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Enhancing Children's Critical Thinking through an Augmented Reality Application: A Digital Solution for Early Childhood Education

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Abstract

Early childhood education in Indonesia continues to encounter significant challenges in fostering critical thinking skills, particularly in under-resourced environments with limited access to adaptive learning technologies. This study investigates the effectiveness of a digital learning model that integrates Augmented Reality (AR) and Artificial Intelligence (AI) to enhance critical thinking among young children. The model, called SMARP (Storytelling, Modifying, Accessible, Real-time, and Promoting), was developed using a Research and Development (R&D) approach based on the 4D model: Define, Design, Develop, and Deploy. The study involved 32 kindergarten students from TK Nada Ashobah in Surabaya, divided into two groups: Class B2 (experimental) and Class B1 (control). The experimental group used an AR–AI-based application, while the control group followed conventional instruction. Data collection included classroom observations, teacher interviews, and critical thinking pre- and post-tests. Statistical analysis using paired sample t-tests and normalized gain (N-gain) scores showed a significant improvement in the experimental group (N-gain = 0.845, categorized as high), while the control group recorded minimal gains (N-gain = 0.0015). The AR–AI model enabled immersive learning through 3D simulations, narrative interaction, and real-time feedback, which promoted observation, analysis, and decision-making. Furthermore, AI features supported personalized learning pathways, increasing student autonomy and engagement. These findings affirm the potential of AR and AI to improve foundational cognitive abilities in early childhood education. The study highlights the need for context-responsive digital pedagogy and recommends comprehensive teacher training and infrastructure support to ensure sustainability. Future research should explore the model's scalability, long-term impact, and adaptability across diverse educational settings.

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Introduction

The development of literacy and critical thinking in early childhood has become a pressing global concern, especially within the digital information age. These competencies are essential not only for academic success but also for active participation in complex, information-saturated societies (Abinaya & Vadivu, 2023; Mohammadhossein et al., 2024). However, significant global disparities persist. The 2022 PISA assessment published in December 2023 showed that Indonesian students scored far below the OECD average: 359 in reading, 366 in mathematics, and 383 in science. These were the lowest scores since Indonesia joined PISA, reflecting a potential foundational learning crisis. Furthermore, many 15-year-olds in Indonesia struggle to comprehend core ideas from extended texts, remaining at or below Level 2 on the PISA reading scale (OECD, 2023; Tutkun, 2024). This highlights a systemic failure to cultivate higher-order literacy and interpretation skills, necessitating a reassessment of early childhood education (ECE) frameworks.

Despite increased policy attention, foundational literacy development among Indonesian preschool children remains inadequate. According to Kemendikbud (2022), a significant number of early learners do not reach the expected literacy benchmarks. Although various national literacy programs exist, most still rely on conventional, print-oriented instruction that does not address the multimodal and digital literacy needs of today's learners. Emerging technologies, especially augmented reality (AR) and artificial intelligence (AI), offer promising solutions but are underutilized in Indonesia's ECE context (Lampropoulos et al., 2023; Morales et al., 2022). International research indicates that AR fosters engagement, vocabulary acquisition, and comprehension through immersive and interactive environments (Mohammadhossein et al., 2022). Local empirical studies on AR-based early literacy instruction are still lacking, pointing to a research and innovation gap.

AR provides contextualized and individualized learning experiences by integrating stories, simulations, and gamified interactions. These characteristics foster children's intrinsic motivation and autonomy, encouraging independent exploration and analytical thinking (Gómez-Rios et al., 2025; Lampropoulos et al., 2023). Especially in the digital age, AR stands out as a transformative pedagogical tool for preparing children for complex futures. Yet, structural barriers persist. Educators often lack adequate training in educational technology, and schools frequently face resource limitations that hinder AR implementation (Rahman et al., 2025; Yang et al., 2016). These constraints underscore the need for context-sensitive models that integrate AR and AI meaningfully while being feasible in low-resource environments.

To respond to these needs, this study introduces the SMARP model—Storytelling, Modifying, Accessible, Real-time, and Promoting—an AR-based instructional framework tailored to early childhood education. This model synthesizes principles from discovery learning and multimodal learning theory, which posits that engaging multiple sensory modalities enhances cognitive processing and retention (Abuas & Kamsin, 2024; Şimşek, 2024). AR applications leveraging 3D visuals, contextual feedback, and storytelling have been shown to improve narrative comprehension, critical thinking, and learning engagement (Lunding et al., 2022; Najmi et al., 2023).

The SMARP model prioritizes story-based learning with real-time interactions and modifiable content to meet diverse learner needs. Immediate feedback mechanisms help children reflect and problem-solve, building independence and deeper understanding. Such a model aligns with calls for pedagogical innovation that bridges technology with children's cognitive development (Durrani & Pita, 2018; Kim et al., 2025). By enabling active, multimodal engagement, SMARP contributes to the personalization and contextualization of early literacy learning. Moreover, it aims to address the gap between digital learning theory and its practical application in Indonesian early childhood classrooms.

The integration of AR and AI into early learning supports not only critical thinking but broader 21st-century competencies, including creativity, collaboration, and digital literacy. Effective AR design can facilitate the visualization of abstract concepts, communication, and shared meaning-making among young learners (Radu & Schneider, 2023). However, successful implementation requires long-term studies, contextual adaptation, and professional development for educators (Mohammadhossein et al., 2024; Shinnick & Woo, 2013). The current research seeks to contribute to this domain by offering a scalable and inclusive AR–AI model supported by empirical testing. It also intends to enrich the discourse on early childhood innovation within the constraints of limited infrastructure.

Preliminary observations at TK Nada Ashobah revealed that teachers struggled to stimulate reflective and analytical thinking in children using conventional methods. Limited access to digital tools further constrained cognitive development and engagement. Teachers noted that students were often passive, with limited opportunities for exploration or problem-solving. These findings reinforce the urgency of introducing immersive digital interventions that can accommodate young children's developmental stages (Vashisht, 2024). While prior studies have demonstrated the value of AR in secondary and tertiary education (Radu & Schneider, 2023), research on its use in ECE, especially in developing countries, remains limited.

This study seeks to fill that gap by evaluating the efficacy of an AR–AI learning model tailored to the developmental needs of preschool-aged children. The research aims to generate evidence-based recommendations for policymakers, educators, and designers working toward equitable and impactful digital learning solutions. Ultimately, this study seeks to contribute to the broader effort to enhance early literacy and critical thinking in Indonesia through relevant, scalable, and context-sensitive innovations.

Methods

Research Design

This study employed a Research and Development (R&D) method using the 4D Holistic Development Model, which includes four sequential phases: Define, Design, Develop, and Deploy. Each phase was adapted to address the specific goal of creating an AI-based augmented reality (AR) learning application aimed at enhancing critical thinking skills in early childhood education. In the Define phase, observations and interviews were conducted with teachers at TK Nada Ashobah to identify instructional gaps. The findings revealed a lack of interactive, adaptive learning media to support children's cognitive development. AR was selected as the solution due to its potential for immersive and interactive learning experiences that align with early childhood developmental needs (Flavián et al., 2019).

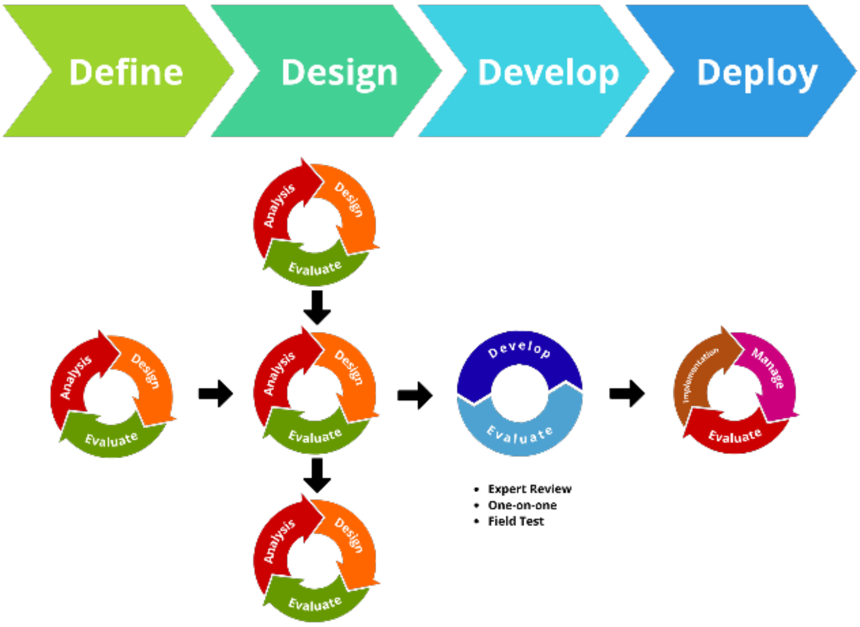

Figure 1. 4D Holistic Development Model

In the Design phase, a prototype AR application was developed incorporating game-based activities, story scenarios, and interactive simulations to encourage analysis, interpretation, and problem-solving. Pedagogical principles suitable for early learners guided the interface and content development, ensuring age-appropriate usability and relevance. The Develop phase included validation through expert reviews by early childhood educators and pilot testing in Class B at TK Nada Ashobah. Data collection tools included observation sheets, teacher interviews, and pre- and post-tests on critical thinking indicators. Quantitative analysis was conducted using paired sample t-tests and N-gain scores to measure the effectiveness of the intervention.

The Deploy phase focused on preparing the application for broader use. This included providing professional development sessions and technical assistance for teachers to ensure sustainable classroom implementation. Despite the structured four-phase development cycle,

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the study was limited to one school site and did not include iterative design revisions or large-scale testing, which may constrain generalizability. Moreover, the absence of usability evaluation instruments and detailed control of external variables remains a methodological limitation. Nonetheless, the study produced a contextually grounded AR-AI solution designed to address critical thinking challenges in early childhood settings.

Research Data Sources

The study was conducted at TK Nada Ashobah in Surabaya, Indonesia. The participants included 32 kindergarten students aged 5–6 years, divided into two groups: Class B2 as the experimental group and Class B1 as the control group. Students were selected using purposive sampling based on their active participation in learning activities. Kindergarten teachers were also included as key informants during both the needs analysis and post-intervention evaluation. While the use of purposive sampling enabled focused data collection, it may introduce selection bias, limiting the representativeness of the sample.

Data Collection Techniques

Data were collected through classroom observation, structured interviews with teachers, and testing procedures. Observations aimed to capture student engagement, interaction with digital tools, and learning behaviors. Interviews provided qualitative insights into classroom dynamics, instructional challenges, and the perceived value of the AR application. Critical thinking was evaluated through pre-tests and post-tests administered to both the experimental and control groups. The lack of details on the validity and reliability of the test instruments is a limitation that may affect the accuracy of the assessment results. Additionally, triangulation of data sources from parents or external observers was not implemented.

Data Analysis Techniques

Data analysis utilized descriptive and inferential statistics. The normalized gain (N-gain) score was used to assess the extent of learning improvement from pre-test to post-test. This helped classify the effectiveness of the AR-AI application in fostering critical thinking. Paired sample t-tests were conducted using SPSS version 22 to determine whether the differences in learning outcomes between pre- and post-tests were statistically significant, applying a 0.05 significance threshold. However, the analysis did not include independent t-tests between groups, ANCOVA, or checks for confounding variables, which limits the depth of inference regarding treatment effects. The study's reliance on a small sample size and single-location implementation further constrains the generalizability of its findings.

Result

The study was conducted at Nada Ashobah Kindergarten in Surabaya, involving 32 children from classes B1 and B2. The data was obtained through a process of observation, interviews with teachers, and the administration of pre-test and post-test designed to evaluate the children's critical thinking skills.

Classroom observations of both B1 and B2 groups revealed that the predominant instructional strategies were largely teacher-centered and reliant on verbal instruction and printed materials. Children's engagement was often passive, with limited opportunities for exploratory learning, problem-solving, or open-ended questioning. Activities typically focused on rote memorization and repetition, with few tasks designed to stimulate higher-order thinking skills.

As one teacher noted during the interview;

"*The children usually just imitate what we teach. They are not yet accustomed to thinking independently or explaining the reasons behind their answers*" (P1).

This statement reflects a general pattern of passive learning environments that do not support the development of critical thinking abilities.

Furthermore, interview data revealed a shared perception among educators regarding the need for more interactive, engaging, and visually rich learning environments. Teachers observed that children showed increased curiosity and motivation when exposed to digital storytelling tools or animated learning videos, albeit in a limited and unsystematic manner.

These qualitative insights underscore a critical gap in current pedagogical practice and support the need for an interactive and adaptive learning medium. They provide the foundational justification for the development and implementation of the SMARP AR–AI learning model in the subsequent phases of the research. The inclusion of observation and interview data ensures a balanced presentation of the mixed-methods approach as outlined in the methodology.

The primary objective of this research is to evaluate the efficacy of the learning methodologies employed in enhancing critical thinking abilities in early childhood. The subsequent section presents the findings of the data analysis.

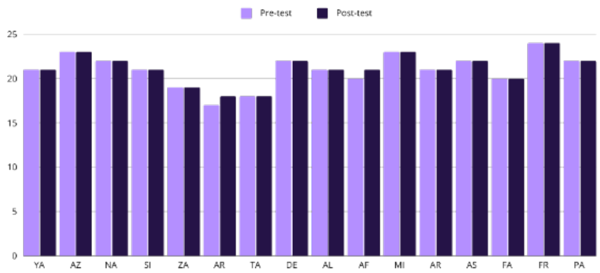

Figure 2. The result of the pre-test and post-test in the control class

The results of the pre-test and post-test in the control class were employed to ascertain whether there was an increase in the literacy scores of children subsequent to their participation in learning activities that did not utilize the Augmented Reality-based learning model. The extent of the improvement in scores is quantified using N-gain. Subsequently, the N-gain score is classified according to the established criteria for N-gain effectiveness. The findings pertaining to the N-gain score are presented below:

Table 1. Control Class N-Gain Results

	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Ngain	**16**	.00	.08	.0094	.02580
Ngain Persen	**16**	.00	8.33	.9375	2.57975
Valid N (listwise)	**16**				

The result of the N-gain score for the critical thinking variable in the control class is 0.0015, which falls within the low category and is below the minimum criteria of $0.03 \leq g \leq 0.7$. This demonstrates that the control class, which did not utilise augmented reality, was not an effective method for enhancing children's literacy abilities. This is evidenced by the N-gain value not aligning with the established criteria.

Additionally, the visual representation in Figure 2 should be enhanced for clarity, including axis labels, units of measurement, and an appropriate title. The original graph lacks sufficient resolution and fails to distinguish between mean scores or standard deviations.

A paired sample t-test was conducted to further assess effectiveness:

Table 2. Control Class T-Test Results

One-Sample Test							
	Test Value = 0						
	t	**df**	**Significance**		**Mean Difference**	**95% Confidence Interval of the Difference**	
			One-Sided p	**Two-Sided p**		**Lower**	**Upper**
PreTest	45.115	15	<.001	<.001	21.00000	20.0079	21.9921
PostTest	49.478	15	<.001	<.001	21.12500	20.2150	22.0350

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Although pre-test and post-test mean scores show slight improvement, the significance value of 0.164 exceeds the threshold of 0.05, indicating no statistically significant difference. Thus, learning without the use of augmented reality does not significantly enhance children's critical thinking or literacy skills.

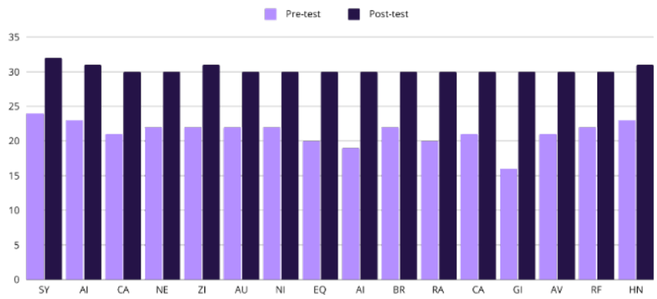

Figure 3. The result of the pre-test and post-test in the experimental class

Pre-test and post-test results for the experimental class were used to evaluate the impact of Augmented Reality-based learning. The magnitude of score improvement was measured using N-gain and interpreted using effectiveness criteria.

Table 3. Experimental Class N-Gain Results

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Ngain	16	.80	1.00	.8450	.05438
Ngain_Persen	16	80.00	100.00	84.5009	5.43806
Valid N (listwise)	16				

The N-gain score of 0.845 falls within the high category, indicating strong effectiveness of the Augmented Reality intervention. Compared to the control class, this suggests a considerable pedagogical benefit.

The visualization for Figure 3 must also be revised to meet publication standards. It should indicate whether it reflects mean scores, standard deviation, or individual score distributions, and should include clearly labeled axes and units.

Table 4. Experimental Class T-Test Results

One-Sample Test							
	Test Value = 0						
	t	df	Significance		Mean Difference	95% Confidence Interval of the Difference	
			One-Sided p	Two-Sided p		Lower	Upper
PreTest	45.220	15	<.001	<.001	21.25000	20.2484	22.2516
PostTest	201.385	15	<.001	<.001	30.31250	29.9917	30.6333

The significance value of 0.000 ($p < 0.05$) confirms a statistically significant difference, validating that the use of augmented reality significantly improved children's critical thinking and literacy skills. This reinforces the pedagogical value of integrating digital tools in early education.

The results of the data analysis indicate a significant divergence in outcomes between the two classes. In class B1 (control), the lack of significant gain and unchanged student performance reinforce the limitations of traditional instructional strategies. This highlights the inadequacy of teacher-centered approaches in fostering critical thinking skills among young learners.

In contrast, class B2 (experimental) showed substantial gains with an N-gain of 0.845 (Hake, 1998). This was further supported by robust t-test results and a narrow confidence interval. These findings align with the observed increase in children's engagement during AR-integrated lessons, confirming both qualitative and quantitative advantages. To visually demonstrate the intervention, Figure 4 illustrates the implementation of the augmented reality-based application in the experimental classroom setting.

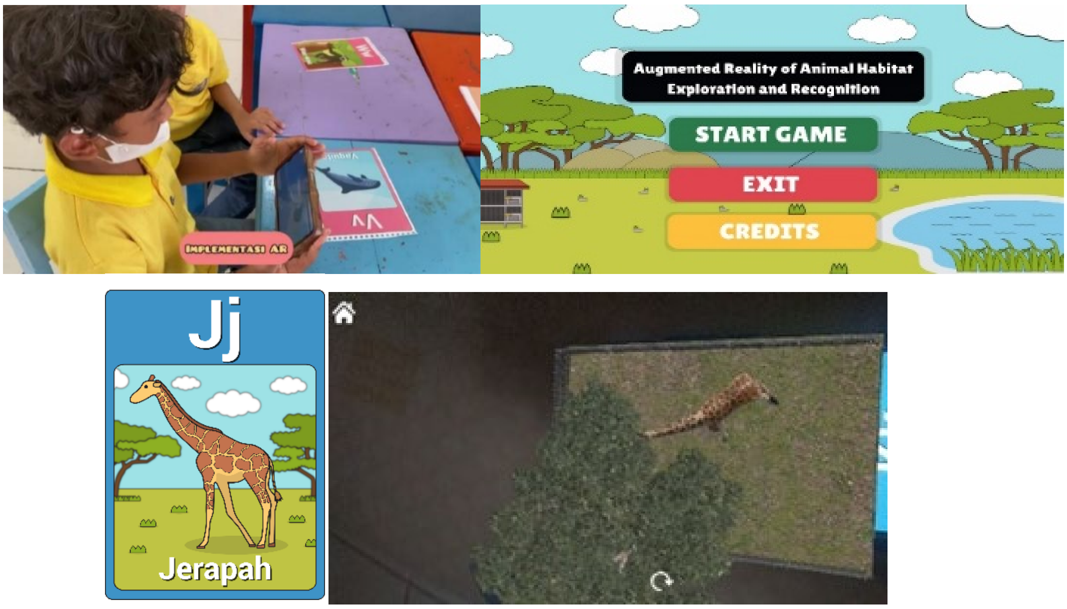

Figure 4. Augmented Reality Implementation

Figure 4 depicts students in the experimental group actively engaging with a three-dimensional AR-based learning application. This real-time interaction allows children to observe, manipulate, and explore digital content in a way that aligns with their developmental stage. The immersive environment promotes sustained attention and cognitive engagement, facilitating the development of higher-order thinking skills. This observation-based insight corroborates the statistical data and emphasizes the value of integrating AR into early childhood pedagogy.

Discussion

The integration of augmented reality (AR) and artificial intelligence (AI) in early childhood education has been shown to significantly enhance critical thinking abilities. The findings from this study reinforce the effectiveness of technology-mediated learning environments, particularly through the use of the AR–AI SMARP model. This model facilitates deeper engagement and cognitive development in early learners. Students in Class B2, which implemented AR-based instruction, demonstrated higher N-gain scores and improved post-test results compared to the control class. These outcomes affirm the transformative potential of digital interventions in advancing foundational cognitive abilities. The results also underscore the importance of adopting innovative pedagogical tools to improve educational outcomes (Gómez-Rios et al., 2025; Srinivasa et al., 2024).

The immersive features of AR, including manipulation of three-dimensional visual objects and real-time interaction, create dynamic environments conducive to higher-order thinking. Students in the experimental class engaged in simulations and problem-solving scenarios that supported their comprehension of complex scientific and contextual concepts. These tasks encouraged cognitive processes such as analysis, synthesis, evaluation, and decision-making—hallmarks of critical thinking. When learners are actively involved in manipulating their learning environment, their depth of understanding improves significantly (Li, 2024). This aligns with previous research emphasizing that visually enriched and context-driven experiences enhance children's ability to engage critically with learning material (Villanueva et al., 2020). Hence, AR supports a robust environment for cognitive scaffolding through interactive, meaningful engagement.

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Moreover, the adaptive features of AI integrated into the AR application provide personalized learning experiences that are responsive to children's individual developmental trajectories. The technology accommodates diverse learning needs by adjusting difficulty levels, pacing, and content presentation in real-time. This personalization increases student motivation and autonomy, allowing them to learn at their own pace and revisit content as needed. In addition, AI-based systems encourage metacognitive reflection, prompting learners to evaluate their own progress and make informed decisions. These functionalities reinforce the development of self-regulated learning behaviors, which are essential to nurturing critical thinking from an early age (Rahman et al., 2025; Vashisht, 2024). These findings confirm that the use of AI in early learning can enhance both the process and outcomes of learning by fostering cognitive agency (Sadat et al., 2023).

In contrast, the stagnant results in Class B1 highlight the pedagogical limitations of conventional, teacher-centered approaches that lack interactive features. Traditional instruction often prioritizes rote memorization and passive reception of knowledge, which are inadequate for cultivating analytical or reflective abilities in young learners. Without the aid of visual, tactile, or dynamic stimuli, children's engagement tends to decline, as observed in this study's qualitative findings (Fisher et al., 2013; Siraj-Blatchford & Sylva, 2004). Moreover, classroom observations and teacher interviews revealed limited opportunities for exploration, questioning, and conceptual manipulation. This lack of stimulation inhibits children's ability to connect learning with real-world contexts and diminishes the potential for critical thinking development (Cao et al., 2025; Tomar & Sharma, 2022). These results echo earlier critiques of conventional instruction, particularly its failure to address the multidimensional learning needs of early childhood students.

The model employed in this study reflects a theoretical convergence between discovery learning and multimodal learning theory. Discovery learning promotes active inquiry and exploration, while multimodal theory suggests that multisensory engagement deepens understanding and memory retention. The SMARP model actualizes these theories by integrating storytelling, interactive simulations, and visual-spatial tasks into early learning activities. These components foster not only cognitive but also emotional and motivational engagement, increasing the effectiveness of instructional delivery. Additionally, the model allows learners to draw on their own prior knowledge, creating meaningful connections between new content and existing experiences (Lampropoulos et al., 2022; Wang et al., 2019). Thus, SMARP offers a pedagogically sound and developmentally appropriate framework for technology-based instruction.

Multiple studies have demonstrated that the use of Augmented Reality (AR) significantly enhances learning effectiveness across various disciplines. AR- and VR-based educational models have been shown to substantially improve learning outcomes in neuroanatomy training (Gurses et al., 2024). AR also increases student motivation and academic performance while reducing cognitive load during the learning process (Mokmin et al., 2024). In the context of civil engineering education, the effectiveness of AR varies according to learning styles, with abstract-oriented learners benefiting the most (Liu et al., 2025). AR applications for teaching structural systems have been proven to improve quiz scores and students' perceived achievement of learning objectives among non-engineering students. Authentic context and user interface design have been identified as critical factors influencing successful AR-based learning experiences (Hu et al., 2021). Overall, AR supports deeper understanding of abstract concepts, fosters interactivity, and enhances the overall learning process (Durrani & Pita, 2018).

Beyond cognitive benefits, AR enhances affective learning dimensions and supports inclusive education. Augmented reality enables differentiated instruction by offering multiple pathways for engagement and comprehension. Children with varying abilities, including those with special needs, benefit from the multisensory and customizable nature of AR environments. These features foster participation, reduce anxiety, and promote social interaction through collaborative tasks. Additionally, the affective domain—such as interest, enjoyment, and emotional safety—is significantly enhanced when children learn through interactive technologies. These emotional experiences are crucial in shaping attitudes toward learning and influencing long-term academic success (Gómez-Rios et al., 2025; Javornik, 2016). As such, AR contributes to holistic child development by addressing both cognitive and emotional dimensions of learning.

Despite its promise, the successful integration of AR–AI tools into early childhood education depends on adequate infrastructure, teacher readiness, and institutional support. The study's findings indicate that many educators are still unfamiliar with these technologies or lack confidence in using them effectively. Furthermore, access to hardware, software, and internet connectivity remains uneven across educational settings, particularly in under-resourced communities. These disparities can hinder implementation and exacerbate existing educational inequalities. Therefore, it is essential to provide targeted professional development and ensure equitable access to digital tools to maximize the impact of AR–AI interventions (Abinaya & Vadivu, 2023; Su & Zhong, 2022). Policy frameworks must prioritize investment in digital capacity and pedagogical innovation to sustain long-term improvements in learning quality.

The implications of this study extend to curriculum development, teacher training, and educational policy. Integrating AR and AI into early education offers a pathway to modernize instructional practices and align them with 21st-century competencies. In low- and middle-income countries, these tools can help close foundational learning gaps and provide cost-effective solutions to systemic challenges. Moreover, the contextual flexibility of AR–AI applications makes them adaptable to various cultural and linguistic settings. Educational policies must support the scaling of evidence-based digital models, including guidelines for development, evaluation, and ethical use. By doing so, stakeholders can ensure that technological innovations are meaningfully integrated and accessible to all learners (Flavián et al., 2019; Spector & Ma, 2019).

The findings validate the SMARP AR–AI model as an effective and adaptable instructional framework for enhancing critical thinking in early childhood education. Its integration of personalized learning, multisensory engagement, and exploratory inquiry offers a robust platform for child-centered pedagogy. The model's strength lies in its alignment with developmental psychology and instructional design principles. Future research should explore longitudinal outcomes, including how sustained use of AR–AI affects cognitive trajectories and school readiness. In addition, further studies are needed to examine implementation in diverse settings and identify best practices for scaling innovation (Kim et al., 2025; Ređep & Hajdin, 2021). The growing body of evidence suggests that digital technologies, when thoughtfully applied, can transform early learning and prepare children for a rapidly evolving world.

Conclusion

The findings of this study affirm that the integration of Augmented Reality (AR) and Artificial Intelligence (AI) technologies in early childhood education significantly enhances critical thinking skills, as evidenced by a high N-gain score (0.845) and marked differences between pretest and posttest results in the experimental group. The SMARP model fosters interactive and personalized learning experiences through the manipulation of three-dimensional objects, real-time feedback, and narrative simulations that encourage exploration and reflection. This approach surpasses the limitations of conventional learning, which tends to be unidirectional and text-based. However, its effectiveness depends on adequate infrastructure, teachers' technological literacy, and sufficient institutional support. Challenges remain, particularly in resource-constrained areas, where limited access to digital devices and educators' capacity pose significant barriers. Therefore, comprehensive policy strategies, teacher training, and adaptive curricula are required to support a sustainable digital learning ecosystem. In conclusion, SMARP presents a relevant and promising pedagogical solution, but its success relies on the synergy between technological innovation, human resources, and sustained educational policy.

The significance of these findings lies not only in their empirical contribution to demonstrating the effectiveness of AR–AI in strengthening critical thinking among young

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children, but also in their potential to shape a new direction for inclusive and adaptive instructional design in the digital age. The SMARP model can serve as a reference for developing early childhood education curricula that integrate multimodal technology-based approaches and narrative pedagogy. The implications include the need to reposition the teacher's role from a transmitter of information to a facilitator of digital exploration, attuned to children's cognitive development. Accordingly, the primary recommendation of this study is the implementation of hands-on, practice-based training programs for early childhood educators in the use of interactive learning technologies. Government bodies and policymakers must also formulate affirmative policies to ensure equitable and sustainable provision of digital infrastructure. Future research is recommended to test this model across broader geographical and social contexts to validate its external applicability and scalability within national education systems.

Declarations

Author Contribution Statement

The author affirms responsibility for all aspects of this study, including the conception of the research design, data collection, analysis, and interpretation. The author also prepared, reviewed, and approved the final manuscript.

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Data Availability Statement

The datasets generated and/or analyzed during this study are available from the corresponding author upon reasonable request.

Declaration of Interests Statement

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Additional Information

No additional information is available for this paper at this time.

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