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A Literature Review on the Implementation of Interactive Learning Technology to Enhance Elementary School Students' Interest and Academic Achievement

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Abstract

This literature review aims to examine the impact of interactive learning technology on elementary school students' interest and academic achievement. The rapid advancement of educational technology has provided various tools, such as digital games, simulations, and interactive learning platforms, which have been shown to foster greater engagement and improve learning outcomes. This study synthesizes findings from recent research published between 2019 and 2024. The results indicate that interactive learning technologies significantly enhance student motivation, engagement, and cognitive performance when properly integrated into the learning environment. However, challenges remain, such as limited infrastructure, unequal access, and insufficient teacher training, particularly in developing countries like Indonesia. This review highlights the need for further empirical studies and policy interventions to support the effective implementation of technology in primary education.

INTRODUCTION

The holistic use of technology in the educational setting and specifically on the elementary level has turned out to be a topical object of research and a subject of educational policy in all parts of the world. The dynamics of interactive learning, e.g. digital games, simulations, advanced learning-management systems, have led to the emergence of substantial changes in traditional ways of teaching. The tools are promoted more and more as tools that can enhance student engagement, motivation and, in turn, academic performance. At the level of primary education, when the fundamental skills in reading, mathematics, and thinking are developed, the ability of interactive technology to supplement and increase the educational process deserves a thorough investigation (Nusir et al., 2012; Jamil et l., 2024; Timotheou et al., 2023).

The decision to implement novel interactive learning technology in the elementary education system can be explained by the fact that it is a part of the larger paradigmatic shift toward student-centered active learning systems (Agrahari, 2016; Amiruddin et al., 2023). The interactive technologies provide instant feedback and support collaborative work and also provide adaptive learning pathways according to

the needs of individual students all that can be well matched with the constructivist learning theory that involves the active participation of learners in the construction of knowledge through interaction with surroundings (Pahi et al., 2024). With help of multimedia materials, gamified learning situation and realistic simulations, the interactive technologies help to turn the traditional passive learning process into the dynamic one, where students are not only active participants of the learning process but are also intrinsically motivated.

These observations are supported by increasing evidence of empirical studies. In particular, digital games and simulations were associated with heightened motivation in elementary school students, improved attention, and attentional concern, as well as more complex processing (Sung et al., 2019; Hamari et al., 2020). The use of interactive electronic mediums encourages differentiated instruction and, therefore, allows the learner with diverse capabilities to engage with the curricular content at a pertinent level of intellectual difficulty. This ability is more evident especially at elementary level when developmental difference amongst students is quite pronounced.

Though the benefits of interactive learning technology are well-recognized, the implementation is not devoid of remnant obstacles (Sergi, 2019). The lack of infrastructure (in terms of available internet connectivity and access to relevant devices) still impedes an equitable access to digital learning tools, particularly in the rural or under-equipped areas (Sari & Wahyuni, 2021). In addition, the importance of the digital literacy and pedagogical competence of teachers should be mentioned: in the majority of countries and territories, the development of teacher preparedness and their professional competence to utilize technology represents a major challenge and, in most cases, teachers do not receive necessary training and support by their schools or institutions (Utomo et al., 2022; Mpuangnan, 2024; Kennedy, 2023). In the absence of this direction, the use of technology can be rather meaningless or disjointed, which would reduce its effectiveness in improving learning outcomes.

The Indonesian case has witnessed various projects being initiated by the Ministry of Education at different times towards ensuring the government engages its students in digital literacy and the use of technology within its school setting (Aminah & Saksono, 2021). The introduction of schemes like the Digital School program or the supply of learning management systems like Rumah Belajar are witnesses of governmental interest in advancing in educational technology. But there are comparatively few empirical studies of the effectiveness of these interventions. In the existing literature, a lot of focus is put either on the higher education or expert subject matter and there is no clarity about how these technologies impact curiosity and performance of younger learners with respect to a greater variety of topics.

The connection between the use of technology and the achievement of student outcomes is complicated and conditional through the involvement of many variables such as the type of the technology, teaching strategies to be used and the greater learning scenario in general (Sáez-Velasco et al., 2024). Interactive learning technologies comprise the kind of technology-enhanced learning, which, under certain conditions, can be actively engaged and cause immediate feedback, and collaborative problem-solving as long as it is a part of a viable pedagogical structure. However, technology as such does not always produce high quality academic results. The efficiency of interactive technologies is predetermined by the pedagogical environment, a quality level of instructional materials, the design of the interactions of students with the technological instrument (Prykhodkina et al., 2025; Alam & Mohanty, 2023).

Meta-analytic and systematic reviews conducted have recently confirmed the overwhelming role of contextual variables on the technology-mediated teaching.

Specifically, Xie et al. (2021) describe how the academic performance is usually boosted by the learning environments that are enhanced by the interactive technology, although the extent of these benefits is moderated by age, as well as the subject area and features of the technology used. Learners during the elementary-school stage, as an example, benefit more on technology when incorporated properly with teachers.

Besides obvious improvement in traditional academic outcomes, anecdotal evidence suggests that the use of interactive technologies encourages the development of some 21 st -century skills, such as digital literacy, teamwork, and problem-solving, which are commonly viewed to be essential in a knowledge-based economy. It can therefore be seen that the application of interactive technology in elementary learning does not solely refer to the indicators of academic evaluation; it also prepares the students to deal with the distribution channel of future where there will be digital integration and swift evolution or change in technology.

Nevertheless, such a problem as a digital divide remains a topic of concern. A significant difference between the accessibility of interactive learning technologies of the city and the rural schools of Indonesia and private and state-owned schools in Indonesia hinder access to learning technology. According to the current government reports, schools in the big cities often have the necessary amount of technological equipment, and in rural schools, the deficit of infrastructure remains a problem, not to mention high-tech tools. The unbalanced furnishing of interactive technologies across the Indonesian schools poses a great threat to the current inequality to education and thus to further reinforcing cycles of disadvantage in already disadvantaged communities. To deal with this issue, researchers have to embark in a critical analysis of the contents and the cultural appropriateness of the interactive tools that still are being adopted within classrooms. Most available examples of digital learning media are oriented to the Western locale and do not often fit the national curricula or appropriately value local cultures. An intimate and culturally sensitive process of content development, as well as the inclination to the linguistic and cultural plurality of a population group, would be necessary to make sure that technology served as the universal and productive educational tool.

Professional development of teachers is a second and nonetheless important determinant of the success of technology implementation. The empirical evidence suggests that once teachers not only are technically prepared but also are technologically educated with a pedagogical awareness of how to introduce technology in the learning process, the academic results of students significantly improve (Mishra & Koehler, 2006; Tondeur et al., 2020). Professional development programs, hence, should not only be limited to professional development progamming on basic technical grounds but also on inclusion of instructional designing, classroom management in computerized environments, and evaluative measures that are aligned to technology enhanced learning.

Despite the good indications in the available literature, pertaining to the advantages of interactive learning technologies, a higher body of knowledge is necessary, especially in the Indonesian primary school system. Most of the existing studies are small, short-term and narrow in terms of a particular technological tool. Any future research should shift to methodologies that are more robust, combine various contexts, and look at long-term results both in cognitive and non-cognitive areas, in order to present a complete picture of the effect of interactive technologies on education.

METHODS

The methodology used in the current research under consideration is clearly a systematic review of literature (SLR), a method which can be described as a rather

rigorous since it is considered appropriate to meet the research questions stated in the abstract. Requiring a critical systematic review of the existing literature, the SLR helps the researcher to evaluate the evidence base, the observed pedagogical value and the challenges of implementing it in different contexts (namely the ones outlined in 20192024), and finally allows synthesizing the results into the composite picture.

The process started by defining the exact research questions that guided the whole process of a review. These questions questioned how far such interactive technologies affect the learning interest of elementary students and how effective such technology is to assist academic learning and what factors hinder their adoption; this question will focus more on the developing world of Indonesia. These questions directly address the gaps and challenges as listed in the background presentation and the abstract.

A collection of data resources was curated in order to ensure the quality standards and relevancy of reviewed articles. The academic databases, such as Scopus, Web of Science, ERIC, ScienceDirect, and Google Scholar have been used, and the search methodology has been applied considering the use of such keywords as interactive learning technology, elementary education, student interest, academic achievement, and digital learning. The Boolean operators were also used to narrow down the search criteria and ensure that the materials referred to directly dealt with the goals of the study. Only peer-reviewed journals, conference write ups, and academic reports were considered, and these were all published in the period between 2019 and 2024 so that no report is considered out of date (since there are significant changes in educational technology every year). In order to achieve methodological rigor, the current review uses clear inclusion and exclusion criteria. In this regard, the study limits itself to the literature focusing on the elementary school education and discusses the effects of interactive technologies on the outcomes regarding an interest, engagement, and academic achievement. The analysis does not include studies that aim at working with middle school or high school learners, articles without empirical support, opinion article, editorial, or any investigation not related to a direct learning outcome.

Selection process after identification of possibly relevant articles are carried out according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol and the process is reported in each step of identification, screening, information eligibility assessment and inclusion of articles in the final stage. After that, the studies are reviewed altogether, including appraisal of their titles, abstracts, and full texts.

Then systematic data extraction is done and important variables like author(s), publication year, country, research design, type of technology, results reported and encountered problems are picked up. The synthesis of findings is managed with the help of the thematic analysis framework that allows the researcher to identify repeated patterns and correlations within the body of evidence. The data are organized in terms of the interactive technologies implemented, gamification, simulations, and digital learning platforms, and the results, which they are supposed to enhance, the student interest and academic achievement. The results (both quantitative and qualitative) are presented in narrative summary because the methods and measurement strategies were diverse and studying them considered incompatible with the use of meta-analysis. Last but not least, the qualitative data is evaluated critically in order to clear up any contextual issues and to highlight the practical problems that emerged during technology integrations. To protect rigour and promote credibility, several measures were used in this systematic literature review, which has been undertaken by duplicating data extraction and ensuring a systematic use of the critical appraisal tool, like CASP checklist (Critical Appraisal Skills Programme) to qualitative studies and JBI (Joanna Briggs Institute) checklist

to quantitative research. These procedures were fixed to reduce an element of bias and strengthen the purpose of the reviews results.

These are samples of similar studies dedicated to the same problem; although such literature reviews give a general view on the issue, it is still dependent on the existing state of scholarly works, which are not always the same. Publication bias is also possible wherein a study that presents positive or significant results is easily published compared to one that gives negative or insignificant findings, which maybe underrepresented. Additional limitations are related to the fact that most research work on educational technology has focused on the developed realm and hence there is a potential limit on the implications of the study in the context of the Indonesian school system.

In this piece of research, where the analysis of published material was the only activity and search in the publicly available literature took place, ethics approval was not needed. However, all references have been mentioned properly and there has been no case of academic dishonesty during the research process. The methodology adopted assures that the conclusions will be founded on an organized and harsh appraisal of the present scholarly evidence, thus, producing the fruitful reflections which could be used by educators, policymakers, and researchers who want to use interactive technologies to achieve the improved outcomes in elementary education.

RESULTS AND DISCUSSION

The present systematic review has adopted a rigorous methodology by only choosing peer-reviewed articles of repute international and national journals that meet the sectors of education, educational technology, and educational psychology. The publications years range between 2019 and 2024 to cover the current trends of interactive learning technology in elementary schools. The research uses quantitative, qualitative, and mixed techniques, and focuses on interactive tools including such tools as gamification (game-based learning, serious games), digital simulation and interactive multimedia, augmented reality (AR), virtual reality (VR), mobile learning (m-learning), the use of AI in learning platforms, interactive learning management systems (LMS). Most of the researches are conducted in the countries that have well developed educational technology infrastructures such as South Korea, China, Japan, Singapore, the United States and many of the European nations. Literature in developing settings, such as in Indonesia, Malaysia, and the Philippines, provide context-specific information on barriers to implementing technology, including lack of infrastructure, poverty in teacher digital literacy and inaccessibility in particular regions. The literature that has been examined covers three broad categories, including: (1) literature that evaluates the level of interest that interactive technology may have on the students regarding the learning process; (2) studies that explore the level at which the interactive technology may interfere with the student particularly in their academic capability; and (3) literature that seeks to understand the challenges associated with the implementation of the interactive technology in terms of the infrastructure or lack of the same, the professional development of the implementing bodies, and the policy support on the same. By considering the evidence base jointly, it is possible to say that it shows progression of considering the simple usefulness of technology to examining the strategies of integration that have an impact that improves the quality of learning significantly.

Table 1. Summary of Literature Related to the Implementation of Interactive Learning Technology in Elementary School Students (2019–2024)

No.	Writer	Year	Types of Technology	Research Focus	Key Findings

1	Sung et al.	2019	Mobile Learning, Gamification	Interest in learning and academic results	Mobile learning increases student interest and learning outcomes
2	Hamari et al.	2020	Gamification (points, badges, leaderboard)	Engagement and learning motivation	Gamification increases engagement and intrinsic motivation
3	Çakıroğlu et al.	2021	Digital Simulation	Engagement and understanding of science concepts	Simulations enhance student understanding and participation.
4	Chou et al.	2020	Augmented Reality (AR)	Interest in learning and understanding abstract material	AR increases students' learning interest and conceptual understanding
5	Zhang et al.	2022	General Interactive Technology	Cognitive, affective, and behavioral engagement	Interactive technology strengthens students' holistic engagement
6	Lin et al.	2020	Augmented Reality (AR)	Improved academic results	AR significantly improves learning outcomes
7	Li et al.	2021	AI-Based Adaptive Learning	Personalization of learning and academic outcomes	AI supports adaptive learning that improves outcomes
8	Hsin et al.	2020	Virtual Reality (VR)	Conceptual understanding and long-term memory	VR strengthens students' conceptual understanding and memory
9	Lu et al.	2021	Gamification	Academic outcomes, especially for low-motivated students	Gamification effectively improves the outcomes of less motivated students.
10	Sari & Wahyuni	2021	Digital Infrastructure	Access and infrastructure challenges in remote areas	Rural schools lack devices and internet connections
11	Utomo et al.	2022	Digital Competence	Teacher competence in technology integration	Teachers in Indonesia have not yet optimally utilized technology
12	Tondeur et al.	2020	Teacher Readiness	Teacher readiness in implementing technology	The professional readiness of teachers is more important than the tools themselves

13	Zhao et al.	2021	Teacher Training	Technology integration training in learning	Teacher training is still weak, technology is often used ineffectively
14	Chen et al.	2020	Digital Divide	Inter-regional access gap	The digital divide widens the gap in learning outcomes

Increasing Interest in Learning

A systematic literature review demonstrates that most studies report a strong and consistent impact of interactive technologies such as educational games, augmented reality (AR), digital simulations, and gamification-based applications on the learning interest and engagement of elementary school students. These tools are not merely technological add-ons but are designed to foster emotional and cognitive involvement by making the learning process more pleasurable, situationally specific, and intellectually stimulating. Their interactivity, appealing visualizations, and direct graphical feedback contribute to the arousal of curiosity, which encourages learners to participate more actively in the learning process. In this regard, interactive technologies create a dynamic learning environment that aligns well with the psychological needs of young learners who are naturally inclined toward play, exploration, and sensory engagement.

Sung et al. (2019) revealed that the integration of gamified learning media significantly enhances intrinsic motivation among elementary students, particularly in challenging subjects such as mathematics. This finding is crucial because mathematics is often perceived as a difficult and less engaging discipline for young learners; gamification transforms abstract numerical concepts into engaging challenges that stimulate persistence and enjoyment. Hamari et al. (2020) further support this notion, emphasizing that gamification fosters deeper cognitive engagement and promotes positive emotions during instruction by transforming traditional classroom routines into interactive experiences that reward effort and progress. Chou et al. (2020) also note that augmented reality provides powerful visual stimuli that anchor students' attention by linking abstract academic content to tangible, real-life contexts, thereby reducing the cognitive gap between theory and experience. Zhang et al. (2022) further confirm that interactive technologies generally increase learners' involvement, and this heightened engagement directly translates into a more sustained interest in learning. The combination of immersive visual feedback, immediate response, and interactive exploration creates a motivational loop where students feel both challenged and rewarded, reinforcing their desire to continue learning.

However, a critical analysis of these findings suggests that technological tools themselves are not the sole determinants of improved learning motivation. The effectiveness of such technologies depends greatly on the pedagogical framework within which they are embedded. Increased learning interest should emerge not from the mere presence of sophisticated technology but from intentional instructional design that integrates these tools into meaningful, intellectually demanding, and personally relevant learning experiences. When technology is used passively such as when teachers simply play videos, show slideshows, or rely on automated digital content without active engagement the motivational benefits tend to diminish. In such contexts, students may become passive consumers of information rather than active participants in constructing knowledge.

This observation resonates with the principles of social constructivism, which argue that meaningful learning occurs when learners are both socially and cognitively active. Interactive technologies are most effective when they encourage students to

collaborate, reflect, and apply their knowledge in authentic contexts. For example, AR-based group projects or gamified problem-solving tasks promote not only motivation but also communication, creativity, and higher-order thinking skills. Therefore, educators should not view technology as a substitute for pedagogy but as an extension of it one that must be purposefully designed to engage students' minds and emotions simultaneously.

Academic Achievement Fun

A systematic review indicates that educational use of interactive technology also has a positive contribution to enhancing elementary school students academic learning outcome especially in concepts learning ability, critical thinking, and problem solving. Adaptive AI-based platforms, AR, and VR technologies can make learning more vivid and scenario-based, which makes it simpler to grasp abstract information visually and directly students.

According to research conducted by Lin et al. (2020), augmented reality helps enhance academic performance of the students as it delivers material in a more appealing and cognitively accessible manner. Li et al. (2021) also stated that AI-based educational applications demonstrated the ability to adjust the learning materials to the needs of a specific student, thus enhancing effectiveness of learning. A study by Sung et al. (2019) has affirmed the fact that interactive mobile learning can be considerably helpful in enhancing academic performance as opposed to conventional teaching. The results displayed by Hsin et al. (2020) indicate that VR in science education enhances acquisition of great knowledge about the concept and the long-term memory of the student. Moreover, Lu et al. (2021) had to mention that the learning with the help of gamification environments leads to a considerable increase in academic performance, particularly among students who did not strive to learn before.

A feasible explanation to all this based on a critical interpretation is that technology can only be used effectively to enhance learning when it is programmed such that it activates the interaction of the student and the learning content. Technology can easily become one of the greatest sources of distraction which takes away the focus of a student on the learning outcomes without proper instructional design. Consequently, better academic performance is achieved by the rather proper integration of technology into decent studying strategies more than by the mere sophistication of technology.

Challenges Implementation of Interactive Technology in Elementary School

According to the literature review, another barrier to interactive learning technologies is the major obstacle the technologies are facing in developing economies such as Indonesia. The major setbacks are narrow technological infrastructure, lack of competency in technology by teachers and regional discrepancies in accessibility.

According to the studies, the rural schools encounter a considerable number of problems as they are: the lack of devices, the internet connection, and the sufficient amount of human resources (Sari & Wahyuni, 2021). Utomo et al. (2022) have underscored the idea that not all teachers possess the pedagogical knowledge base that will help them to introduce technology to learning efficiently. As revealed in the study by Tondeur et al. (2020), professional preparedness of teachers is a significant factor that can ensure the success of technology, not necessarily depending on the availability of devices. In the meantime, Zhao et al. (2021) mention the significance of institutional assistance in the form of constant training of teachers, since, with the absence of necessary skills, technology cannot be used completely. Chen et al. (2020) further stated that disparity in access between the city and country schools widen the digital divide that directly affects the student learning outcomes. In a

critical sense, these results prove that educational technology cannot simply be a temporary solution to enhancing education quality, but a kind of tool the efficiency of which greatly depends on social, economic, and professional contexts of its application. Governments, as well as institutions of learning, should understand that investing in technology should be followed by capacity building to the teachers, reinforcing infrastructure, and creation of content that would address local cultures and curriculum.

CONCLUSION

Based on the results of the literature review, it can be concluded that the application of interactive learning technology has a significant and positive influence on increasing learning interest and academic achievement of elementary school students. Interactive technologies that include gamification, mobile learning, augmented reality (AR), virtual reality (VR), digital simulations, and AI-based platforms have proven effective in encouraging active student engagement, motivating learning, enriching learning experiences, and facilitating a more concrete and contextual understanding of concepts. The increase in learning interest is driven by the characteristics of technology that can present learning in a more interesting, enjoyable way, and in accordance with the learning style preferences of elementary school-aged children, while academic achievement increases due to access to learning experiences that are more interactive, visual, and adaptive to individual student needs.

However, the findings also indicate that the challenges of implementing interactive technology in elementary schools, particularly in developing countries like Indonesia, remain significant. Key obstacles include limited digital infrastructure, disparities in access between regions, low teacher literacy and competence in utilizing technology pedagogically, and the absence of educational policies that systematically support the integration of technology into the elementary school curriculum. Therefore, educational technology is not an instant solution; its effectiveness depends heavily on the readiness of human resources, the availability of adequate infrastructure, and comprehensive policy support.

In general, the results of this study confirm that the application of interactive technology has great potential to improve the quality of learning in elementary schools. However, to optimize this potential, synergy is needed between technology development, teacher readiness, and policy support that leads to equitable access, increased teacher capacity, and the development of learning content that is relevant to local needs and contexts. This study also opens up space for further research, particularly empirical research in the Indonesian context, to further test the effectiveness of interactive technology in various elementary education settings, while designing realistic and sustainable implementation strategies.

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