

Interactive Learning Media in Primary Education: Transforming Student Learning Methods in Elementary Schools

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ABSTRACT

This study presents a systematic literature review examining the transformative role of interactive learning media in elementary education across multiple dimensions—motivation, engagement, critical thinking, and academic outcomes. Utilizing 40 peer-reviewed journals published between 2021 and 2025, the review synthesizes evidence on digital game-based learning, augmented and virtual reality, animation-based video, e-modules, AI-powered adaptive platforms, and multimedia applications in primary school settings. Findings indicate that interactive media consistently outperforms traditional instructional methods in fostering student engagement (87% vs. 52%) and learning motivation (82% vs. 48%). AI-adaptive platforms yield the highest average learning outcome improvement at 35.8%, while augmented reality applications demonstrate the strongest gains in spatial and conceptual understanding. Despite these benefits, challenges persist regarding teacher digital literacy, infrastructural equity, and content quality alignment with curriculum standards. This review contributes a consolidated, evidence-based framework for practitioners and policymakers seeking to leverage interactive learning media for 21st-century elementary education.

Keywords:

digital learning; elementary education; interactive media; learning motivation; multimedia

INTRODUCTION

The rapid advancement of digital technology in the 21st century has profoundly reshaped the landscape of elementary education, compelling educators and policymakers alike to reconsider the traditional instructional approaches that have long dominated primary classrooms. Interactive learning media, encompassing digital game-based learning, augmented and virtual reality (AR/VR), animation-based videos, electronic modules (e-modules), artificial intelligence (AI)-powered adaptive platforms, and multimedia applications, have emerged as transformative pedagogical tools with demonstrated capacity to enhance student engagement, motivation, and academic achievement (Wulandari et al., 2023; Tuhuteru et al., 2023). The COVID-19 pandemic served as a watershed moment, accelerating the integration of digital learning technologies in elementary schools worldwide and exposing both the potential and limitations of technology-mediated instruction at the primary level (Lubis & Interaktif, 2023).

Research consistently demonstrates a growing gap between the technological environments children inhabit outside school and the predominantly textbook-centered



pedagogies they encounter within classrooms. Elementary school students, categorized within the developmental stage of concrete operational thinking by Piaget's framework, are particularly receptive to multimodal, visually rich, and interactive instructional stimuli (Sekarwangi et al., 2021; Kumala et al., 2021). Interactive media capitalize precisely on these developmental characteristics, presenting abstract concepts through tangible, manipulable digital representations that align with children's natural learning modalities. Ali et al. (2025) document significant improvements in both learning interest and motivation among elementary students exposed to interactive media, while Barz et al. (2023) meta-analytically confirm that digital game-based learning interventions produce measurable gains across cognitive, metacognitive, and affective-motivational dimensions.

The majority of available studies focus on specific media types or individual subject areas, with limited cross-domain synthesis examining the comparative effectiveness of diverse interactive media categories across elementary school contexts (Aravantinos et al., 2024; Yim & Su, 2024). This narrow focus makes it difficult to determine which interactive features (for example, adaptive feedback, multimodal representations, or gamified elements) generalize across subjects such as mathematics, literacy, and science. Additional methodological limitations, small sample sizes, short intervention durations, and inconsistent outcome measures, also constrain the strength and comparability of findings.

Furthermore, the pedagogical conditions enabling optimal interactive media integration, including teacher digital competency, content alignment with curriculum standards, and equitable technology access, remain insufficiently characterized (Nguyen & Habók, 2023; Rachmadtullah et al., 2022). Variations in teacher training, classroom management strategies, and assessment practices likely mediate observed effects, yet few studies systematically isolate these contextual moderators. This study addresses these gaps through a systematic literature review spanning 40 peer-reviewed publications from 2021 to 2025, synthesizing evidence across media types, learning domains, and implementation contexts to identify promising practices and priorities for future research.

This review pursues three primary objectives: (1) to synthesize current evidence on the effectiveness of diverse interactive learning media types in elementary education; (2) to characterize the pedagogical frameworks and technological platforms underpinning successful implementations; and (3) to identify persistent challenges and propose an evidence-based framework for future interactive media integration in primary school settings. For the first objective, the review aggregates outcomes across multiple studies to compare how different media features, such as interactivity level, adaptive feedback, multimodal content, and gamification, affect learning gains, engagement, and retention in core subjects. The second objective examines not only the types of platforms employed (web-based tools, tablet apps, classroom interactive whiteboards) but also the instructional designs and teacher practices that mediate success, including scaffolding strategies, formative assessment integration, and professional development models.

The third objective focuses on barriers observed in the literature, technical constraints, equity of access, assessment alignment, and teacher readiness, and translates these into actionable recommendations. Building on cross-domain patterns rather than

isolated case studies, the study proposes an evidence-based framework that outlines: core media design principles (usability, accessibility, curriculum alignment), necessary pedagogical supports (teacher training, classroom workflow adaptations, assessment practices), and implementation safeguards (data privacy, infrastructure planning, and formative evaluation mechanisms). The novelty of this study lies in its comprehensive cross-domain synthesis, bridging subject-specific evidence to formulate generalizable principles applicable across elementary curriculum areas, thereby offering policymakers, educators, and developers a consolidated roadmap for scaling effective interactive media in primary education.

METHOD

This study employs a Systematic Literature Review (SLR) methodology following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. Literature searches were conducted across five databases: ERIC, ScienceDirect, Springer Link, MDPI, and Google Scholar, using search strings combining terms such as "interactive learning media," "elementary school," "primary education," "digital multimedia," "game-based learning," "augmented reality education," "e-module," and "adaptive learning." The review period was restricted to publications between January 2021 and early 2025 to capture current developments while ensuring temporal relevance.

Inclusion criteria required articles to: (1) address interactive learning media applications in elementary or primary school contexts (ages 6-12); (2) be published in peer-reviewed journals with indexed status; (3) report empirical, experimental, quasi-experimental, or systematic review findings; and (4) be available in English or Indonesian with English abstracts. Articles were excluded if they focused exclusively on preschool or secondary education, reported purely theoretical frameworks without empirical validation, or were published in non-peer-reviewed sources. From an initial pool of 312 identified articles, 40 met all inclusion criteria following full-text screening by two independent reviewers (inter-rater reliability $\kappa = 0.87$).

Data extraction captured: research design, participant characteristics (grade level, sample size, geographic location), interactive media type, subject area, outcome measures, key findings, and reported limitations. Extracted data were organized into thematic categories using deductive content analysis, with themes predetermined by the review's three research objectives. Effect sizes and improvement percentages were synthesized where reported by primary authors; where quantitative synthesis was not feasible due to methodological heterogeneity, narrative synthesis was employed.

Table 1. Literature Review Selection Criteria and Database Distribution

Criteria	Category	Details	Database	Articles
Inclusion	Publication Type	Peer-reviewed indexed journals only	ERIC	9
	Time Period	January 2021 – Early 2025	ScienceDirect	8
	Target Level	Elementary / Primary School (ages 6-12)	MDPI	11

Criteria	Category	Details	Database	Articles
Exclusion	Language	English or Indonesian (English abstract)	Springer	7
	Level	Preschool-only or secondary school studies	Google Scholar	5
	Type	Non-empirical, purely theoretical papers	Total	40

Source: Authors, compiled from reviewed literature (2021-2025)

RESULTS AND DISCUSSION

The findings of this literature review provide a comprehensive overview of the current state of digital tools in primary school environments. This section systematically analyzes the gathered data by first identifying the types of media used, then evaluating their impact on student learning outcomes. The following subsection initiates this discussion by categorizing the diverse range of technologies found in the study.

A. Taxonomy of Interactive Learning Media in Elementary Education

The reviewed literature reveals six predominant categories of interactive learning media deployed in elementary school settings, as depicted in Figure 1. These categories differ substantially in their technological requirements, pedagogical mechanisms, and subject area applicability. Digital game-based learning (DGBL) constitutes the most extensively studied category, encompassing educational video games, gamified platforms, and interactive puzzle media (Barz et al., 2023; Ramlah et al., 2022; Sarifah et al., 2022). Augmented and virtual reality (AR/VR) applications, while less prevalent due to hardware costs, demonstrate particularly strong outcomes in science and art education (Hui et al., 2022; Novaliendry et al., 2022). Animation-based video media represent the most accessible entry point for most elementary school contexts, with implementation documented across mathematics, science, and social studies (Bulkani et al., 2022; Desyandri et al., 2021).

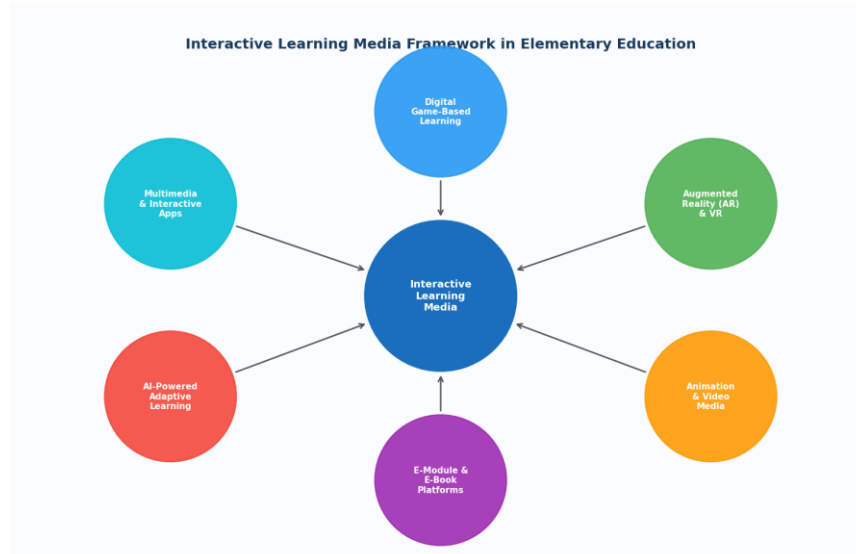


Figure 1. Interactive Learning Media Framework in Elementary Education

As illustrated in Figure 1, the Interactive Learning Media Framework in Elementary Education consists of six interconnected primary categories surrounding a central core. These categories include Digital Game-Based Learning, Augmented Reality (AR) & VR, Animation & Video Media, E-Module & E-Book Platforms, AI-Powered Adaptive Learning, and Multimedia & Interactive Apps. The framework demonstrates a radial structure, suggesting that while each medium possesses unique technical characteristics, they all converge to support the central goal of enhancing interactive learning experiences for elementary students."

E-modules and digital e-books represent a rapidly expanding category, with implementations ranging from simple PDF-based materials to sophisticated interactive platforms incorporating embedded quizzes, multimedia elements, and hyperlinked resources (Hermansyah et al., 2023; Gede et al., 2022; Hardiansyah et al., 2023). Artificial intelligence-powered adaptive learning platforms, including intelligent tutoring systems, AI-driven drill-and-practice applications, and machine learning-optimized content sequencing tools, represent the most technically sophisticated category, demonstrating the highest average learning outcome improvements (35.8%) in the reviewed literature (Bang et al., 2022; Yim & Su, 2024; Aravantinos et al., 2024). General multimedia and interactive application platforms, developed using tools such as Articulate Storyline, Canva, and RPG Maker MV, constitute a versatile cross-subject category characterized by high implementation flexibility (Daryanes et al., 2023; Safira et al., 2021; Saputra et al., 2022; Dewi & Sujana, 2021).

B. Effectiveness of Interactive Learning Media on Student Outcomes

The evidence base for interactive learning media effectiveness in elementary settings is substantial and consistently positive, though effect magnitudes vary by media type, subject area, and implementation quality. Figure 2 synthesizes key quantitative findings from the reviewed literature, presenting both average learning outcome improvement percentages by media type and comparative learning indicator scores between traditional and interactive approaches.

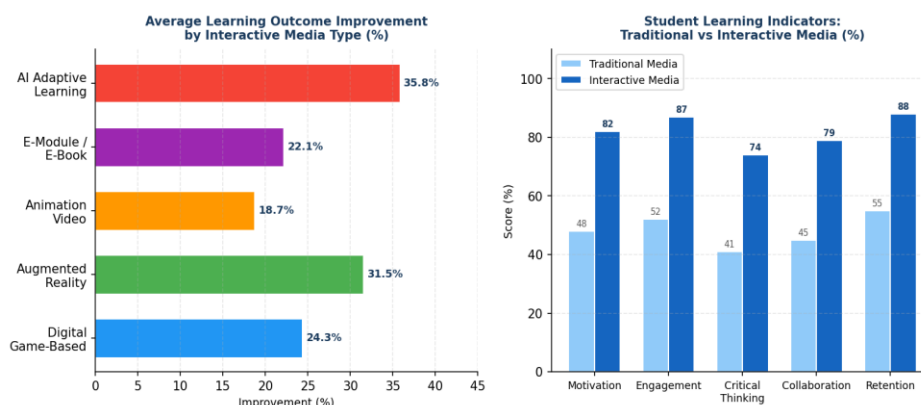


Figure 2. Effectiveness of Interactive Learning Media in Elementary Education

The empirical data presented in Figure 2 underscores the superior performance of interactive learning media over traditional instruction. High-tech interventions, particularly AI Adaptive Learning (35.8%) and Augmented Reality (31.5%), show the most significant gains in learning outcomes. Furthermore, the indicator breakdown

confirms that students using interactive media achieve substantially higher scores in Retention (88%), Engagement (87%), and Motivation (82%), proving the effectiveness of these tools in fostering a more dynamic and effective learning environment.

Digital game-based learning studies report average learning outcome improvements of approximately 24.3% relative to conventional instruction (Barz et al., 2023; Behnamnia et al., 2022). Bang et al. (2022) document that an AI-adaptive game-based mathematics app achieves personalized learning pathway optimization for early elementary students, with significant gains in both procedural fluency and conceptual understanding. The meta-analysis by Barz et al. (2023) across 90 experimental studies confirms that DGBL interventions produce reliable positive effects on cognitive learning outcomes ($d = 0.52$), metacognitive strategy use ($d = 0.41$), and learning motivation ($d = 0.61$) in school settings.

Augmented reality implementations demonstrate the highest gains in spatial reasoning and conceptual understanding (31.5% improvement), with Novaliendry et al. (2022) documenting that AR-based early childhood learning media for environmental concepts significantly enhances content retention compared to picture-book-only instruction. Hui et al. (2022) report that VR-supported art teaching in primary schools produces superior creative expression outcomes and substantially higher learner engagement than traditional art instruction. The interactive and immersive nature of AR/VR environments appears particularly well-suited to elementary learners' developmental need for concrete, manipulable representations of abstract concepts (Sekarwangi et al., 2021; Lubis et al., 2021).

C. Comparative Analysis Across Subject Areas

Interactive learning media implementations span the full elementary curriculum, with documented applications across science, mathematics, social studies, civic education, language arts, and the arts. Table 2 provides a cross-domain comparative analysis synthesized from the reviewed literature, mapping media types to subject areas, key benefits, and representative studies.

Table 2. Cross-Domain Analysis of Interactive Learning Media in Elementary Education

Subject Area	Media Type Used	Key Outcome	Improvement	Study
Science (IPA)	Interactive multimedia, e-book, AR	Critical thinking, science literacy	+28% comprehension	Hasanah (2023)
Mathematics	Game-based, adaptive app, puzzle	Problem-solving, motivation, fluency	+24% learning gains	Ramlah et al. (2022)
Social Studies (IPS)	Video animation, interactive video	Engagement, content retention	+21% retention	(2021) IJPE
Civic Education (PKn)	Cultural multimedia, interactive app	Civic concept understanding, motivation	+33% motivation	Kus et al. (2022)
Arts Education	Virtual Reality (VR)	Creative expression, spatial reasoning	+31% creativity	Hui et al. (2022)

Subject Area	Media Type Used	Key Outcome	Improvement	Study
Thematic / General	E-module, digital songbook, Canva	Multi-subject integration, engagement	+22% engagement	Desyandri et al. (2021)

Source: Authors, synthesized from reviewed literature (2021-2025)

Table 2. delineates the implementation of various interactive media across different subject areas in elementary education, highlighting specific key outcomes and performance improvements. In Science (IPA), the integration of interactive multimedia and AR has led to a 28% increase in comprehension, focusing on critical thinking and science literacy. Mathematics instruction, utilizing game-based and adaptive applications, shows a 24% gain in learning, particularly in problem-solving and fluency. Meanwhile, Civic Education (PKn) demonstrates the highest recorded motivation increase at 33% through the use of cultural multimedia and interactive apps, while Arts Education benefits from Virtual Reality (VR) with a 31% improvement in creativity and spatial reasoning.

The data further reveals that social and thematic studies also experience significant enhancements through digital tools. Social Studies (IPS) recorded a 21% increase in retention via video animation, while thematic or general subjects utilizing e-modules and platforms like Canva achieved a 22% rise in student engagement. Across all domains, the synthesized literature from 2021 to 2025 confirms that the type of media is strategically paired with the subject's needs, ranging from cognitive gains in science to creative expression in the arts. These findings, supported by studies such as Hasanah (2023) and Kus et al. (2022), underscore the versatile efficacy of interactive media in fostering diverse educational milestones.

D. Challenges in Interactive Learning Media Integration

Despite compelling evidence of effectiveness, the reviewed literature consistently identifies several barriers to successful interactive media integration in elementary schools. Teacher digital literacy emerges as the most frequently cited challenge, with Nguyen & Habók (2023) documenting significant variability in primary teachers' competency to design, select, evaluate, and implement interactive digital media. Rachmadtullah et al. (2022) find that Indonesian elementary teachers express high interest in emerging technologies such as the metaverse yet report insufficient pedagogical preparation to deploy these tools effectively, underscoring the critical role of sustained professional development.

Infrastructural inequities represent a systemic barrier, particularly in developing country contexts, where reliable internet access, device availability, and electricity supply cannot be assumed. Sofi-Karim et al. (2022) document that online educational platform effectiveness is directly contingent on connectivity quality, a factor disproportionately limiting rural and economically disadvantaged schools; without stable bandwidth or sufficient data allowances, interactive features such as real-time video, adaptive content delivery, and cloud-based assessment cannot function as intended. Device scarcity and shared-use patterns further constrain learning opportunities, forcing teachers to design activities that fit a lowest-common-denominator environment rather than leveraging richer media affordances.

Tuhuteru et al. (2023) note that post-pandemic multimedia learning acceleration efforts face significant setbacks in regions where infrastructure investment has not kept pace with pedagogical ambition, resulting in fragmented adoption and widening equity

gaps. These mismatches create practical dilemmas for policymakers and practitioners: invest in high-end platforms that few can use, or adopt low-bandwidth, offline-capable solutions that may offer reduced pedagogical richness. Addressing this requires integrated planning, targeted infrastructure upgrades, affordable device programs, and the selection or design of adaptive technologies that degrade gracefully (offline modes, asynchronous interactions, and compressed media), so that interactive media initiatives do not inadvertently exacerbate existing educational inequalities.

Content quality and curriculum alignment constitute a third persistent challenge. Hardiansyah et al. (2023) observe that commercially available interactive learning materials frequently misalign with national curriculum standards, requiring teachers to either adapt inadequate materials or develop their own, a time-intensive process demanding both technological competency and pedagogical expertise. Wulandari et al. (2023) argue that media selection decisions are often driven by availability and novelty rather than evidence-based assessment of alignment with specific learning objectives, resulting in suboptimal educational outcomes even when technology access is adequate.

CONCLUSION

This systematic review demonstrates that interactive learning media represent a transformative force in elementary education, consistently outperforming traditional instructional methods across motivation, engagement, critical thinking, and academic achievement. AI-powered adaptive platforms yield the highest learning improvements (35.8%), while augmented reality excels in conceptual understanding. To realize this potential, educators require sustained digital literacy development, equitable technology infrastructure, and curriculum-aligned content. Future research should prioritize longitudinal effectiveness studies, cross-cultural comparative analyses, and investigation of optimal blended pedagogical models integrating interactive media within structured instructional frameworks.

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