introduce local cultural values from an early age, so that children grow up with a love for their nation's cultural heritage. One of the cultural riches of Indonesia that should be preserved is the sasirangan fabric motif which is a typical cultural heritage of South Kalimantan. The integration of sasirangan motifs into AR-based learning media not only provides educational content, but also strengthens children's cultural identity. Based on this description, the development of Augmented Reality (AR) Book learning media that is integrated with sasirangan motifs is very relevant.

This media is expected to be an interesting and effective learning solution, as well as a means of preserving local culture. Thus, this research aims to develop AR books based on local culture to improve early childhood cognitive abilities in a fun and meaningful way. This research is a strategic initiative to realize the development of superior human resources (HR), which is part of the 4th Asta Cita Improving Superior Human Resources from Early Childhood: Focusing on children's cognitive abilities as the foundation of Indonesia's golden generation. The Utilization of

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Digital Technology (AR) in the world of early childhood education. As well as the 8th Asta Cita Strengthening Diversity and Strengthening Indonesia's Social Restoration by integrating the motifs of Sasirangan (South Kalimantan's cultural heritage), this research strengthens the values of diversity and cultural preservation in educational media learning for early childhood.

Urgency The development of digital technology has provided new opportunities in the world of education, including early childhood education (PAUD). Today's children are growing up in a digital age that demands a more interactive, engaging, and appropriate approach to learning. On the other hand, early childhood education is also required to introduce local cultural values so that children are not uprooted from their own cultural roots. Sasirangan as a typical cultural heritage of South Kalimantan has high aesthetic and philosophical value. The mastery of cognitive abilities at an early age is crucial as the basis for the formation of thinking skills, recognizing patterns, understanding basic concepts, and solving problems in the future The urgency of this research is strengthened by: 1) The lack of interactive digital learning media that contains local content of regional culture, especially in the context of early childhood education; 2) Not optimal early childhood cognitive development due to limited innovative and fun learning approaches; 3) The need for the integration of educational technology with the preservation of local culture, as a response to the challenges of globalization and the penetration of foreign cultures; 4) The potential of AR in improving focus, exploration, and information retention in early childhood, which has been proven by various previous studies; 5) The suitability of the AR Book with the characteristics of early childhood, namely learning through play, visualization, and direct interaction with objects.

Based on a *state of the art* study, research on the use of Augmented Reality (AR) in the field of education shows consistent results in improving the quality of learning. Research by Wati et al. (2020) proves that AR is able to improve children's memory and participation, while Fadhilah and Andriyani (2021) show that the implementation of AR contributes positively to the cognitive development and visual abilities of early childhood. The 2023 study also confirmed the effectiveness of AR in visualizing abstract concepts, while Noor Baiti (2024) found that flipbook-based AR can improve literacy skills through a combination of text and interactive animation.

However, there are still research gaps that need to be developed. Most research focuses on science material, literacy, or abstract concepts without integrating local cultural values. In addition, some studies only focus on the implementation of media without producing innovative learning products, and there are studies that target the higher education level so that they are not in accordance with the characteristics of early childhood. Therefore, it is necessary to develop AR-

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based learning media that integrates local culture and is specifically designed to support learning that is contextual, interactive, and in accordance with the needs of early childhood learners.

These studies show the effectiveness of AR in early childhood learning. The development of digital technology in the world of education is increasingly rapid, especially in the use of Augmented Reality (AR) technology as an interactive learning medium. AR technology has been widely used to create immersive learning experiences, increase attention, and help children understand abstract concepts in a more concrete and fun way (Eddy et al. 2022). However, the majority of AR media developed is still general and has not raised the richness of local culture as part of its content. In fact, the integration of cultural values in learning media not only functions as a means of cognitive education, but also as an effort to preserve culture from an early age. On the other hand, the Sasirangan motif, as a typical cultural heritage of South Kalimantan, has educational value that can be integrated into children's visual learning materials. Until now, there has been no research that specifically develops AR book media that incorporates aspects of local culture such as Sasirangan into the context of early childhood cognitive development.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach using the ADDIE instructional design model, with a pre-experimental designs approach with a one group pretest-posttest design. The implementation of the experiment in this study only used one group and did not use a control class. The development model in this study uses the ADDIE development model from Robert Maribe Branch (Baiti et al, 2024). The ADDIE model is suitable for developing educational products and learning resources because the steps are explained in detail and simply consisting of five stages, namely Analysis, Design, Development, Implementation and Evaluation.

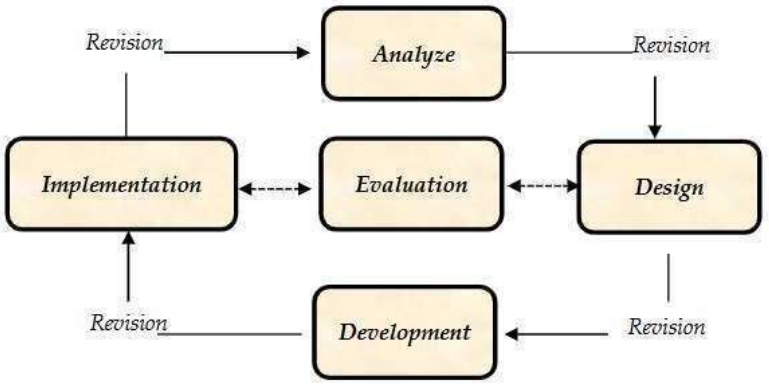


Figure 1. ADDIE Development model

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Data were collected through multiple complementary techniques, including classroom observation, expert validation, interviews, documentation, and pretest–posttest assessments. The research instruments consisted of expert validation sheets evaluating content accuracy, language, instructional design, and media quality, observation sheets measuring children's learning engagement, interview protocols for collecting teachers' responses, and cognitive assessment instruments administered before and after the intervention. The use of multiple instruments was intended to ensure methodological triangulation and strengthen the validity of findings by capturing both quantitative evidence of learning improvement and qualitative evidence regarding product feasibility and user acceptance. Data analysis combined descriptive quantitative analysis to determine the validity and feasibility level of the developed media through percentage-based criteria with comparative analysis of pretest and posttest scores to identify improvements in children's cognitive achievement. This analytical strategy was selected because it provides comprehensive evidence regarding both the educational quality of the developed product and its instructional effectiveness, thereby maintaining consistency between the research objectives, the developmental methodology, and the evaluation procedures. Furthermore, the methodological framework reflects constructivist learning principles by emphasizing authentic interaction between learners, instructional media, and culturally meaningful learning contexts, ensuring that the developed AR Book serves not only as a technological innovation but also as a pedagogically and culturally relevant educational resource (Mayer, 2021; Branch, 2009; UNESCO, 2023).

RESULTS AND DISCUSSION

Based on the results of the study, it is known that this research started from the analysis stage, namely the researcher has analyzed the needs and characteristics of early childhood learning needs and the early childhood education curriculum related to early childhood cognitive abilities. In addition, an assessment was carried out on the technological infrastructure available in schools and students' homes. From this stage, the researcher found: 1) The lack of interactive digital learning media that contains local content of regional culture, especially in the context of early childhood education; 2) Early childhood cognitive development has not been maximized due to the limited innovative and fun learning approaches. 3) The need for the integration of educational technology with the preservation of local culture, as a response to the challenges of globalization and the penetration of foreign cultures; 4) The potential of AR in improving focus, exploration, and information retention in early childhood, which has been proven by various

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previous studies. 5) The suitability of the AR Book with the characteristics of early childhood, namely learning through play, visualization, and direct interaction with objects.

The design stage, the design of learning media is created, including AR storyboards and AR book prototypes. The content is compiled using a design approach that includes educational content, visual motifs, and AR interactions.

1) Drafting an augemented reality-based Flippbook *framework*

Opening section	The opening section consists of a cover, a foreword, Instructions for use
Contents section	The contents consist of the solar system by giving rise to its writing and its thickness
Closing	This section consists of the back cover

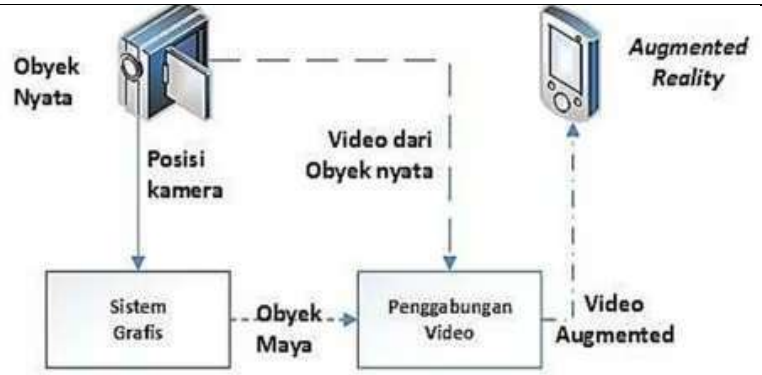


Figure 2. Augemented Reality Working Diagram

2) Systematic and material planning

The material is taken from the theme of the solar system. The material was raised with a theme according to the theme in the school and the storyline as well.

3) Instrument design

At this stage, the creation of a grid of research instruments as media assessment criteria. validation sheets, observation sheets and interview guidelines. Validation sheets are used to determine the feasibility of the project based on the assessment of material experts and media experts. Material experts give assessments based on material and language aspects while media experts give assessments based on aspects of programming, presentation and cover. Observation sheets and interview guidelines are used to find out the responses and responses of teachers and children using a likert scale with a maximum score of 4 and a minimum of 1.

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The development stage of the AR Book application is going well, able to bring up 3D objects from book markers

1) At this stage, the creation *of the Motif Sasirangan AR book* was carried out using Canva software, and Fliphtml5 and an edu assembler for AR including story narratives and references. The steps implemented are; 1) Create a storyline that is tailored to the child's theme, characteristics,
2) Media is created using Canva and Fliphtml5 as a form of Flippbook that can be distributed to schools in electronic form. The material in the *AR book media Motif Sasirangan* takes the theme of the solar system in which there are several planets. 3) after editing the image in Canva it is adjusted to the storyline that has been narrated 4) the final design is made in the form of an e-book using the fliphtml 5 application and made into the assembler application to be used as AR



Figure 3. e-book using fliphtml application

3) Subject Matter Expert Validation

Before the trial, *the AR book media Motif Sasirangan* was to improve children's writing skills at Aisyah Barito Kindergarten in Kuala. The media is validated first by a subject matter expert. The validation of the material was carried out by a lecturer of Early Childhood Education, STKIP Sabilal Muhtadin Banjarmasin who is also a practitioner at the school of Mrs. Salasiah, S.Pd, M.Pd and Noor Halida Yanti, S.Pd.I, M.Pd Banjarmasin who have a background in accordance with the material developed. The validation of material experts aims to obtain information, criticism, and suggestions so that *the learning media of the AR book Motif Sasirangan* can become a quality product in terms of material, learning and

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language. The results of the validation can be seen in the following table, with the likert scale validation instrument the maximum score of the question items in the validation sheet is 4 while the minimum score is 1. The total assessment score can be calculated using the following formula by Arikunto (2008:216):

$$P = \frac{\text{Jumlah skor hasil pengumpulan data}}{\text{Jumlah skor maksimal ideal}} X100$$

Keterangan:

P : Presentase kelayakan.

The conformity data is used to determine the feasibility level of the product produced. The following is a table of Sugiyono's (2014:94) assessment scores:

Table 1. Assessment score

Score	Answer Options	Presentase (%)	Eligibility
4	Excellent	81-100	Very valid
3	Good	61-80	Valid
2	Not Good	41-60	Invalid
1	Very bad	0-40	Very less valid

Based on the eligibility table, indicating that the product will be developed ends when the media reaches a percentage of eligibility with a valid or very valid category.

Table 2. Material Expert Validation Results

No	Aspects	Indicator	Validator	
			1	2
1	Material	Theme-Appropriate	3	4
2		The material is in accordance with the subtheme	3	4
3		The content of the material is accurate	3	3
4		Accuracy of the meaning of the story in the image	3	3
5		Pictures have a lot of vocabulary for children	3	4

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6		Illustration material is easy to understand	3	3
7		The storyline of the images used is already collapsed and easy to understand	3	3
8		Media introduces many objects	3	4
9		Media helps children Presenting his world in words	3	3
10		Media contains symbols and signs	2	3
Total Score			28	33
Presentase			70%	82%
Criteria			**Valid**	**Highly Valid**
11	Languag e	The illustrations used are straightforward	3	3
12		Illustrations used communicative	3	4
13		The illustration presented is simple	3	4
Total Score			9	11
Presentase			75%	91,6%
Criteria			**Valid**	**Highly Valid**

Source: Primary data processed

The score of the results of the material expert validator in the assessment of the material aspect obtained an average result of 70 with valid criteria, then the linguistic aspect was obtained on average 75% with the criterion of "valid" in validator 1. Validator 2 gives a very valid value to the material that has already been created. The results of the material validation show valid and very valid criteria can be seen in the following graph:

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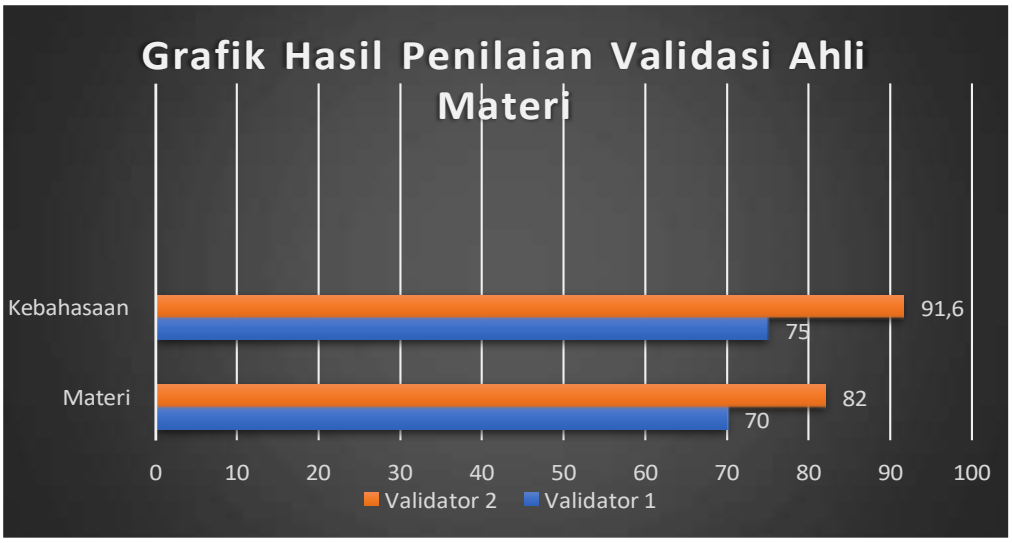


Figure 4. Results of the validators' assessment

The graph in this image shows the results of the validators' assessment of the AR-based Book Sasirangan aspect Based on the validation results, it is stated to be quite valid but there are several parts to be revised.

As for suggestions for improving the validation of subject matter experts as in this table;

Table 3. Subject matter expert validation improvement suggestions

Yes	Suggestions/Feedback for Improvements	Improvement Results
1	The story in the filppbook is good but details can be added related to the explanation of what the solar system is and the content of the sasirangan motif	The addition of material related to what is cognitive with sasirangan motifs and various kinds in it

1) Media expert validation results

The learning media is validated before being tested by media experts. Media validation was carried out by a lecturer of Early Childhood Education, Faculty of Education, IAIS Sambas West Kalimantan, Hadisa Putri, M.Pd. Validation by media experts aims to obtain information, criticism and suggestions that are developed into quality products in terms of programming and appearance. The maximum score of each statement item in the validation sheet is 4 while the

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minimum score is 1.

2) Test Results

The trial was carried out to be able to determine the feasibility of *Flippbook media based on augemented reality based* on the responses and responses of teachers and early childhood aged 5-6 at Aisyiyah Kindergarten Banjarmasin City. This trial was carried out in early childhood, Aisyiyah Bustanul Athfal Kindergarten 1 Banjarmasin, Aisyiyah Bustanul Athfal Kindergarten 42 Banjarmasin and Aisyiyah Bustanul Athfal Kindergarten 31 Banjarmasin.

The total number of trial respondents was 5 teachers and 20 children. This trial was carried out using products as learning media in the classroom in accordance with the theme of recreation. The trial assessment consists of media and material aspects. Data collection is carried out by observation during the use of media in learning and interviews after media use.

a) Small Group Trials

The trial was conducted to test the attractiveness of the product and measure whether it can help improve children's literacy skills with the use of media. This trial was carried out by taking samples of 10 children at Aisyiyah Bustanul Athfal 37 Kindergarten Banjarmasin.

Table 4. Small Group Pre-test and Post Test Results

No	Subject Code	Pre test	Post tes	Percentage of final test	Criteria
1	A	20	24	100,0	Very deserved
2	B	18	22	83,3	Very deserved
3	C	20	23	95,8	Very deserved
4	D	19	23	95,8	Very deserved
5	E	17	23	83,3	Very deserved
6	F	20	24	100,0	Very deserved
7	G	16	23	91,7	Very deserved
8	H	15	20	70,8	Worthy
9	I	12	20	75,0	Worthy
10	J	15	20	70,8	Worthy

Based on the results of the pretest and post test above, an increase can be seen in the mean value of the initial test score of 17.76 and the final test of 22.59.

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b) Large Group Trials

Large group trials were carried out to convince the data and to know the attractiveness of the product at large. In the last product trial, a large group test was carried out involving 3 Aisyiyah kindergartens, Aisyiyah Bustanul Athfal 1 Banjarmasin kindergarten, Aisyiyah Bustanul Athfal 42 Banjarmasin kindergarten and Aisyiyah Bustanul Athfal 31 Banjarmasin kindergarten.

Based on the results of the pretest and post test above, an increase can be seen in the mean value of the initial test score of 15.85 and the final test of 21.15.

c) Results of Educator Response (Reviewer)

Small group trials and large group tests have been carried out, followed by observing the response from educators in the two schools. This educator's response is intended to test the attractiveness of the product.

Table 5. Product attractiveness score

No	Subject Code	Total Score	Presentase	Criteria
1	A	122	98,4	Highly feasible
2	B	110	88,7	Highly feasible
3	C	120	96,8	Highly feasible
4	D	109	87,9	Highly feasible
5	F	122	98,4	Highly feasible

The findings demonstrate that the development of the Augmented Reality (AR) Book integrated with Sasirangan motifs successfully addressed the instructional needs identified during the analysis phase, particularly the lack of interactive digital learning media, the limited integration of local culture into early childhood education, and the necessity of improving children's cognitive abilities through meaningful learning experiences. The product achieved positive expert validation, with material experts categorizing the learning content as valid to highly valid, while media validation also confirmed its feasibility for classroom implementation. Furthermore, both small-group and large-group trials revealed consistent improvements in children's post-test scores compared with their pre-test performance, indicating that the AR Book effectively facilitated cognitive development through immersive visualization and active interaction. These outcomes can be explained by constructivist learning theory, which argues that young children construct knowledge more effectively when they actively interact with concrete and meaningful learning objects rather than passively receiving information. The integration of

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three-dimensional visualization, storytelling, and culturally contextualized Sasirangan motifs enabled children to connect abstract concepts with familiar cultural experiences, thereby strengthening cognitive processing, memory retention, and conceptual understanding. These findings are consistent with previous studies reporting the educational benefits of Augmented Reality in early childhood learning. Wati et al. (2020) found that AR significantly improved children's participation and memory, while Fadhilah and Andriyani (2021) demonstrated that AR enhanced cognitive and visual learning performance among preschool children. Likewise, Eddy et al. (2022) emphasized that AR facilitates understanding by transforming abstract concepts into concrete visual experiences, whereas Noor Baiti (2024) reported that AR-based flipbooks improved children's literacy through interactive multimedia. However, the present study extends these earlier findings by integrating local cultural heritage into AR-based instructional media, an aspect largely absent from previous research. Rather than employing AR solely as a technological visualization tool, this study combines digital innovation with culturally responsive pedagogy through Sasirangan motifs, allowing children to simultaneously develop cognitive competence and cultural awareness. This distinction highlights that the effectiveness of AR is influenced not only by technological sophistication but also by the relevance and authenticity of the learning context embedded within the instructional design (Mayer, 2021; UNESCO, 2023).

From a theoretical perspective, the results reinforce Mayer's Cognitive Theory of Multimedia Learning, which posits that meaningful learning occurs when verbal and visual information are processed simultaneously through integrated cognitive channels. The interactive features of the AR Book reduced cognitive overload while increasing learners' attention, engagement, and knowledge retention by presenting information in an organized and visually meaningful format. In addition, Vygotsky's sociocultural theory provides further explanation for these findings, emphasizing that cognitive development is mediated through cultural tools and meaningful social contexts. The Sasirangan motifs functioned not merely as decorative elements but as cultural mediators that enriched children's learning experiences and strengthened their connection with local identity. Consequently, this study contributes to the growing body of literature by demonstrating that culturally integrated AR media can simultaneously promote cognitive achievement and cultural preservation, offering a more holistic educational innovation than conventional AR applications that primarily emphasize technological interaction without embedding local cultural values. These findings therefore provide important implications for future instructional media development, suggesting that the integration of emerging technologies with indigenous cultural content can create more meaningful, sustainable, and contextually

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relevant learning experiences for early childhood education.

CONCLUSION

This study concludes that the development of an Augmented Reality (AR) Book integrated with Sasirangan motifs constitutes an effective instructional innovation for enhancing the cognitive abilities of early childhood learners while simultaneously introducing local cultural values within the learning process. The systematic application of the ADDIE development model produced a learning medium that was validated as feasible by experts and positively received by teachers and children during implementation. Furthermore, the observed improvement in children's cognitive performance following the use of the AR Book indicates that the integration of immersive visualization, interactive learning experiences, and culturally meaningful content creates a learning environment that is more engaging and cognitively stimulating than conventional instructional media. Scientifically, this study contributes to the advancement of educational technology by demonstrating that the pedagogical effectiveness of Augmented Reality is strengthened when digital innovation is combined with local cultural heritage, thereby extending the application of culturally responsive learning within early childhood education.

Nevertheless, this study has several limitations that should be acknowledged. The implementation employed a pre-experimental one-group pretest–posttest design without a control group, limiting the ability to establish stronger causal inferences regarding the effectiveness of the developed media. In addition, the research involved a relatively limited number of participants from several kindergartens within one geographical area, which may restrict the generalizability of the findings to broader educational contexts. Future research is therefore recommended to adopt quasi-experimental or randomized controlled designs involving larger and more diverse populations across different regions and cultural settings.

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