

Developing Augmented Reality Flashcards Featuring *Rumah Lontiok* of Kampar to Support Cultural Literacy in Early Childhood

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	12 children in a large-group trial. Data were collected through observations, interviews, validation and practicality questionnaires, as well as cultural literacy pretests and posttests. The large-group data were analyzed using the Wilcoxon Signed-Rank test because the data were not normally distributed. The results showed validity scores of 87.5% from media experts, 96.8% from language experts, and 95.0% from cultural literacy experts, while practicality based on teacher responses reached 86.2%. In the large-group trial, the mean score increased from 16.33 to 28.50, with $p = 0.002$ and an average individual normalized gain of 0.8154 (81.54%), categorized as high. These findings indicate that the developed AR flashcards are highly valid and practical and provide preliminary evidence of improved children's cultural literacy.
	Keywords: <i>Augmented Reality; Cultural Literacy; Early Childhood; Rumah Lontiok; ADDIE.</i>

INTRODUCTION

Early childhood education provides a foundation for children's cognitive, language, social-emotional, physical-motor, moral, and artistic development. At ages 5–6, learning is particularly responsive to experiences that are concrete, visually accessible, playful, exploratory, and supported by meaningful interaction. These characteristics imply that learning resources should not merely deliver information; they should help children observe objects, connect new information with prior experiences, communicate their understanding, and participate actively in learning. Meaningful learning is strengthened when new information can be related to learners' existing knowledge and represented in an accessible form (Bryce & Blown, 2024).

Cultural literacy is particularly important because early encounters with local culture contribute to children's sense of identity, belonging, and understanding of cultural diversity. Acevedo (2019) shows that young children's intercultural understanding can develop through playful and socially situated experiences, while culturally responsive early childhood education emphasizes the relevance of children's cultural environments to learning (Chen et al., 2024; Slaughter et al., 2024). Local cultural content therefore needs to be presented not only as information to memorize but also as an object of observation, discussion, appreciation, and communication. In this study, cultural literacy is operationalized through four dimensions: recognition, understanding, appreciation, and expression, with the learning content focused specifically on the *Rumah Lontiok* of Kampar.

The characteristics of Augmented Reality (AR) are theoretically compatible with these learning needs. Azuma (1997) defines AR as a system that combines real and virtual environments in real time, enabling digital information to be perceived within the user's physical context. For young children, this combination can bridge static representation and direct experience: a printed flashcard remains a tangible object, while scanning it can generate a three-dimensional representation that children can observe from different perspectives. The multimodal presentation of 3D objects, animation, narration, and short textual information can also support attention and discussion. Pan et al. (2021) found that AR can support early childhood literacy learning through interactive experiences, while Yilmaz (2016) reported positive effects of AR-based educational toys on children's motivation, engagement, and conceptual understanding. Thus, AR is relevant not because technology itself guarantees

learning, but because its affordances can be deliberately aligned with children's concrete, visual, playful, and exploratory learning characteristics.

The cultural content is equally important. Technology becomes pedagogically meaningful when the digital representation is connected to a cultural context that is familiar or locally relevant to children. Research on culturally relevant early childhood learning indicates that local heritage can support children's cultural understanding and identity when it is integrated into contextual learning experiences (Hasanah et al., 2025; Hayashi et al., 2022; Zheng & Guo, 2024). In the present study, the AR content is deliberately limited to the *Rumah Lontiok* rather than representing all elements of Kampar culture. The flashcard presents the name of the house and its main parts, while the AR visualization provides a more concrete representation for guided observation and discussion.

Preliminary observations at *TK Mutiara Bunda*, Bangkinang Kota, showed that cultural learning was still dominated by conventional media such as pictures, books, and oral explanations. Teachers reported a need for interactive media that could make cultural content more concrete and engaging, and they had limited experience using AR in classroom learning. These conditions provided a practical basis for developing a locally contextualized AR learning resource.

Previous studies provide a foundation but also reveal a specific gap. Yilmaz (2016) examined AR educational toys for early childhood education and reported gains in motivation and engagement, but the content was not focused on local cultural literacy. Pan et al. (2021) examined AR in early childhood literacy learning, but the literacy target was not cultural heritage. Fitriani et al. (2024) developed 3D AR media based on Sasambo culture, demonstrating the feasibility of linking AR with local cultural content, but the cultural context and learning indicators differed from those of Kampar. Mardiansyah et al. (2025) examined AR-supported pop-up books for early childhood literacy about Indonesian cultural heritage, but the product and cultural focus were broader. Further studies demonstrate the potential of AR flashcards for cultural diversity learning, although their participants were elementary school students (Candra & Astuti, 2026). Taken together, these studies indicate that AR has been used for early literacy, cultural learning, and interactive flashcards, but the specific combination of marker-based AR flashcards, *Rumah Lontiok* content, and cultural literacy indicators for children aged 5–6 remains insufficiently addressed in the studies reviewed for this manuscript.

The novelty of this study therefore lies in the contextual integration of a marker-based AR flashcard featuring *Rumah Lontiok* as a specific cultural object from Kampar with developmentally appropriate cultural literacy indicators for children aged 5–6. The contribution is not simply the use of AR technology, but the alignment of local cultural content, tangible flashcards, 3D visualization, teacher-guided interaction, and the four cultural literacy dimensions used in the study. Accordingly, this research aimed to develop an AR flashcard featuring *Rumah Lontiok* and to examine its validity, practicality, and preliminary evidence of changes in children's cultural literacy scores.

Table 1. Synthesis of Selected Prior Studies and the Research Gap

Study	Main Focus	Participants/Context	Contribution Relevant to the Present Study
Yilmaz (2016)	AR educational toys	Early childhood	Shows potential of AR for motivation, engagement, and conceptual understanding.

Study	Main Focus	Participants/Context	Contribution Relevant to the Present Study
Pan et al. (2021)	AR for early literacy	Young children	Shows that interactive AR can support early literacy learning.
Fitriani et al. (2024)	3D AR based on Sasambo culture	Early childhood	Demonstrates the feasibility of combining AR with local cultural content.
Mardiansyah et al. (2025)	AR pop-up book and Indonesian cultural heritage	Early childhood	Shows potential of AR for cultural-literacy-related learning.
Candra & Astuti (2026)	AR flashcards and cultural diversity	Elementary students	Supports the flashcard–AR format, but differs in age and learning context.
Present study	Marker-based AR flashcard featuring <i>Rumah Lontiok</i>	Children aged 5–6, <i>TK Mutiara Bunda</i>	Combines tangible AR flashcards, specific <i>Kampar</i> heritage content, and cultural-literacy indicators.

METHOD

This study employed a Research and Development (R&D) approach using the ADDIE model proposed by Branch (2009). The model was selected because its sequential and iterative structure allows learning needs to inform design decisions, design outputs to guide product development, expert feedback to guide revision, and implementation data to inform evaluation. The product developed was a marker-based Augmented Reality (AR) flashcard featuring the *Rumah Lontiok*, including the name of the house and its major parts. The AR component was accessed through a smartphone camera. After the marker was detected, the application displayed a three-dimensional representation of the *Rumah Lontiok* along with supporting information.

The study involved different participants for different development purposes. Three experts participated in product validation: one media expert, one language expert, and one cultural-literacy expert. Six kindergarten teachers participated in the Focus Group Discussion (FGD) and completed the practicality questionnaire after using and discussing the media. Four children aged 5–6 years participated in the formative small-group trial. Twelve children aged 5–6 years from Group B participated in the large-group trial and constituted the dataset for the final pretest–posttest analysis. Thus, the 16 children were not treated as one homogeneous effectiveness sample: the four-child group was used for formative development, whereas the 12-child group was used for the final inferential analysis.

The Analysis stage combined classroom observation, teacher needs analysis through Google Forms, curriculum analysis, and identification of children's learning characteristics. The output was a needs profile indicating reliance on conventional media for cultural learning, the need for interactive visualization, teachers' interest in AR, and curriculum alignment for introducing the *Rumah Lontiok*. The Design stage translated these findings into a media framework, storyboard, flashcard marker, 3D content plan, short narration and supporting information, learning objectives, and research instruments. The Development stage involved producing the AR flashcard and the 3D representation of the *Rumah Lontiok*, followed by internal testing and expert review. Expert feedback resulted in revisions, including adding learning objectives to the flashcard, italicizing local terms, completing the regional naming of the *Rumah Lontiok*, and adjusting visual proportions. The Implementation stage consisted of

the four-child formative trial and the 12-child large-group trial. The Evaluation stage integrated formative feedback, validation results, practicality results, and the large-group pretest–posttest analysis.

The instruments were developed based on the study's cultural-literacy framework, product specifications, and learning objectives. The validation and practicality sheets used a five-point scale, whereas the child cultural-literacy observation instrument used a four-level performance scale. The instruments were reviewed by the corresponding experts before data collection. The media-validation sheet contained 12 items covering visual presentation, attractiveness and motivation, learning suitability, ease of use, technical functionality, child safety, and readability. The language-validation sheet contained eight items covering age appropriateness, clarity and accuracy, cultural-language suitability, and grammar. The cultural-literacy/content validation sheet contained five items addressing the relevance of the content to the four cultural-literacy dimensions: recognition, understanding, appreciation, and expression of the *Rumah Lontiok*. The practicality questionnaire contained nine items covering ease of use, child engagement, usefulness, and technical stability and was completed by six teachers. The effectiveness instrument contained eight child indicators: two recognition indicators, two understanding indicators, two appreciation indicators, and two expression indicators. The maximum possible score across the eight indicators was 32.

Table 2. Summary of Research Instruments

Instrument	Respondent	Items	Scale	Purpose
Media validation	Media expert	12	1–5	Visual, usability, technical and safety quality
Language validation	Language expert	8	1–5	Age appropriateness, clarity, cultural language and grammar
Cultural-literacy/content validation	Cultural-literacy expert	5	1–5	Content relevance and alignment with cultural-literacy indicators
Practicality	6 teachers	9	1–5	Ease, engagement, usefulness and technical stability
Cultural-literacy effectiveness	12 children in large-group analysis	8	1–4	Recognition, understanding, appreciation and expression

Validity and practicality percentages were calculated by dividing the obtained score by the maximum possible score and multiplying the result by 100. Following the criteria used in the development study, scores of 80–100% were interpreted as highly valid, scores of 60–79% as sufficiently valid, and scores below 60% as invalid. For practicality, scores of 81–100% were interpreted as highly practical, 61–80% as practical, 41–60% as sufficiently practical, 21–40% as less practical, and 0–20% as impractical. These percentage-based interpretations were adapted from the scoring approach described by Sugiyono (2018).

For the large-group pretest–posttest data, normality was examined using the Shapiro–Wilk test because the sample consisted of 12 children. A significance value below .05 was interpreted as evidence of non-normality. Because both the pretest and posttest distributions were non-normal, the Wilcoxon signed-rank test was used at $\alpha = .05$. The null hypothesis stated that there was no significant difference between the pretest and posttest scores, whereas the alternative hypothesis stated that a significant difference existed.

The normalized gain (N-gain) was calculated for each child using the following formula:

$$g_i = (Posttest_i - Pretest_i) / (Maximum\ score - Pretest_i)$$

where the maximum score was 32. The reported N-gain of 81.54% represents the mean of the 12 individual normalized gains, rather than a single group-level gain calculated from the two mean scores. The mean normalized gain was 0.8154. Following Hake (1998), an N-gain value of $g > .70$ was interpreted as high. This distinction is important because calculating N-gain from the group mean pretest and posttest scores would produce a different value.

RESULTS

Analysis and Design

The needs analysis showed that cultural content had already been introduced at *TK Mutiara Bunda*, but teachers relied mainly on pictures, videos, books, and oral explanations. Teachers also reported that the available media did not consistently sustain children's attention and that an interactive medium was needed. The curriculum analysis identified the *Rumah Lontiok* as suitable for the Jati Diri and early literacy/STEAM-related learning goals used by the school. These findings informed the decision to develop a focused AR flashcard rather than a general digital catalogue of Kampar culture.

The design output was a printed flashcard functioning as an AR marker. When the marker is detected by a smartphone camera, the application displays a 3D representation of the *Rumah Lontiok* together with the house name, labels for its main parts, and supporting information. The design was intentionally focused on one cultural object so that the content remained manageable for children aged 5–6 and directly aligned with the cultural-literacy indicators.

Figure 1. AR flashcard featuring *Rumah Lontiok* and its learning objectives



The flashcard serves two functions: it is a tangible learning card that introduces the cultural object, and it functions as the marker that triggers the AR visualization. In classroom use, the teacher guides the child to point the smartphone camera at the marker; once the marker is detected, the 3D representation of the *Rumah Lontiok* appears on the device. This design

connects a physical, child-accessible object with a digital representation while keeping the teacher in the role of facilitator.

Development, Expert Validation, and Revision

The Development stage produced the final AR flashcard focused exclusively on the *Rumah Lontiok*. Three experts evaluated the product using the corresponding validation instruments. Table 3 presents the validation results.

Table 3. Expert Validation Results

Validator	Role	Score	Interpretation
Prof. Dr. Alwen Bentri, M.Pd.	Media expert	87.5%	Highly valid
Dr. Tressyalina, M.Pd.	Language expert	96.8%	Highly valid
Prof. Dr. Farida Mayar, M.Pd.	Cultural-literacy expert	95.0%	Highly valid

All three validation scores were above the 80% threshold. The media expert recommended adding learning objectives to the flashcard. The language expert recommended italicizing local terms, writing the regional name in full as *Rumah Lontiok* Kabupaten Kampar, Provinsi Riau, and correcting the visual proportions. These revisions were completed before the classroom trials. The validation process therefore functioned as both a quality check and a revision mechanism, rather than serving solely as a final score.

Practicality Based on Teacher Responses

Practicality was assessed based on teacher responses only. No separate child practicality questionnaire was used to calculate the 86.2% score. The six teachers completed the nine-item questionnaire after participating in the FGD and using the media. Table 4 presents the calculation.

Table 4. Teacher Practicality Scores

Teacher	Maximum score	Obtained score
Rian, S.Pd., AUD	45	40
Meri Arsita, S.Pd.	45	40
Silvia Agustien, S.Pd.	45	36
Fathiyah Munawwaroh, S.Psi.	45	39
Ratna Juita, S.Pd.	45	43
Evi Susanti, S.Pd., AUD.	45	35
Total	270	233

The practicality percentage was calculated as $233/270 \times 100 = 86.2\%$, placing the product in the highly practical category. Teachers reported that the media was easy to operate, useful for introducing the *Rumah Lontiok*, and attractive to children. These responses indicate the feasibility of classroom use; however, they do not by themselves establish learning effectiveness.

Formative Small-Group Trial

The small-group trial involved four children and was conducted as a formative stage before the large-group analysis. Its purpose was to observe the usability of the marker, the sequence of activities, and children's initial responses to the AR visualization. The mean cultural-literacy score increased descriptively from 16.25 to 30.25. Because this stage involved only four

children and was intended to inform formative development, these scores were not included in the final inferential analysis.

Table 5. Descriptive Results of the Small-Group Trial

Child	Pretest	Category	Posttest	Category
1	17	MB	32	BSB
2	16	MB	31	BSB
3	16	MB	26	BSB
4	16	MB	32	BSB
Mean	16.25	MB	30.25	BSB

Large-Group Trial and Cultural-Literacy Scores

The large-group trial involved 12 children and provided the dataset for the final pretest–posttest analysis. The assessment used eight indicators with a maximum score of 32. Table 6 presents the individual scores.

Table 6. Pretest and Posttest Cultural-Literacy Scores in the Large-Group Trial

No.	Pretest	Category	Posttest	Category
1	24	BSH	32	BSB
2	24	BSH	32	BSB
3	16	MB	31	BSB
4	18	MB	32	BSB
5	16	MB	31	BSB
6	16	MB	24	BSH
7	14	MB	22	BSH
8	16	MB	32	BSB
9	16	MB	30	BSB
10	10	BB	22	BSH
11	10	BB	22	BSH
12	16	MB	32	BSB
Mean	16.33	MB	28.50	BSB

The mean score increased from 16.33 at pretest to 28.50 at posttest. This change indicates a descriptive improvement in the participating children's cultural-literacy scores following the learning sequence using the AR flashcard. The inferential test was subsequently conducted to determine whether the paired score difference was statistically significant.

Normality and Wilcoxon Analysis

Table 7. Shapiro–Wilk Normality Test

Dataset	Statistic	df	Sig.	Interpretation
Pretest	.851	12	.037	Non-normal
Posttest	.712	12	.001	Non-normal

Both Shapiro–Wilk significance values were below .05; therefore, both distributions were treated as non-normal. Consequently, the Wilcoxon signed-rank test was selected for the paired pretest–posttest comparison.

Table 8. Wilcoxon Signed-Rank Test

Comparison	Z	Asymp. Sig. (2-tailed)	Decision
Posttest – Pretest	-3.076	.002	Reject H_0

The Wilcoxon test produced $p = .002$, which is below the .05 significance level. Thus, the null hypothesis of no pretest–posttest difference was rejected. The result indicates a statistically significant difference in cultural-literacy scores within the participating group. Because there was no control or comparison group, this result should not be interpreted as evidence that the AR flashcard alone caused the observed improvement.

Normalized Gain

Table 9. Individual Normalized-Gain Summary

Statistic	Value
Number of children	12
Minimum individual g	0.44
Maximum individual g	1.00
Mean individual g	0.8154
Mean individual N-Gain (%)	81.5446%

The normalized gain was calculated for each child and then averaged. The mean individual gain was 0.8154, equivalent to 81.5446%. Because Hake (1998) classifies $g > .70$ as high, the result falls within the high-gain category. The 81.54% value therefore represents the average individual normalized gain and should not be confused with the group-level gain calculated from the two mean scores.

DISCUSSION

Theoretical Alignment of AR, Early Childhood Learning, and Cultural Literacy

The study's development decisions can be understood through the alignment between children's learning characteristics, cultural-literacy goals, and AR affordances. The needs analysis showed that teachers wanted a more interactive representation of the *Rumah Lontiok*, while the product design provided a tangible marker and a 3D visualization. The data directly demonstrate the need for and acceptance of this format, whereas the explanation that AR supports concrete learning is a theoretical interpretation grounded in the characteristics of the technology and prior research.

For children aged 5–6 years, learning through observation, play, exploration, and guided interaction is particularly relevant. The AR flashcard preserves a physical object that children can hold and examine while adding a virtual 3D representation. Azuma (1997) explains that AR combines real and virtual elements in real time, while Bryce & Blown (2024) emphasize the importance of connecting new information with meaningful prior knowledge. In the present context, children can connect the printed image and spoken name of the *Rumah Lontiok* with the 3D representation and labels of its parts. This multimodal connection may help children organize cultural information more concretely, although the present study did not directly measure the mechanism underlying this learning process.

The cultural dimension further strengthens the pedagogical rationale. Culturally relevant learning environments can support children's understanding of identity and heritage when local content is embedded in meaningful activities (Chen et al., 2024; Hayashi et al., 2022; Zheng & Guo, 2024). Hasanah et al. (2025) likewise found that local cultural heritage can be

integrated into early childhood learning to support cultural literacy. The present study extends this line of work by using a specific Kampar heritage object and representing it through a marker-based AR flashcard. The contribution is therefore contextual: the technology is used as a means of making a local cultural object more observable and discussable, rather than as an end in itself.

Product Validity and the Role of Expert Revision

The validation scores of 87.5%, 96.8%, and 95.0% indicate that the product met the study's predetermined high-validity threshold. The three expert perspectives were complementary: the media expert addressed visual and technical quality, the language expert addressed age-appropriate communication, and the cultural-literacy expert addressed content alignment. The expert comments also demonstrate why validation should be understood as an iterative quality-assurance process. Adding learning objectives, refining local terminology, and correcting visual proportions improved the alignment between the product and its intended learning use.

This interpretation is consistent with culturally responsive early childhood education, which requires learning resources to consider children's developmental characteristics and the cultural contexts in which they learn (Slaughter et al., 2024). It also complements research showing that AR products for early childhood can achieve feasibility when technology, content, and pedagogy are designed together (Fitriani et al., 2024; Rahmaniar, 2021). The validation data directly support the quality judgment of the product; however, claims about longer-term learning impact remain outside the scope of expert validation.

Practicality and Classroom Use

The 86.2% practicality score was based solely on six teacher responses and therefore represents perceived usability from the teachers' perspective. No separate child practicality questionnaire was used to calculate this score. Teachers reported that the media was easy to use and useful for introducing the *Rumah Lontiok*. During implementation, children were observed to show interest in scanning the marker and viewing the 3D object. The practicality score directly supports the usability claim, while these observations provide contextual evidence of children's engagement rather than a separate quantitative measure of practicality.

The teacher's facilitator role is important. AR should not replace social interaction in early childhood learning; rather, it can provide an additional representation that the teacher uses to prompt naming, pointing, questioning, and discussion. Pan et al. (2021) similarly highlighted the interactive potential of AR in early childhood literacy. In the present study, the teacher guided children in scanning the flashcard and discussing the name and parts of the *Rumah Lontiok*. Thus, the product's practicality is best understood in terms of its compatibility with teacher-guided classroom routines.

Preliminary Evidence of Change in Cultural Literacy

The small-group trial showed a descriptive increase from 16.25 to 30.25, while the large-group trial showed an increase from 16.33 to 28.50. In the large group, the Wilcoxon test yielded $p = .002$, indicating a statistically significant paired difference. The N-gain analysis further showed a mean individual gain of 0.8154, classified as high. These results indicate an improvement in cultural-literacy scores among the participating children.

A possible theoretical interpretation of this improvement is that the AR flashcard provided children with a richer representation of cultural information than the conventional materials identified during the needs analysis. The children could see the physical flashcard, scan the marker, observe the 3D house, identify its parts, and respond to teacher questions. Fitriani et al. (2024) similarly reported that 3D AR based on local culture can support children's early understanding of cultural content. However, that study and the present study differ in product design, indicators, and participants; therefore, the comparison should be interpreted as converging evidence for the potential of AR-supported cultural learning rather than as evidence of an identical learning mechanism.

Most importantly, the statistical result must be interpreted within the context of the one-group design. A significant pretest–posttest difference cannot isolate the effect of the AR flashcard from teacher guidance, repeated exposure, maturation, classroom interaction, or other learning experiences. The present findings therefore provide preliminary evidence of improvement associated with the implementation of the developed media, rather than definitive causal evidence of its effectiveness. Future studies should use larger samples and, where feasible, comparison groups or stronger experimental designs.

ADDIE as an Integrated Development Process

The five ADDIE stages were interconnected. The Analysis stage identified the limitations of conventional cultural-learning media and the need for concrete, interactive representations. These findings informed the Design stage, in which the researchers selected a focused flashcard format, developed the storyboard, specified the AR marker, and aligned the content with the cultural-literacy indicators. The Development stage transformed the design into a functioning product and used expert feedback to revise the learning objectives, terminology, and visual presentation. The Implementation stage then examined the product first with four children for formative purposes and subsequently with 12 children for the final paired analysis. The Evaluation stage brought together validation, practicality, formative observations, and pretest–posttest evidence.

This sequence is important because the quality of the final product was not determined by the technology alone. The needs analysis established the pedagogical problem; the design translated the problem into product requirements; development and expert validation addressed product quality; implementation examined classroom use; and evaluation integrated the evidence for further judgment. This is consistent with Branch's (2009) view of ADDIE as a systematic instructional-design process in which development decisions are informed by analysis and evaluation. The present study therefore illustrates ADDIE as an iterative bridge between a local learning need and a classroom-ready technological resource.

Contribution and Limitations

The main contribution of the study is the contextualization of AR within early childhood cultural literacy using a specific Kampar heritage object. The product makes the *Rumah Lontiok* accessible through a tangible flashcard and 3D visualization while maintaining teacher-guided interaction. This contribution complements studies emphasizing local wisdom and culturally responsive learning in early childhood (Eliza et al., 2024; Suryaningsih et al., 2025).

Several limitations should be considered. The final inferential analysis involved only 12 children from one kindergarten and used a one-group pretest–posttest design. The study therefore cannot establish a causal effect attributable exclusively to the AR media. The cultural content was also intentionally limited to the *Rumah Lontiok*, specifically its name and

major parts, rather than representing the full range of Kampar cultural heritage. In addition, the marker-based format depends on a functioning smartphone camera and successful marker detection. These limitations define the appropriate scope of the present findings and should guide future development and testing.

CONCLUSION

This study developed a marker-based Augmented Reality (AR) flashcard featuring the *Rumah Lontiok* of Kampar using the ADDIE model. The product demonstrated high validity based on assessments by media, language, and cultural-literacy experts and high practicality based on teacher responses. The pretest–posttest findings also showed an increase in children's cultural-literacy scores, supported by a statistically significant paired difference and a high mean individual normalized gain.

These findings indicate that the developed AR flashcard is a valid and practical learning resource and provides preliminary evidence of improved cultural-literacy scores among the participating children. The product contributes to early childhood cultural learning by integrating a tangible flashcard, 3D AR visualization, and teacher-guided interaction around a specific local cultural object.

However, the findings should be interpreted within the limitations of the one-group pretest–posttest design, small sample, and absence of a comparison group. Therefore, the study does not establish a definitive causal effect of the AR media on children's cultural literacy. Future research should involve larger and more diverse samples, comparison or experimental designs, and broader cultural content beyond the *Rumah Lontiok* to further examine the potential of AR-based learning for early childhood cultural literacy.

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