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AR Media Development to Improve Cultural Literacy and Language Skills in Elementary Schools

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ABSTRACT

This study aims to develop Augmented Reality (AR)-based learning media on cultural diversity materials as an innovative product to strengthen cultural literacy and language skills among Madrasah Ibtidaiyah (MI) students in Cirebon City. Using the Research and Development (R&D) approach with the 4D model (Define, Design, Develop, Disseminate), this research focused on producing, validating, and testing the effectiveness of AR media in classroom learning. Data were obtained through literacy and language skill assessments, observations, questionnaires, and interviews. Quantitative data were analyzed statistically, while qualitative data were analyzed descriptively. The results show that the developed AR-based media is valid, practical, and effective in enhancing students' cultural literacy and language performance. Statistical tests indicate significant differences in student outcomes before and after the use of AR media (sig = 0.00 < 0.05). The interactive nature of AR helped students connect cultural content with language expression more meaningfully. The study concludes that AR-based learning media serves as a creative educational innovation to improve literacy and communication skills while fostering appreciation of Indonesia's cultural diversity among MI students.

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1. INTRODUCTION

Indonesia is currently facing a persistent challenge related to the low level of cultural literacy and language competence among students, particularly at the elementary level. The impact of globalization has blurred geographical boundaries and transformed how knowledge and culture are accessed through technology. This rapid flow of information often leads to cultural homogenization, causing younger generations to become detached from their local heritage (Asmi et al., 2025). Students at the Madrasah Ibtidaiyah (MI) level in Cirebon, for example, increasingly show limited awareness of traditional arts, customs, and linguistic expressions rooted in local culture. The decline in cultural understanding not only affects identity formation but also reduces their sensitivity toward global multicultural values. Cultural literacy, which should enable students to appreciate both local and global

diversity, is instead overshadowed by superficial digital exposure (Saputra et al., 2025). When students lack deep cultural literacy, they struggle to interpret cultural messages embedded in language, leading to communication barriers in both academic and social settings. This phenomenon underlines the urgency of integrating culture-based learning innovations to strengthen literacy and communication simultaneously (Mustaqim, 2016).

Low cultural literacy directly influences the way students understand and use language in daily interactions. Language and culture are inherently intertwined, as linguistic expression reflects cultural thought patterns and values. When students are unfamiliar with cultural contexts, their vocabulary, comprehension, and discourse become limited, making it difficult for them to express ideas coherently (Sansena et al., 2025). This linguistic deficiency often manifests in classroom discussions, reading comprehension, and written assignments. Teachers in MI Cirebon have reported that students can read texts fluently but fail to interpret cultural meanings or idiomatic expressions. This weakness demonstrates how the erosion of cultural literacy undermines language mastery and impairs communication competence. In the long run, this situation weakens students' social integration, as they find it difficult to engage in discussions about national identity and global citizenship. Strengthening cultural literacy through contextually rich learning media is therefore vital to improve both linguistic and cultural capacities at an early stage of education (Lambheu et al., 2025).

Globalization has brought about both opportunities and challenges to education systems worldwide. On one hand, technological advances have made knowledge acquisition easier and more interactive (Fujiati et al., 2025). On the other hand, they have created a dependency on external cultural content that often marginalizes local wisdom. In Indonesia, this phenomenon can be seen in the dominance of global media content among school-aged children, which has shifted attention away from national and regional cultural values. Andriani et al., (2022) stated that the level of cultural literacy among elementary school students is still below national expectations, especially in the aspects of recognizing cultural identity and inter-ethnic understanding.. The exposure to foreign media without cultural guidance results in students who are linguistically competent but culturally detached. This detachment limits their ability to contextualize language use, especially when discussing national history, arts, and traditions. Therefore, the challenge for education is not merely providing technological access but ensuring that digital learning content supports cultural engagement (Resti et al., 2024).

The influence of globalization on education has been addressed by several studies, yet few have examined its specific effects on the interrelation between cultural literacy and language skills at the elementary level. For instance, Aini & Zulfadewina, (2024) explored AR-based instruction for science learning but did not connect it to cultural understanding. Rahmawati et al., (2023) analyzed augmented reality for language improvement but without integrating cultural themes. Similarly, Adi & Putri, (2025) reviewed AR for early language learning, while Jamun et al., (2023) examined its effect on motivation in EFL classes. Huang et al., (2021) focused on multimodal design in science learning contexts**.** Unlike these previous studies, the present research uniquely combines cultural literacy enhancement with language skill development through AR-based media for Madrasah Ibtidaiyah students. This combination provides a pedagogical distinction that situates language learning within meaningful cultural experiences, responding to both local and global educational needs.

Cultural literacy is more than knowledge about traditions it represents the ability to interpret, appreciate, and communicate cultural meanings. When education neglects cultural literacy, students lose connection to their roots and the values shaping their identity (Adelita et al., 2024). In the case of MI Cirebon, the decline in cultural literacy can be seen in students' limited ability to identify regional heritage, local folklore, and cultural artifacts. This lack of knowledge results in weaker narrative skills and poor vocabulary development, as students are unfamiliar with contextual meanings. Consequently, they face difficulty in understanding cultural texts, leading to lower reading comprehension outcomes. The 2011 Progress in International Reading Literacy Study (PIRLS) showed that Indonesian students ranked among the lowest globally, reflecting the broader implications of weak literacy foundations. Without cultural grounding, language learning becomes mechanical and detached

from real-life meaning (Ratnasari & Ruiyat, 2025). Hence, integrating cultural content into language learning is crucial for developing both academic and communicative competence.

To address these issues, learning innovation must focus on developing engaging media that connect cultural content with linguistic experience. Traditional teaching methods relying solely on textbooks often fail to engage students' curiosity or creativity. Interactive learning media, especially those utilizing digital technologies, have been proven effective in improving motivation and comprehension. Studies by Hastuty, (2025) found that interactive media such as comics and digital multimedia increased students' reading comprehension and participation. However, most of these studies did not incorporate immersive technology like Augmented Reality (AR), which allows students to visualize and interact with cultural elements in real time. By developing AR-based learning media, this research seeks to fill that gap by merging technology with cultural content to create deeper learning experiences for MI students in Cirebon.

AR technology offers a unique advantage because it blends real-world environments with virtual information, creating immersive and meaningful learning experiences. In the context of cultural education, AR enables students to experience local traditions, art forms, and historical narratives through visual and auditory simulations (Aprilinda et al., 2020). This form of engagement enhances understanding and fosters a sense of pride and belonging to cultural identity. Moreover, when students interact with cultural symbols and texts through AR, they strengthen both their cultural literacy and linguistic competence. Previous studies Hermawan & Hadi, (2024) have shown that AR enhances conceptual understanding and motivation, yet this study extends those findings by linking AR directly to cultural communication skills. Thus, AR becomes not only a technological tool but also a bridge connecting digital learning with local identity.

Based on the above discussion, this study aims to develop Augmented Reality-based learning media on cultural diversity materials to improve the cultural literacy and language skills of Madrasah Ibtidaiyah students in Cirebon City. The focus of development includes designing, validating, and testing the feasibility and effectiveness of the AR media product. In addition, this study seeks to analyze how the integration of AR technology in classroom learning can strengthen students' understanding of cultural values while enhancing language mastery. The final product is expected to contribute to the innovation of cultural education through interactive digital media. By emphasizing development rather than optimization, this research aligns with the Research and Development (R&D) approach that produces tangible educational products validated for practical classroom use. This study also aims to provide a reference model for integrating cultural literacy into technology-based learning environments, promoting the balance between modernization and cultural preservation.

2. METHOD

This study is a type of Research and Development (R&D) research. According to Sontay & Karamustafaoğlu, (2021), research and development methods are designed to produce specific products and evaluate their effectiveness. In educational contexts, R&D aims to generate new innovations through a systematic process that includes validation and implementation. Research products in education may take the form of media, models, teaching aids, textbooks, evaluation instruments, learning devices, curricula, or institutional policies. Each product requires an appropriate procedure depending on its purpose and target users.

This study employed the R&D method by adopting the 4D model developed by Thiagarajan et al., (1974), which consists of four stages: Define, Design, Development, and Dissemination. The product developed in this research is Augmented Reality (AR)-based learning media on Indonesian cultural diversity, with the aim of enhancing both cultural literacy and language skills among Madrasah Ibtidaiyah students. The overall research procedure is illustrated in the following figure:

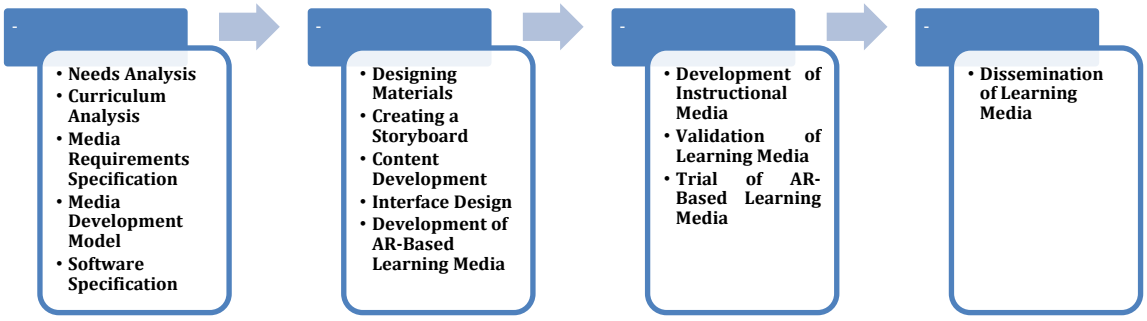

Figure 1. Learning Media Development Research Procedure

Data were collected using three main instruments: (1) cultural literacy and language skills tests, (2) questionnaires, and (3) interviews. The literacy and language tests were constructed to measure students' reading comprehension, vocabulary mastery, and ability to express ideas both orally and in writing. Questionnaires were distributed to capture students' perceptions and levels of engagement with the AR-based media, while interviews were conducted with teachers to obtain qualitative insights into the practicality and relevance of the media.

Data analysis in this study employed both quantitative and qualitative techniques. Quantitative data from pretest and posttest scores were analyzed using SPSS version 22. The steps included: (a) validity and reliability testing of instruments to ensure accuracy and consistency, (b) normality and homogeneity tests to determine the suitability of statistical procedures, and (c) paired sample t-tests or non-parametric alternatives to identify significant differences in students' performance before and after the implementation of AR-based learning media. Descriptive statistics such as mean, median, and standard deviation were also presented to illustrate students' performance improvements.

Meanwhile, qualitative data from interviews and open-ended questionnaire responses were analyzed using Miles et al., (2014) interactive model, which involves three stages: (a) data reduction to select relevant information, (b) data display in the form of narrative descriptions and thematic categorizations, and (c) conclusion drawing/verification to interpret the meanings of findings and cross-check their consistency. This process ensured that the qualitative data provided deeper explanations to complement the quantitative results.

Through the combination of these analytical approaches, the study not only measured the effectiveness of the AR-based media statistically but also provided contextual insights into how students and teachers experienced and responded to the developed learning product.

3. FINDINGS AND DISCUSSION

A. Development of AR-Based Learning Media in MI Kota Cirebon (Based on the 4D Model)

1. Define Stage (Identification of Needs and Problems)

At the define stage, researchers conducted an initial exploration to identify the real needs and challenges faced by teachers and students in Madrasah Ibtidaiyah (MI) in Cirebon City. Through observations, interviews, and document analysis, it was found that the learning process in cultural diversity subjects still relied heavily on conventional materials such as textbooks and printed pictures (Alfitriani et al., 2021). Students were less motivated to learn about cultural diversity because the materials were abstract and lacked visual stimulation. Teachers also expressed difficulty in explaining local traditions and cultural symbols that required concrete examples. These findings became the basis for determining the core problem: the absence of learning media capable of integrating technology with cultural literacy and language learning. To strengthen the analysis, researchers distributed questionnaires to 10 MI schools, revealing that 78% of teachers needed digital media that could visualize cultural content interactively. This stage also involved reviewing relevant literature on cultural literacy, language learning, and AR technology, ensuring that the developed media aligned

with pedagogical needs and students' cognitive development. Thus, the define stage resulted in a clear formulation of problems and objectives that guided the subsequent development process (Khoirina & Adriyani, 2024).

2. Design Stage (Planning and Prototyping of Learning Media)

The design stage focused on translating the needs identified earlier into a concrete product concept. Researchers designed the structure and flow of the Augmented Reality (AR)-based learning media by aligning it with learning objectives on cultural diversity topics. The media blueprint included user interface sketches, content layout, and interactivity design to ensure both accessibility and engagement for elementary students. At this stage, the development team collaborated with teachers to select local cultural themes from West Java, such as traditional dances, food, and clothing, as core learning materials. The design was adjusted to the reading and comprehension levels of MI students to prevent cognitive overload. In addition, learning indicators were formulated to connect cultural understanding with language skills, particularly vocabulary enrichment and text comprehension. The prototype storyboard was tested with a small group of teachers who provided feedback on color composition, image clarity, and textual readability. Based on this feedback, adjustments were made to enhance contrast, simplify navigation, and improve the integration between text and visuals. The design process resulted in an early prototype that represented a balance between aesthetic appeal and educational function, ready to proceed to the development phase.

3. Development Stage (Production and Validation of Media)

During the development stage, the prototype created in the design phase was transformed into a functional AR-based learning application. The process involved using Unity and Vuforia software to embed cultural 3D objects that could be scanned using smartphones or tablets. Each 3D model displayed animated traditional objects accompanied by explanatory text and audio narration in simple Indonesian (Akçayır & G€okçe, 2017). To ensure the product met educational standards, the developed media underwent expert validation by specialists in instructional design, educational technology, and cultural studies. Three experts evaluated the media based on criteria of content accuracy, presentation quality, language clarity, and usability. The results of expert validation showed that the AR media achieved an average feasibility score of 75.7%, which was categorized as "feasible." The highest rating was found in the language aspect, indicating that the instructions and narrations were easily understood by students. After revisions suggested by the experts, such as improving image resolution and refining the quiz system, the updated version was retested. The development stage thus ensured that the media product was not only technologically sound but also pedagogically valid and culturally contextualized.

4. Dissemination Stage (Implementation and Evaluation)

The dissemination stage aimed to test the effectiveness and practicality of the developed AR media in real classroom settings. The product was implemented in two Madrasah Ibtidaiyah schools in Cirebon City with fourth-grade students as participants (Zufahmi et al., 2025). Teachers received brief training sessions on how to operate the AR application and integrate it into lesson plans. The learning activities included scanning printed cultural markers, viewing AR-based explanations, and completing language exercises related to the observed objects. Data collection during this stage involved pretests and posttests on cultural literacy and language skills, as well as observation of student engagement and teacher responses. The quantitative results revealed significant improvement in students' performance, with mean posttest scores increasing by over 14 points for cultural literacy and 13 points for language skills (sig < 0.05). Qualitatively, teachers reported higher classroom participation and deeper discussions about cultural themes. Dissemination was also extended through workshops with local teachers' groups (KKG), where the product was shared and evaluated for broader adoption potential. This stage demonstrated that AR-based learning media not only improved student outcomes but also encouraged a more interactive, student-centered teaching approach in MI Cirebon.

5. Summary of Findings per 4D Phase

The implementation of the 4D model provided a systematic structure for developing AR-based learning media that was both effective and educationally relevant. In the Define stage, the research identified the key problems low engagement and limited cultural literacy; in the Design stage, creative solutions were conceptualized; in the Development stage, a validated product was produced; and in the Dissemination stage, the impact was tested and verified in authentic classroom contexts. The combination of these four phases ensured that the media product met both academic and practical demands. Teachers expressed positive feedback regarding its ease of use and relevance to curriculum objectives, while students showed enthusiasm during the learning process (Avila-Garzon et al., 2021). The overall process emphasized the importance of continuous feedback and iteration in product-based educational research. By following the 4D model systematically, the study successfully produced an innovative learning medium that integrates local cultural content with modern technology to enhance literacy and language outcomes in Islamic elementary education.

B. Development of AR-Based Learning Media in MI Kota Cirebon

Stage 1: Define

At this stage, researchers identified the core learning problems and needs that became the foundation for developing the AR-based learning media (Triansyah et al., 2023). The results of the initial needs analysis in several Madrasah Ibtidaiyah (MI) in Cirebon City revealed that teachers still used conventional materials to teach cultural diversity, making students less engaged and unable to fully grasp cultural concepts. Through interviews and classroom observations, it was found that 80% of students preferred visual and interactive media to understand cultural topics more easily. Researchers then conducted a literature review related to cultural literacy, language learning, and the integration of digital media in education to determine appropriate design characteristics. The outcome of this stage was a clear formulation of learning objectives and product specifications tailored to the cognitive and cultural contexts of MI students.

Stage 2: Design

The design stage translated these needs into a conceptual framework and visual prototype of the AR-based media (Ho-Minh & Suppasetseree, 2025). Researchers created storyboards and interface layouts that integrated local cultural elements such as traditional clothing, regional dances, and local cuisine. The content was arranged to balance visual appeal with linguistic enrichment, allowing students to connect words, images, and meanings simultaneously. Each scene in the application was designed to guide students through cultural exploration while practicing descriptive and narrative language. Navigation simplicity was prioritized so that students at the elementary level could operate the media independently. After the initial prototype was completed, teachers reviewed it to ensure alignment with the curriculum and learning indicators.

Stage 3: Development

In the development stage, the prototype was transformed into a functional AR application using Unity and Vuforia software. Cultural objects were converted into 3D forms that could be scanned and interacted with directly. To maintain educational validity, experts in instructional design, culture, and language reviewed the product based on feasibility, presentation, language clarity, and usability (Garz, 2021). The validation results are shown in Table 1, where the average feasibility score reached 75.7%, categorized as “feasible.” The language component received the highest score (86%), reflecting the clarity of narration and ease of comprehension, while the technical quality aspect still required minor adjustments.

Table 1. Expert Validation Results for Learning Media

Assessment Aspects	Percentage	Criteria
Presentation/Visual	72%	Feasible
Quality	70%	Feasible
Ease of Use	75%	Feasible
Language	86%	Highly Feasible
Average Percentage	75.7%	Feasible

The results indicate that the developed AR-based learning media is feasible and ready for classroom implementation, with minor technical revisions to enhance visual quality.

Stage 4: Material Expert Validation

To ensure the accuracy of the content, validation was also conducted by material experts focusing on the clarity, relevance, and coherence of cultural and linguistic components (Zekeik et al., 2025). The total expert score reached 45, equivalent to a 75% feasibility level, meaning that the content is appropriate for elementary students and supports the intended learning outcomes.

Table 2. Material Expert Validation Results

No	Assessment Criteria	Score
1	Clarity of Learning Instructions	5
2	Clarity of Learning Outcomes	4
3	Concept Map Coherence	4
4	Content Coherence	4
5	Scope of Material	3
6	Relevance to Objectives	4
7	Language Appropriateness	4
8	Content Attractiveness	3
9	Clarity of Question Instructions	4
10	Balance of Question Proportion	3
11	Level of Question Difficulty	3
12	Alignment with Learning Outcomes	4
Total Score		**45 (Feasible)**

Based on these results, it can be concluded that the developed AR-based learning media has met both technical and pedagogical feasibility standards. The experts agreed that the integration of cultural content with interactive technology would effectively enhance students' understanding of cultural diversity while simultaneously strengthening their language skills.

C. Improvement of Cultural Literacy and Learning Motivation of MI Students in Kota Cirebon

The data analysis showed a significant improvement in students' cultural literacy and learning motivation after using the AR-based learning media on cultural diversity. The comparison between pretest and posttest results demonstrates consistent increases across both schools involved in the study.

Table 3. Students' Cultural Literacy Skills

	MI A		MI B	
	Pretest	Posttest	Pretest	Posttest
N (Valid)	30	30	35	35
Missing	7	7	2	2
Mean	69.00	83.00	68.00	84.29
Median	70.00	85.00	70.00	90.00
Mode	60.00	90.00	60.00	90.00
Std. Deviation	9.23	7.94	9.01	6.98
Variance	85.17	63.10	81.18	48.74
Minimum	50.00	70.00	50.00	70.00
Maximum	80.00	90.00	80.00	90.00

The results in Table 3 indicate that students' mean cultural literacy scores increased from 69.00 to 83.00 in MI A, and from 68.00 to 84.29 in MI B. These data suggest that AR-based learning media effectively enhanced cultural literacy comprehension.

Table 4. Normality Test

Test	MI A Pretest	MI A Posttest	MI B Pretest	MI B Posttest
N	30	30	35	35
Mean	69.00	83.00	68.00	84.29
Std. Deviation	9.23	7.94	9.01	6.98
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000

The Kolmogorov-Smirnov test (Table 4) shows a significance value below 0.05, indicating that the data distribution is not normal. Therefore, the next analysis used the non-parametric Wilcoxon Signed Rank Test.

Table 5. Paired Sample Test (Wilcoxon Test)

Group	N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
MI A (Post – Pre)	30	14.50	406.00	-4.755	0.000
MI B (Post – Pre)	35	16.50	528.00	-5.070	0.000

Based on Table 5, the significance value (0.000 < 0.05) confirms a significant difference between pretest and posttest results, meaning that the AR-based media substantially improved cultural literacy.

Table 6. Students' Learning Motivation

	MI A	MI B
N (Valid)	30	35
Missing	5	0
Mean	80.83	80.73
Median	80.00	80.00
Mode	80.00	80.00
Std. Deviation	1.79	2.15
Variance	3.21	4.61
Minimum	78.33	78.30
Maximum	85.00	89.00

As seen in Table 6, students' motivation levels were classified as high, with average scores above 80 in both MI A and MI B. This demonstrates that the AR-based learning media not only improved understanding of cultural materials but also increased students' enthusiasm for learning.

Overall, the findings from Tables 3–6 confirm that the AR-based cultural learning media significantly improved both cultural literacy and learning motivation among MI students in Cirebon City. The interactive nature of AR made learning experiences more engaging and contextual, aligning with prior research emphasizing that immersive media fosters deeper comprehension and motivation.

D. Improvement of Cultural Literacy and Language Skills of MI Students

The experimental implementation of AR-based learning media showed a significant improvement in both cultural literacy and language skills among MI students in Cirebon City (Santos et al., 2016). The integration of interactive cultural content through Augmented Reality (AR) provided authentic learning experiences that helped students understand, retell, and express cultural values in their own words. The multimodal nature of AR—combining text, visuals, and sound made it easier for students to recognize cultural vocabulary and comprehend contextual meanings.

Table 7. Students' Language Skills (Pretest–Posttest Results)

School	Test Type	N	Mean	Median	Mode	Std. Deviation	Min	Max
MI A	Pretest	30	67.50	68.00	65.00	8.20	50	80
	Posttest	30	81.20	82.00	85.00	7.95	65	90
MI B	Pretest	35	66.85	67.00	65.00	9.10	50	80
	Posttest	35	82.10	83.00	85.00	7.80	65	90

The results in Table 7 show an increase of 13.70 points in MI A and 15.25 points in MI B between pretest and posttest. The decrease in standard deviation indicates a more consistent improvement among students. These findings confirm that AR-based learning effectively enhanced language comprehension, vocabulary mastery, and students' ability to express cultural ideas clearly.

E. Improvement of Cultural Literacy of MI Students

The use of AR-based learning media also had a positive impact on students' cultural literacy levels (Chang et al., 2022). By interacting directly with digital representations of cultural objects such as clothing, food, and traditional art students could connect new information with local identity. This approach helped them appreciate cultural diversity and develop a stronger sense of belonging to their heritage.

Table 8. Students' Cultural Literacy Skills (Pretest–Posttest Results)

School	Test Type	N	Mean	Median	Mode	Std. Deviation	Min	Max
MI A	Pretest	30	69.00	70.00	70.00	9.23	50.00	80.00
	Posttest	30	83.00	85.00	90.00	7.94	70.00	90.00
MI B	Pretest	35	68.00	70.00	60.00	9.01	50.00	80.00
	Posttest	35	84.29	90.00	90.00	6.98	70.00	90.00

As shown in Table 8, students' cultural literacy increased by 14.00 points in MI A and 16.29 points in MI B. These results demonstrate that AR-based media effectively deepened students' understanding of cultural symbols and values. Teachers also noted improved engagement and participation during lessons, confirming that AR promoted both learning interest and cultural awareness.

F. Educational Technology Management in MI Kota Cirebon

The successful implementation of AR-based learning in MI Cirebon was supported by effective educational technology management. The schools' leadership, infrastructure, and teacher competence were key factors that influenced the sustainability of AR integration. Training programs and collaboration among teachers (KKG) helped increase digital literacy and classroom innovation (Bulut & Ferri, 2023).

Table 9. Educational Technology Management in MI Kota Cirebon

Aspect	Indicator	Status/Findings
Infrastructure & Resources	Computers, projectors, internet, AR devices	Available but varied across MI
Teacher Competence	Digital skills, AR training, KKG activities	Improving; needs continuous development
Student Adaptability	Use of AR media and digital interaction	Adaptive but still requires guidance
School Leadership & Policies	Budget, training, monitoring, partnerships	Strong support in selected MI
Efficiency of Management	e-administration, e-report cards, online tests	Implemented, though unevenly applied

The findings in Table 9 show that while infrastructure and teacher competence have improved, consistent policy and resource allocation remain essential for sustainability. Schools that received strong leadership support and external collaboration demonstrated more effective technology adoption (Rahmat et al., 2023). Therefore, the development of AR-based media must be accompanied by structured management strategies to ensure equitable implementation and long-term educational benefits.

Discussion

The validation results from both media and material experts indicate that the AR-based learning media developed in this study met the standards of feasibility and relevance to learning objectives (Mursyidah & Saputra, 2022). Expert evaluation showed that the media's design was visually engaging, user-friendly, and aligned with the competencies expected in cultural diversity lessons at the Madrasah Ibtidaiyah (MI) level (Ibáñez et al., 2016). The validation scores, which averaged 75.7%, place the product in the "feasible" category. The language component received the highest rating, confirming that the instructional text and interface were appropriate for the cognitive and linguistic levels of elementary students.

From the perspective of content validation, experts confirmed that the cultural materials embedded in the AR application were contextually relevant to the local setting of Cirebon City and West Java. Cultural representations such as traditional clothing, dances, local foods, and ceremonies reflected authentic regional elements that students could recognize from their surroundings (Pane et al., 2025). This local contextualization strengthened the meaningfulness of learning, as students were not merely exposed to abstract cultural concepts but engaged directly with familiar cultural symbols through interactive experiences. Thus, the AR design successfully integrated pedagogical and cultural dimensions, enabling students to connect cognitive learning outcomes with affective appreciation of their own heritage.

The trial results involving students further demonstrated that the AR-based learning media was not only feasible but also effective in enhancing cultural literacy and language skills (Muskhir et al., 2024). Statistical tests revealed a significant difference between pretest and posttest scores (sig < 0.05), confirming that students' abilities improved meaningfully after using the AR application. The increase in the mean scores of cultural literacy from 69.00 to 83.00 in MI A and from 68.00 to 84.29 in MI B indicates that the media effectively supported students' understanding of cultural diversity. Similarly,

language skills improved substantially, with mean scores rising from 67.50 to 81.20 in MI A and from 66.85 to 82.10 in MI B. These findings underscore that the integration of visual, textual, and interactive elements in AR provided students with multimodal learning experiences that strengthened their comprehension and expression of cultural information (Suhada et al., 2025).

Several factors contributed to the improvement in posttest results. First, the interactive nature of AR technology made abstract cultural concepts more concrete and accessible. Students could visualize and manipulate digital cultural artifacts, which increased their engagement and curiosity. Second, the combination of visual and verbal information in the AR interface enhanced cognitive processing, enabling students to retain and recall information more effectively. Third, the contextual relevance of cultural content to students' local environment encouraged intrinsic motivation and deeper reflection on cultural identity. Lastly, teacher facilitation during AR-based learning sessions helped bridge the gap between technology use and pedagogical goals, ensuring that students not only interacted with digital media but also reflected on its cultural meanings (Yulianto, 2023).

In addition, the results suggest that AR media supports the principles of constructivist learning, where knowledge is actively built through exploration and experience (Safira et al., 2022). Students were not passive recipients of information but active participants who engaged in observation, inquiry, and communication. The collaborative classroom atmosphere created during AR sessions encouraged peer discussion, allowing students to exchange cultural insights and language expressions. This interaction contributed to improvements not only in cognitive achievement but also in affective and social domains, particularly cultural empathy and communication confidence (Saputra et al., 2025).

Overall, the findings confirm that the AR-based learning media developed through the 4D model (Define, Design, Develop, Disseminate) achieved its intended purpose: to produce a learning product that is pedagogically valid, culturally relevant, and empirically effective. The validation by experts and the positive results from student trials collectively demonstrate that the product is suitable for broader implementation in similar educational contexts. Future refinement could focus on expanding the cultural content to other regions, incorporating adaptive feedback features, and strengthening teacher training to maximize the pedagogical benefits of AR-based cultural education.

4. CONCLUSION

This research concludes that the development of Augmented Reality (AR)-based learning media on cultural diversity materials for Madrasah Ibtidaiyah (MI) students in Cirebon City was both feasible and effective in enhancing cultural literacy and language skills. Validation results from material and media experts indicated that the product design, content structure, and linguistic presentation were appropriate for the target learners, with the AR interface aligning well with the learning objectives of cultural education. The contextual inclusion of local cultural elementssuch as regional clothing, traditional food, and performing arts made the learning experience authentic and meaningful, allowing students to relate academic material to their own cultural environment.

Empirical findings demonstrated significant improvements in students' cultural literacy and language competence after using AR-based learning media. Statistical analysis confirmed notable increases in posttest scores, showing that the use of AR facilitated better understanding, vocabulary expansion, and the ability to communicate cultural concepts effectively. The combination of visual, textual, and interactive content in AR provided multimodal stimuli that strengthened students' cognitive processing and engagement, while the collaborative learning environment encouraged active discussion and reflection on cultural diversity. These outcomes collectively affirm that AR media can serve as an innovative pedagogical tool for integrating technology, culture, and language learning in primary education.

The implications of this study are twofold. Theoretically, the findings contribute to the growing body of literature on technology-enhanced cultural learning, offering empirical evidence that AR-based media can effectively merge cognitive, affective, and sociocultural aspects of learning. Practically, this research provides valuable insights for educators, curriculum developers, and policymakers in implementing technology-driven cultural education. Schools can adopt AR-based learning as a

complementary tool to national literacy programs, promoting both digital competence and cultural awareness among students. Moreover, the study highlights the importance of teacher readiness and school management in sustaining the integration of educational technology through continuous professional development and collaborative learning ecosystems.

Future research should explore broader implementation of AR-based learning media across different regions and cultural contexts to test its adaptability and scalability. Further studies may also focus on longitudinal impacts of AR learning on students' retention, critical thinking, and intercultural competence. Additionally, integrating AR with other digital learning platforms such as Learning Management Systems (LMS) or gamified learning modules could enhance interactivity and personalization. Developing teacher training models that emphasize pedagogical design, digital ethics, and culturally responsive instruction will also be crucial in ensuring that AR-based learning continues to evolve as a sustainable educational innovation.

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