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Interactive Learning Media for Better Learning Outcomes in Elementary School: A Systematic Literature Review

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Abstract. The rapid development of digital technology is impacting the learning system in elementary schools and increasing students' screen time. Currently, teachers in Indonesia lack adequate digital competencies, which has become one of the factors affecting students' learning outcomes. This research aims to provide scientific evidence that learning through the use of interactive learning media can improve students' learning outcomes. This study employs the PRISMA method for a systematic literature review, utilizing internationally reputable databases such as Scopus, ScienceDirect, Springer, and ProQuest, covering publications from 2020 to 2024. A total of 21 articles met the research objectives based on the established inclusion and exclusion criteria. The study found a growing trend in the use of interactive learning media in elementary schools, with China emerging as the country with the highest number of relevant publications. Most of the research focuses on STEM subjects and utilizes online learning platforms. The study also revealed that the majority of interactive learning media are multimedia-based, making them engaging and enhancing student motivation. These findings serve as recommendations for future researchers to develop multimedia-based interactive learning media that accommodate various student learning styles. This report provides a scientific foundation for policymakers to establish best practices for the use of technology in education.

Keywords: Educational Technology; Elementary School; Interactive Learning Media; Learning Outcomes; Systematic Literature Review.

1. Introduction

Elementary school is an educational unit that provides basic skills to students, enabling them to continue to secondary education. Basic education is also an important stage for instilling positive character traits in students (Aningsih et al., 2022). Currently, elementary schools face significant challenges in their learning processes. The development of technology greatly influences students' learning methods and learning styles. In addition, elementary school students have increased their daily screen time through activities such as chatting, browsing social media, streaming, and reading news, which has reduced their participation in outdoor and nature-based activities. Based on a survey of teenagers in Australia, it was reported that their time spent outdoors is only 13% (Oswald et al., 2020; Raisal et al., 2024). A previous study by Szymkowiak et al. (2021) stated that education and technology have been integrated over the past 20 years. Therefore, teachers, as facilitators of learning, need to adapt and innovate in their use of digital technology for educational media (Rachmadtullah et al., 2020; Szymkowiak et al., 2021). Currently, Indonesia has adopted a curriculum that focuses on Science, Technology, Engineering, the Arts, and Mathematics (STEAM) to meet industrial needs (Rachmadtullah et al., 2020; Sumardi et al., 2020). To achieve the desired student competencies, learning media that support learning outcomes are essential. Teachers are highly encouraged to utilize digital-based learning media to keep pace with technological advancements and students' increasing proficiency with digital devices.

1.1. Problem Statement

Based on previous studies, students' learning outcomes can be optimized by applying the principles of the Cognitive Theory of Multimedia Learning (CTML), which include using relevant

and balanced content, avoiding excessive cognitive load, and minimizing the use of overly lengthy text (Albers et al., 2023; Cavanagh & Kiersch, 2023). According to Mayer (2024), students who use conversational language in online learning achieve better outcomes compared to traditional methods, and the use of informal words enhances learning outcomes more than formal language. The use of interactive learning media aligns with CTML because it allows students to actively engage and interact with learning objects. This improves learning outcomes by enabling students to experience and internalize knowledge in a more relevant and engaging manner (Marougkas et al., 2024).

Bentri and Hidayati (2023) reported that the Indonesian Ministry of Education and Culture found elementary school teachers' digital competencies in Indonesia to be inadequate, with survey results indicating that only 40% of teachers are prepared to face advancements in information and communication technology as well as digital literacy. In the digital era, elementary schools are also experiencing a shift from traditional to technology-based teaching methods (Sumardi et al., 2020; Tuma, 2021). If the government, schools, and teachers fail to address the need for digital competencies, this may negatively affect students' learning outcomes, which are key indicators of educational quality (Demissie et al., 2022). The increasing intensity of students' technology use creates a positive demand for interactive learning styles, as digitalization can transform thinking patterns, behaviors, working methods, and communication styles (Demissie et al., 2022).

Technology provides dynamic and rapidly delivered audiovisual information; therefore, teaching methods must also adapt accordingly (Szymkowiak et al., 2021). Currently, interactive learning media are essential as a technological innovation in teaching methods. Interactive learning media enhance engagement, efficacy, and efficiency in education through the application of technology, making them particularly suitable for difficult, abstract, and complex material (Irwan & Aznam, 2021). Elementary schools, as the foundational stage of students' education, require special attention in adopting digital-based learning methods to keep pace with technological advancements. Low learning outcomes are often due to students' low motivation, which stems from teachers' limited ability to utilize digital-based learning media effectively (Aswirna & Harahap, 2020).

Therefore, efforts must be made to enhance the technological skills of teachers and prospective teachers through mentoring, reflection, instructional design, and collaboration (Knezek et al., 2023). By utilizing interactive learning media, it is hoped that optimal learning outcomes can be achieved. Learning outcomes represent the final achievements at the end of each learning period and reflect students' competencies in a particular subject (Zhao et al., 2023).

1.2. Related Research

Previous research using systematic literature reviews on the utilization of interactive learning media has been extensively conducted. Research by Ghanbaripour et al. (2024) demonstrates that the adoption of emerging technologies such as Virtual Reality (VR), Mixed Reality (MR), Augmented Reality (AR), and gamification can substantially enhance student engagement, professional competencies, and learning outcomes. This study focuses more specifically on identifying the types of technology used as learning media for elementary school students, as well as the corresponding subject matter. A more detailed study on the use of AI in elementary schools, conducted through a systematic review by Aravantinos et al. (2024), identified categories such as research objectives, learning content, learning activities, learning outcomes, and pedagogical approaches. In contrast, this research explores the technologies utilized in learning media at the elementary school level, extending beyond a sole focus on AI.

Previous research by Kerimbayev et al. (2023) found that the use of modern technology in distance learning effectively improves student motivation, engagement, and learning outcomes. Additionally, their study assessed the advantages, limitations, and challenges of technology integration. In comparison, this research focuses on primary education and does not limit its scope to distance learning but considers the use of technology in a broader context. According to research by Lara-Alvarez et al. (2023) on the use of VR in elementary schools, students learning in virtual environments achieve better academic performance than their

peers in traditional classrooms. Furthermore, the study found that mobile VR is more advantageous than tethered VR. However, this research investigates a wider range of technologies used in elementary education, not limited solely to VR. E-modules, which are interactive multimedia-based learning resources, have also been shown to effectively enhance learning outcomes in spatial content areas (Alyusfitri et al., 2024). Accordingly, this study comprehensively examines both the types of learning media technologies and the associated learning materials.

As previously mentioned, this study focuses on identifying instructional media technologies and learning resources used in elementary schools. It explores various applications of interactive learning materials and examines the opportunities and challenges related to their implementation in primary education, aspects that have not been systematically addressed in prior research.

1.3. Research Objectives

Through a systematic review of the utilization of interactive learning media, which has been shown to improve learning outcomes for elementary school students, this study aims to analyze the subject matter, the types of technology-based interactive learning media used, the publication year, the countries involved, and the current state of education in Indonesia. This research also seeks to provide scientific evidence that the use of interactive learning media can enhance students' learning outcomes. The findings of this study are expected to serve as best practices for educators in implementing technology-based instruction and as a scientific foundation for the development of policies at the national, regional, and school levels.

2. Theoretical Framework

2.1. Interactive Learning Media

Mayer characterizes learning as an active process in which learners construct meaning and strive to create coherent and organized knowledge structures (Chen & Tsai, 2021). The use of interactive elements that actively engage students in the learning process is referred to as interactive learning media. To emphasize the significance of interactive learning media in education, the author applies Mayer's CTML (C. Wang et al., 2020). CTML integrates cognitive load theory, dual coding theory, and constructivist learning theory. Mayer argues that children can achieve a deeper understanding when they engage with both words and images, rather than with words alone (Mayer, 2024; Tugtekin & Odabasi, 2022). His theory is based on several assumptions: auditory and visual information are processed through separate channels, each with limited capacity, and learners actively process incoming information—such as selecting, organizing, and integrating it with existing knowledge—to achieve effective learning (Heo & Toomey, 2020; Knoop-van Campen et al., 2020). Through the integration of written text and visuals supplemented by audio recordings, Mayer and his team developed 12 CTML design principles. These principles have since evolved to support computer-based, virtual, and augmented learning environments in the contemporary digital era (Çeken & Taşkın, 2022).

2.2. Interactive Learning Media and Learning Outcomes

Students' learning outcomes can be optimized when they apply the principles of the CTML, which include using relevant and balanced content, avoiding excessive cognitive load, and minimizing unnecessary text (Albers et al., 2023; Cavanagh & Kiersch, 2023). By applying CTML, students engage in meaningful learning activities and construct new knowledge from previously encountered stimuli, thereby increasing their cognitive activity (Castro-Alonso et al., 2021). According to Mayer (2024), students who use conversational language in online learning environments achieve better learning outcomes compared to those using traditional methods, and the use of informal language enhances learning outcomes more effectively than formal language. Interactive learning media align with CTML principles because they enable students to engage actively and interact with learning objects. By providing learners with opportunities to encounter and process knowledge in a more relevant and engaging manner, interactive

learning media can improve both learning outcomes and the overall learning experience (Marougkas et al., 2024).

3. Method

3.1. Research Design

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is a framework used to synthesize knowledge within a specific domain, helping to identify future research priorities and answer questions that individual studies cannot address (Page et al., 2021). A systematic literature review (SLR) is a scholarly approach that provides an overview of the latest knowledge on a topic by presenting substantive, theoretical, and methodological findings (Newman & Gough, 2020). Through a systematic literature review, researchers can identify existing subjects, phenomena, and research topics to address unanswered questions in the current body of research (Newman & Gough, 2020; Page et al., 2021). Additionally, SLRs can generate or evaluate hypotheses concerning the causes or mechanisms of various phenomena. PRISMA supports researchers in transparently documenting the rationale for the review, the methodologies employed, and the findings obtained.

A systematic literature review aids in the identification of published studies that meet predefined inclusion criteria. Key components of an SLR include formulating a research question, clearly defining objectives and methods, establishing inclusion criteria, assessing the validity of articles through bias evaluation, systematically presenting and synthesizing information, and aiming to draw scientific conclusions based on the findings (Mengist et al., 2020). The SLR process applies the PRISMA framework through four stages: identification, screening, eligibility, and inclusion.

3.2. Data Collection

The four core phases of PRISMA are identification, screening, eligibility, and data abstraction and analysis (Haddaway et al., 2022; Kahale et al., 2022). The identification stage involves selecting appropriate keywords based on the research topic and determining the reputable databases to be used. This research was conducted in September 2024, utilizing internationally recognized databases such as Scopus, ScienceDirect, Springer, and ProQuest, with the following keywords: "Interactive Learning Media" and "Learning Outcome" and "Elementary School" and "Primary School." The total number of articles retrieved after entering the keywords into each database was recorded.

The screening stage involves identifying and removing duplicate articles using Zotero software. The researchers then screened the remaining articles based on their titles and abstracts, following the predetermined inclusion and exclusion criteria. The inclusion and exclusion criteria for this research are outlined in the Table 1 below to ensure the selection of articles that align with the research objectives.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication timeline	Year 2020- September 2024	Year 2019 and before
Document type	Research articles	Journals (systematic review and meta-analysis), review paper, proceeding, chapters in book, books, book series, dissertation, thesis
Language	English	Non-English
Accessibility	Open access	Non open access
Focus	Using interactive educational materials to enhance the learning outcomes of elementary school students	Articles that do not address learning outcomes should be excluded, as should the usage of interactive learning materials to improve learning

	outcomes in high school, college, and secondary education

The eligibility stage involves a full-text review of the screened articles. The researchers selected articles that specifically focused on interactive learning media and learning outcomes in elementary schools, continuing this process until all articles meeting the established criteria were identified and prepared for analysis in the inclusion stage. To enhance understanding of the research process, the researchers developed a PRISMA flow diagram, which is presented in the Figure 1 below.

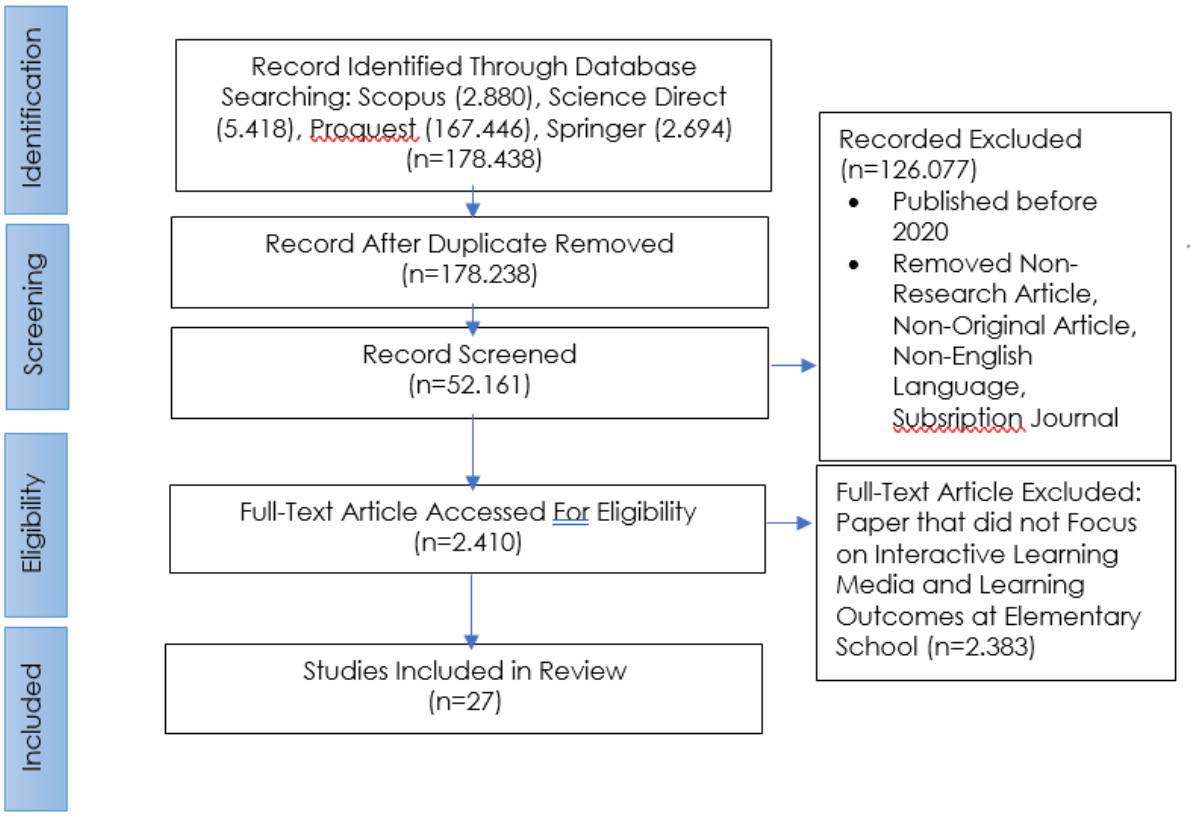

Figure 1. Flowchart of The SLR Process Using PRISMA

3.3. Data Analysis

Descriptive and thematic analysis were used to review the 21 selected articles. A descriptive study was conducted to ascertain the country, the year the papers were published, and the proportion of subjects who had used interactive learning media technology. Microsoft Excel is used as a tool for descriptive analysis. Inductive thematic analysis is conducted to identify themes in the form of subjects and the interactive learning media technologies utilized. Inductive thematic analysis is a qualitative data analysis method where themes and patterns emerge directly from the data without being influenced by theoretical frameworks or prior assumptions (Naeem et al., 2023). The presentation of data uses visual representation to facilitate reading.

3.4. Validity and Reliability

Maintaining validity and reliability ensures that the PRISMA technique stages are accurate and suitable. The researchers preserve the study's validity by clearly following the article search steps, which include choosing keywords, using internationally respected databases, establishing inclusion and exclusion criteria, and utilizing the PRISMA checklist and flow

diagram. To ensure reliability, this study employs the same keywords in all databases, all researchers participate in article and discussion selection, Zotero software is used to prevent article duplication, and systematic data processing (Mengist et al., 2020).

4. Findings

4.1. Number of Articles by Year of Publication

Based on the PRISMA process, 21 articles were identified that align with the research objectives and meet the established inclusion and exclusion criteria. The trend of article publication has shown an increase over the years. As illustrated in Figure 2, the highest number of publications occurred in 2024, with 11 articles, followed by 6 articles in 2023, 2 articles in 2022, and 1 article each in 2020 and 2021. The following Figure 2 represent the publication years of the 21 selected articles, spanning the period from 2020 to 2024.

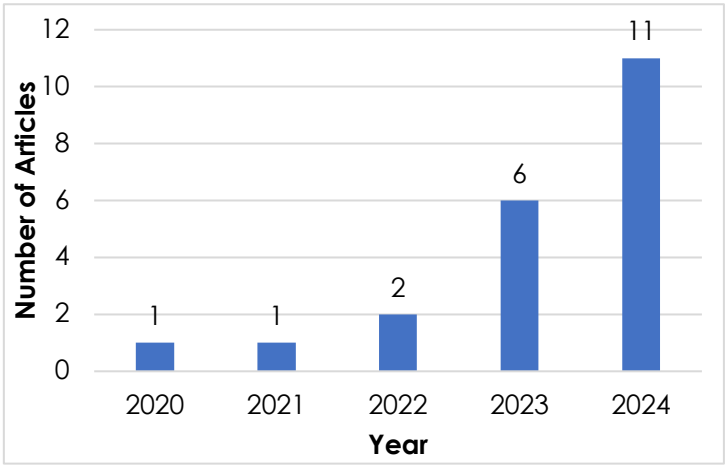

Figure 2. Article Description Based on Year of Publication

4.2. Number of Articles by the Country

Figure 3 illustrates that China conducted the most research on interactive learning media and learning outcomes, contributing 4 articles. This is followed by Greece with 3 articles; South Korea, Indonesia, Taiwan, and the United States with 2 articles each; and Norway, Finland, Israel, Brazil, the United Kingdom, and Chile with 1 article each. The detailed distribution of articles by country is presented in the Figure 3.

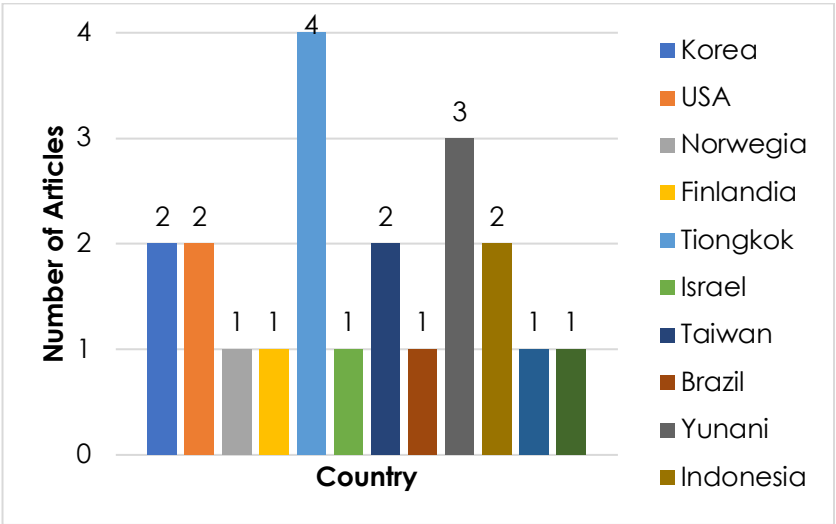

Figure 3. Article Description by the Country

4.2. Number of Articles by the Subject

Figure 4 shows that interactive learning media is most widely used in STEM subjects, with 12 articles, followed by language subjects with 5 articles, and general applications across all subjects also with 5 articles. The detailed results of the subject areas utilizing interactive learning media are presented in the Figure 4.

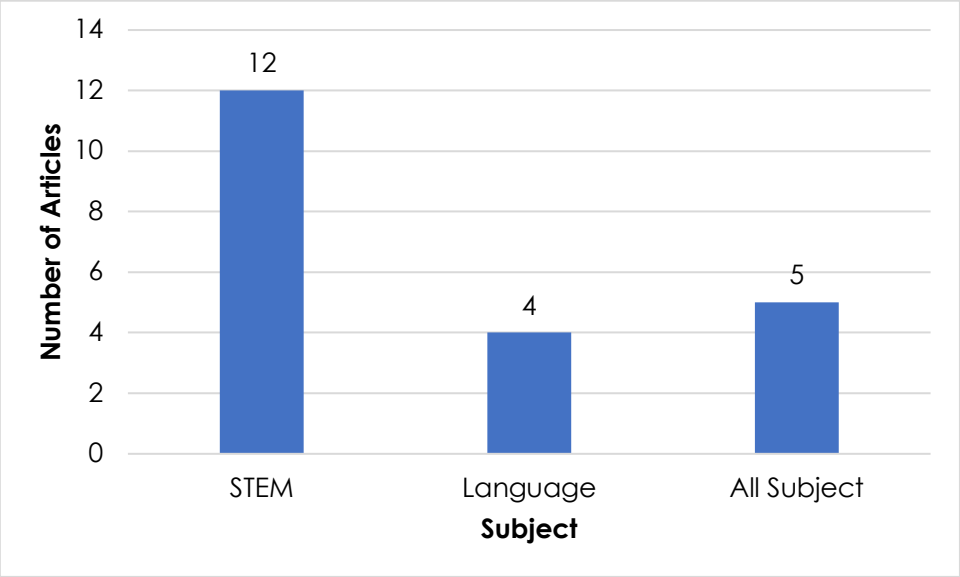

Figure 4. Article Description by the Subject

The identification results of interactive learning media used in each subject have been summarized. Table 2 below presents these findings.

Table 2. Interactive Learning Media Based on the Subject

Subject	Interactive Learning Media	Number of Articles	Authors
STEM (11)	Online Learning Platform	4	(Khattib & Alt, 2024; Lee et al., 2023; Pellas, 2024a; Rayan & Watted, 2024)
	Interactive Visual	1	(Marini et al., 2023)
	Virtual Reality	1	(Xie & Zhang, 2024)
	Augmented Reality	1	(Faria, 2024)
	Game	2	(Bang et al., 2023; Cubillos et al., 2024)
	Video Animation	1	(Zito et al., 2021)
	Google Docs	1	(Lin et al., 2024)
Language (5)	Digital writing	1	(Spilling et al., 2023)
	Virtual Reality Games	2	(Lai, 2024; Li et al., 2022)
	Flipped Learning Classroom	1	(Larsari & Abouabdelkader, 2024)

	Digital Story Telling	1	(Korosidou & Griva, 2024)
All Subject (5)	Video	1	(Laakso et al., 2021)
	Smartphone	1	(J. C. Wang et al., 2023)
	Educational animation with textual instructions	1	(Du et al., 2024)
	Interactive Multimedia E-Module	1	(Alyusfitri et al., 2024)
	Digital Textbook	1	(Im, 2024)
Total		21	

Based on the Table 2, interactive learning media in elementary education is predominantly used in STEM subjects, with a total of 11 articles. The most common platforms are online learning platforms (4 articles), followed by games (2), and individual uses of interactive visuals, virtual reality, augmented reality, video animations, and tools like Google Docs. In language subjects, five articles explored digital writing, virtual reality games, flipped learning classrooms, and digital storytelling. Across all subjects, five articles featured various media such as videos, smartphones, educational animations with textual instructions, interactive multimedia e-modules, and digital textbooks. These findings highlight the diverse use of interactive technologies to support different learning areas.

5. Discussion

Research on the utilization of interactive learning media in elementary schools has been increasing every year. This trend has emerged largely as a result of the COVID-19 pandemic, which compelled educational institutions to adopt technological advancements for remote learning. Additionally, the advancement of interactive technologies such as VR, Artificial Intelligence (AI), gamification, and AR has further stimulated researchers' interest in exploring educational media (Sari & Oktaviani, 2021). The shift toward student-centered learning paradigms has also driven technological innovations in learning media, aimed at enhancing engagement, motivation, and learning outcomes (Chen & Tsai, 2021). These factors align with the countries leading research in interactive learning media, with China contributing the largest number of articles in this study. China has emerged as one of the pioneering countries in technological development (Cheng et al., 2024; Zhu & Gu, 2024). As the first country severely affected by the COVID-19 pandemic, China implemented a series of effective prevention and control strategies, including scientific innovations in educational technology such as "Cloud Education," on a massive and effective scale (Zhu & Gu, 2024). According to Z. Yang and Pan (2024), China recognized the potential of AI development through relevant theoretical research, inspired by the United States' national strategic plan for AI research and development. AI development in China has primarily focused on educational technology, computer science, and engineering. Furthermore, research by Zeng (2022) indicated that during the third stage of China's Information and Communication Technology (ICT) development (2011–2021), there were notable improvements in the ICT competencies of primary school teachers and students.

Indonesia likewise has an opportunity to maximize the use of technology in educational materials. According to data from the Center for Data and Information Technology of the Ministry of Education, Culture, Research, and Technology (2023), the number of teachers and students utilizing ICT for learning in 2023 exceeded the target by 154%. Moreover, the Ministry of Education and Culture has developed various digital platforms to support both administrative and learning activities. For example, the belajar.id account ranks first in usage at the elementary school level for accessing electronic-based learning applications. Through this account, users can access a variety of features such as Google Forms, Google Drive,

Google Meet, Google Slides, Google Classroom, Google Docs, and more. However, challenges remain, including the suboptimal use of educational digital platforms in underdeveloped, frontier, and outermost regions, and the proliferation of applications developed by individual units that are not integrated into the organization's application architecture (Center for Data and Information Technology of the Ministry of Education, Culture, Research, and Technology, 2023). Therefore, capacity building is urgently needed, along with the innovative development of digital platforms that can function offline to address internet connectivity issues.

The utilization of interactive learning media is most prevalent in Science, Technology, Engineering, and Mathematics (STEM) subjects. STEM is inherently complex and encourages students to develop collaboration skills, strengthen teamwork, and enhance their ability to acquire new knowledge to solve real-world problems (Hu et al., 2024; Raisal et al., 2024). Furthermore, STEM education helps bridge the gap between academic knowledge and the needs of the 21st-century workforce (Pricilia et al., 2020). Consequently, STEM subjects require interactive learning media to boost student attention and motivation. This is supported by research from Prastowo in Khairani et al. (2023), which found that elementary-level learning is more effective and efficient when using multimedia and multisensory-based learning media.

As shown in Figure 4, the most widely used interactive learning media in elementary education are online learning platforms, particularly in STEM subjects. These platforms provide features that facilitate teaching and learning via the internet, such as access to learning materials, discussion forums, assignments, and evaluation tools, all designed to foster interaction between students and teachers in a virtual environment, thereby enhancing satisfaction and academic achievement (Abuhassna et al., 2020; Enyoojo et al., 2024; Sari & Oktaviani, 2021). Commonly used platforms include Kahoot (Pellas, 2024b; Rayan & Watted, 2024) and CoSpaces Edu (Khattib & Alt, 2024). The use of these platforms has significantly impacted student motivation and learning outcomes in STEM subjects, as the material is delivered in an interactive and engaging manner. Students can also access the material anytime and anywhere, allowing for independent learning according to their needs (Lestari et al., 2024; Masdayaroh et al., 2022; Wandri & Jalinus, 2022; D. Yang & Baldwin, 2020).

This study also highlights that, in Indonesia, STEM subjects have been increasingly incorporated into research on interactive learning media (Alyusfitri et al., 2024; Marini et al., 2023). According to the Programme for International Student Assessment (PISA) 2022 results, Indonesia improved its ranking in literacy learning outcomes by five to six positions compared to 2018, although the overall score declined (Kemdikbud RI, 2023). To further enhance students' STEM competencies, the government must continue to promote the use of interactive learning media while ensuring balanced technological capacity. Research on the implementation and challenges of STEAM in elementary schools indicates that technology remains a significant barrier (Nuragnia & Usman, 2021).

Beyond online platforms, this study identified 16 types of interactive learning media, as shown in Figure 4. A significant finding is that the majority of these media are multimedia-based. Multimedia refers to software programs that integrate various components—images, sound, text, video, and animations—into a cohesive instructional format (Abdulrahaman et al., 2020; Kissi et al., 2019). Interactive multimedia learning tools combine images, videos, text, audio, and animations, packaged in digital formats to deliver instructional content tailored to both teachers' objectives and students' diverse learning styles (Munawaroh et al., 2022). According to the findings of this systematic literature review, the application of interactive learning media at the elementary school level effectively enhances learning outcomes.

However, while previous research demonstrates the positive impacts of interactive learning media, it also highlights potential risks, such as cyberbullying and exposure to inappropriate content that could affect students' ethics and character development (Cipta et al., 2023). Therefore, as the use of technology in education intensifies, both parents and teachers must exercise strict supervision. Family, school, and social environments play crucial roles in shaping students' character, and it is important to remember that digital media is just one of many factors influencing character development.

Limitation of this study is that it only identified and analyzed the subjects and types of interactive learning media used, without examining the specific content within them. These findings serve as recommendations for future researchers to develop multimedia-based interactive learning media that accommodate various student learning styles and further in-depth research into subject content could reveal characteristics, when combined with interactive learning media, may further enhance learning outcomes.

6. Conclusion

Based on the analysis of 21 articles providing evidence that the use of interactive learning media can improve student learning outcomes, the highest number of publications was recorded in 2024. Research on the utilization of interactive learning media in elementary schools has shown a consistent upward trend, in line with the development of interactive technologies such as gamification, AR, VR, and AI. China has emerged as the leading country in conducting research on the use of interactive learning media, aligned with its policies and advancements in ICT development. Meanwhile, Indonesia has the opportunity to maximize the use of technology in learning media through digital learning platforms provided by the Ministry of Education and Culture, as well as the increasing adoption of technology by teachers and students, particularly at the elementary level. In elementary schools, interactive learning media is predominantly used in STEM subjects to help students comprehend complex material and enhance their motivation and learning outcomes. Most of the interactive learning media utilized are multimedia-based, combining images, videos, text, audio, and animations to accommodate diverse student learning styles.

Limitation

This research is limited to reputable international databases, including Scopus, ScienceDirect, Springer, and ProQuest. The study focuses on publications from 2020 to 2024.

Recommendation

It is recommended that future researchers conduct a more in-depth analysis of the content within each interactive learning medium, ensuring alignment with the subject matter, and further develop multimedia-based interactive learning media to accommodate diverse student learning styles in the digital era. The government should innovate by providing digital platforms that can be accessed offline to address issues related to limited internet connectivity. Additionally, stakeholders are encouraged to increase the availability of free online learning platforms that teachers can use as interactive multimedia tools, while also enhancing teachers' ICT competencies.

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Conflict of Interest

The Authors declare that there is no conflict of interest.

Declaration of Generative AI-assisted Technologies

This manuscript was prepared with the assistance of Generative AI Grammarly and Quillbot. The AI was used to assist in language refinement. All intellectual contributions, critical analyses, and final revisions were conducted by the authors. The authors take full responsibility for the accuracy, originality, and integrity of the content presented in this work.

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