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Educational Games as Learning Media in the 21st Century for Elementary School Students: A Systematic Literature Review

Nurul Istiq'faroh[1], Narong Kiettikunwong[2], Ricky Setiawan[3], and Hitta Alfi Muhimmah[4]
[1,3,4]Universitas Negeri Surabaya, Lakarsantri, Surabaya, East Java 60213, Indonesia
[2]Khon Kaen University, Muang District, Khon Kaen 40002, Thailand
**coresponding author: nurulistiqfaroh@unesa.ac.id*

Abstract

Technology in education is essential in the 21st century. Technology plays an important role in all learning methods today. Educational games can be used in all levels of education. This study presents a systematic literature review on educational games in elementary schools and offers recommendations for future research. This study identified twenty articles that focused on game-based learning in elementary schools. Article quality is assessed at the initial phase of the selection process based on specific criteria. Criteria: Articles published from 2013 to 2022, in English, from journals and proceedings, and open access. The PRISMA methodology was employed to ensure a transparent and comprehensive review process. Data collection involved systematically searching and screening articles from relevant databases. This research also explores the level of education, learning models, learning activities, types of research used, use of digital tools, and the impact of games on learning in elementary schools. Incorporating technology in the teaching and learning process can effectively develop students and educators to achieve better learning and educational outcomes. This research study found that educational games integrated with various digital tools were successfully used in elementary schools to achieve learning objectives.

Keywords: 21st century, educational games, elementary school, and systematic literature review.

INTRODUCTION

In the 21st century, technology plays a very important role in learning (Alenezi, 2023; Jan, 2017). Technology allows students to have access to real-time information and integrate more engaging, interactive, and effective learning experiences (Park et al., 2023; Saidin et al., 2015). In addition, technology also enables the development of digital skills, such as the ability to search, evaluate, and integrate information from multiple sources (Falloon, 2020; van Laar et al., 2017). Various educational technologies, such as learning management systems, simulations, virtual reality, and mobile learning applications enable students and teachers to work more efficiently and effectively. Therefore, technology is an important aspect of learning in the 21st century.

The era of digital technology has become an important part of the learning environment (Burns et al., 2002; Goldie, 2016; Sattler et al., 2020). The integration of digital technology in education is necessary to provide better education. Leveraging digital technology means providing access to technology to transform traditional learning into a modern and digitalized learning system (Bilyalova et al., 2020; Kalimullina et al., 2020). Digital technologies provide an opportunity to reduce the gap between traditional and modern learning approaches as an inclusive factor that supports human rights and dignity (Garcia, 2020; McDougal et al., 2018). Digital technologies provide an opportunity to fulfill the needs in the learning environment and overcome various barriers in the learning process (Huang et al., 2016; Hwang, 2014). Nowadays, digital technology is a very effective tool for acquiring knowledge and increasing learning capacity. In this case, the utilization of digital technology helps to increase the effectiveness of various types of learning, such as e-learning, d-learning, m-learning, and u-learning through the connection among computer technology, networking, information and communication technology (ICT), multimedia, and artificial intelligence (Sarrab, 2019; Vyas & Nirban, 2014; Zouhair et al., 2016).

Digital technology can be implemented in learning, one of which is through educational game applications. Mobile-based game applications that include sound, images, and interactive games, can increase the attractiveness and understanding of teaching materials, especially for young children who are in the learning stage (Cerezo et al., 2019; Konstantakis et al., 2022). Educational games are a form of

visual technology that also has an important role in science (Potkonjak et al., 2016; Xian et al., 2022). Educational games can encourage children's brain development so that they can think more actively and creatively. Educational games are fun learning media, have their curriculum, and can cause addiction (Pramuditya et al., 2018). In addition, games and simulations have been shown to improve students' performance, engagement, and motivation in several educational sectors (Lamb et al., 2018; Vlachopoulos & Makri, 2017).

Educational games are games that are packaged to stimulate thinking, including improving concentration and solving problems (Yu et al., 2021; Zeng et al., 2020). An effective and interactive learning technique for elementary school students is to use educational games because most children at an early age are curious about everything in their environment (SAPUTRI et al., 2018; Wang, 2020). Games have positive functions and benefits for children such as children getting to know computer technology skills, learning to follow directions and rules, practicing problem-solving and logic, training motoric and spatial skills, establishing communication with parents while playing together, and getting entertainment.

Android-based educational games have become an interesting research topic for researchers in the field of education (Qohar et al., 2021; Suddin & Deda, 2020). Several studies have been conducted to evaluate the effect of Android-based educational games on the learning process and students' achievement (Fatahillah et al., 2021; Fitriyana et al., 2021; Yasin et al., 2018). Another study tested the effectiveness of using Android-based educational games in increasing student's motivation and learning outcomes in mathematics. The results showed that the use of Android-based educational games can increase students' motivation and learning outcomes (Sarifah et al., 2022). Another study evaluated the effect of using Android-based educational games on students' critical thinking skills (Rosmiati et al., 2023).

Mora et al. (2017) conducted a systematic literature review on gamification at the university level. The focus of the review was to examine the gamification development framework considering the appropriate age of university students and the types of gamification elements in higher education environments. The conclusions of the review showed the dominance of gamification elements in business environments, while there are fewer gamification tools available in general

activities such as education and health. The authors note that most publications in higher education do not follow a formal design of the gamification process.

The review article (Hamari et al., 2014) presents systematic literature research on gamification in general, not just in education. The purpose of this research is to find out whether gamification is beneficial. The authors emphasize the motivational potential of gamification and analyze its impact on the psychological aspects of motivation. The results show that the effects of gamification tend to be positive, although further research needs to be done to confirm this, especially since the study used more qualitative methods.

One recent review (Nieto-Escamez & Roldán-Tapia, 2021) explored the experience of using gamification in high schools and universities during the COVID-19 pandemic. The article did not use the SLR methodology, and the authors described 11 case studies on the use of gamification, grouped by subject or field (chemistry, biology, medicine, computer science, business). They analyze the impact of gamification on students' motivation and learning outcomes. It showed a positive impact, but the conclusion was that further research is needed as there was no comparison of the learning outcomes between traditional learning and game-based learning.

A review of the existing literature shows that gamification is mostly applied in higher and secondary education, which means that there are still few studies showing the results of gamification in elementary schools. Based on the review of these works, it can be concluded that there is a need for new high-quality systematic literature reviews to prove the long-term sustainability of the benefits of gamification for educational purposes in elementary schools. As most of the studies were conducted in higher and secondary education, it is suggested by the authors that further studies in elementary schools should be conducted. Thus, as a result, this study aims to explore the use of educational games in the context of learning and education to achieve better outcomes, especially in the 21st century.

Gamification is used in higher and secondary education but rarely in primary schools (Dichev & Dicheva, 2017; Navarro-Espinosa et al., 2022; Ortiz et al., 2016). A more comprehensive systematic literature review is needed to determine gamification's long-term effectiveness in primary schools. Most studies focus on

higher education and secondary education, so experts recommend to conduct research in elementary schools. This study examines how 21st-century primary schools use instructional games to improve academic performance. Educational games improve active learning (Kilag et al., 2023), critical thinking (Vong & Kaewurai, 2017), and problem-solving (Granic et al., 2014). Elementary schools must adopt instructional games to educate children for 21st-century learning (Mamayusupovich, 2020). Due to rapid social change, students need knowledge, creativity, collaboration, adaptability, and digital literacy. Educational games engage students and help them master vital abilities (Vlachopoulos & Makri, 2017). Educational games' benefits in primary school need extensive research. This study helps teachers and policymakers incorporate instructional games into elementary school curriculum.

METHODS

Research Design

This research is based on a systematic literature review. Recent information has been included to contribute to the ongoing debate on the potential of technology in changing the educational paradigm. The study mainly focuses on the teaching-learning process that utilizes technology as a convenient approach for learners to get a better education. This research is based on a systematic literature review, utilizing the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology to ensure a comprehensive and transparent review process. The PRISMA framework was employed to identify, screen, and include relevant studies systematically. This approach allows for a detailed examination of the current literature and contributes to the ongoing debate on the potential of technology in transforming the educational paradigm. The study primarily focuses on the teaching-learning process that integrates technology, offering a convenient and effective approach for learners to achieve a better educational experience.

Objectives and Research Questions

The purpose of this systematic literature review is to explore the field of gamification in education with a focus on elementary schools to provide

recommendations for future research. This objective will be achieved by answering the following research questions:

Q1: How is the integration of educational games in elementary school especially in the 21st century?

Q2: What tools are used to create educational games in elementary school?

Q3: What kind of research has been done on educational games and what was the purpose?

Q4: Do educational games have a positive impact on elementary school students?

Search Strategy

The literature search strategy is a very important part of the development in the field of science (Balters et al., 2023). This is because the literature search strategy provides an opportunity to synthesize and reflect on previous research for providing a solid foundation for scientific progress (Mabbott, 2013). Before conducting the SLR (Systematic Literature Review), it was established in the protocol that the research would include a study on the use of educational games in elementary schools. The focus would be on articles published in English in international journals and conference proceedings within the last ten years. The two main bibliographic databases used to search the literature are Web of Science and Scopus. In addition, English keywords were selected to be used in the literature search. Inclusion and exclusion criteria were also defined to select relevant articles, and these will be further explained in the next section.

Quality Assessment

A quality assessment at the beginning of the screening determined which articles were selected according to the specified criteria. The criteria were related to the year of publication, and only recent articles published between January 2013 and January 2022 were considered. In addition, only articles from the journals and proceedings published in English were considered.

Table 1. Basic Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion Criteria
1	Studies from 2013 to 2022	Studies older than 2013
2	Primary studies published in journals and conference proceedings	Literature reviews and book chapters
3	Open accessed articles	Paid articles

Table 2. Additional Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion Criteria
1	The results of the research are described	The results of the research are not described, or the research has not yet been conducted
2	The abstract and the full text are written entirely in English	The abstract is written in English, but the full text is not written in English
3	Relate to the teaching and learning process	Do not relate to the teaching and learning process
4	Relate to elementary and secondary school students	Relate to university students or adult learners
5	List the elements of gamification and/or digital tools	Do not list the elements of gamification and/or digital tools

In the next phase, the quality assessment was conducted by excluding articles that were deemed to lack quality based on the summary reading. The exclusion criteria were again applied to articles that did not highlight the educational levels. The exclusion criteria were also applied to articles that were not open-access. A cursory review excluded articles that did not conduct research or describe research results, articles that did not refer to the teaching process, and articles that did not include elements of educational games or digital tools.

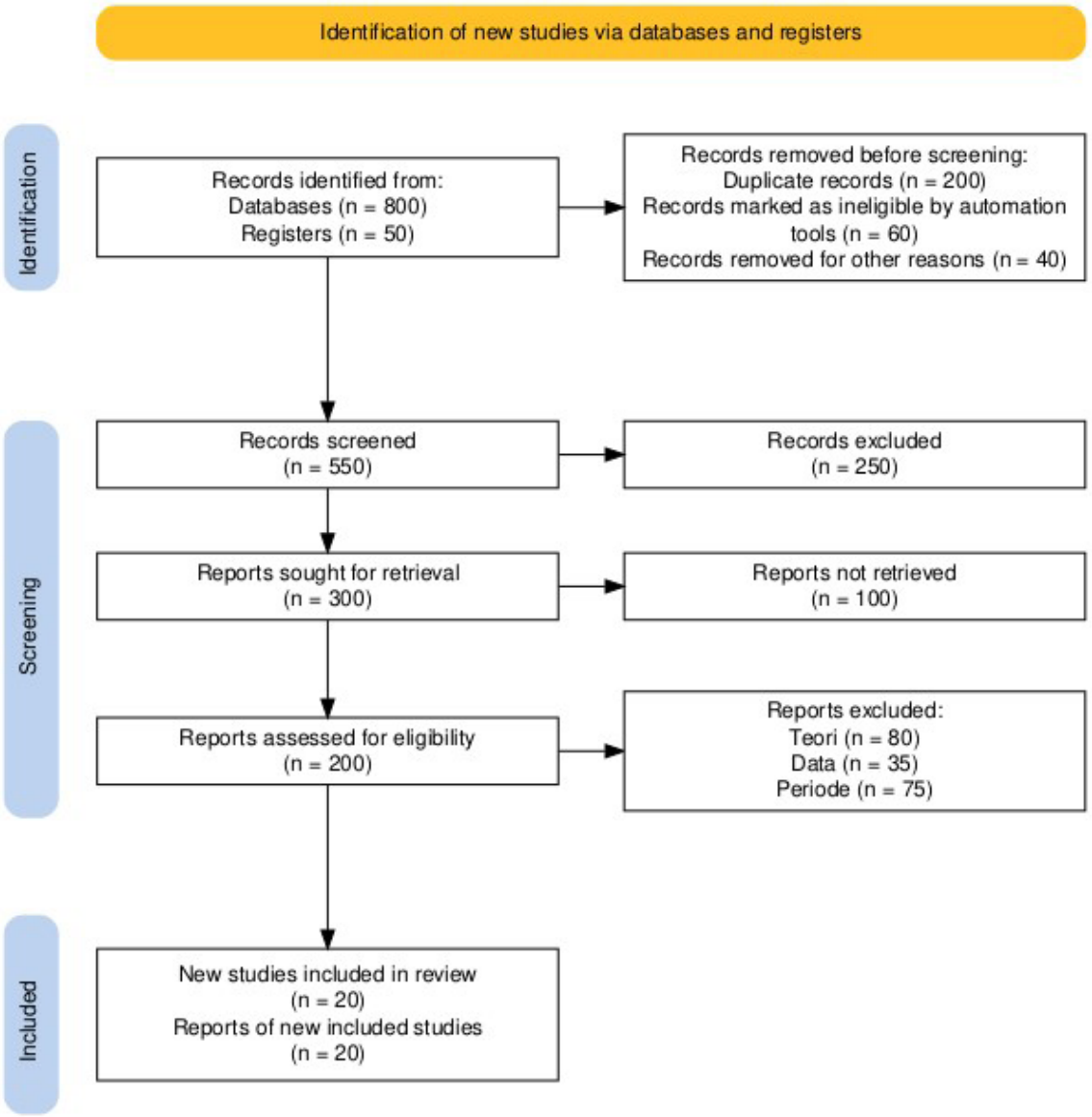

Figure 1. PRISMA flow diagram of document selection

Furthermore, this study followed the Systematic Literature Review and Meta-Analysis Guidelines (PRISMA) to ensure the accuracy and validity of the literature review (Moher et al., 2009). Initially, 200 documents were found, but after the selection and screening process, 20 documents were found. The following summarizes the research findings from the PRISMA metadata

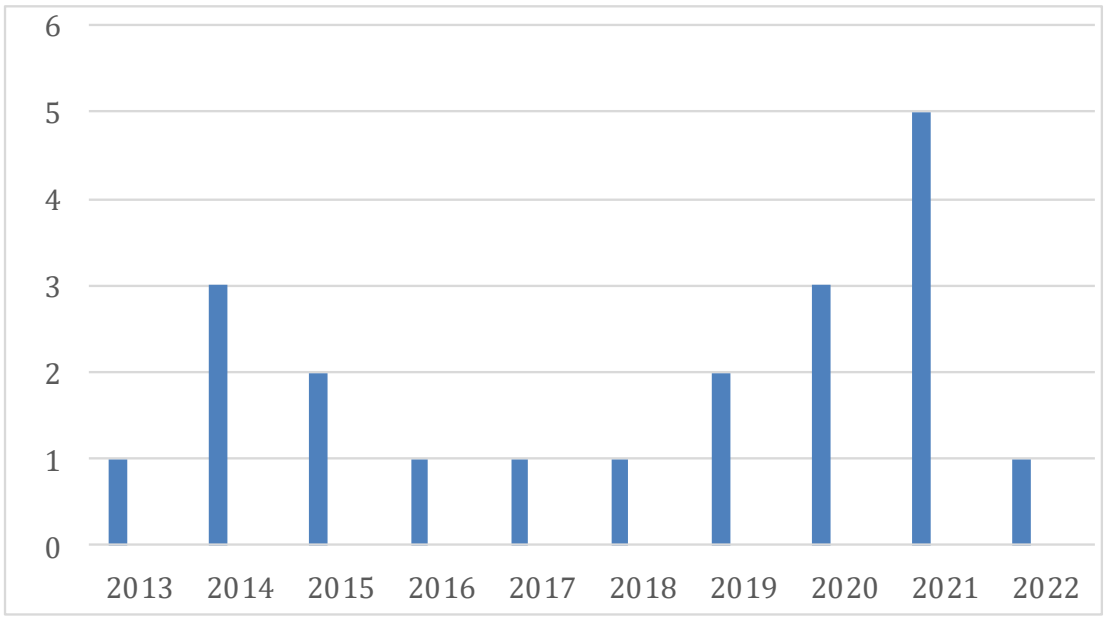

Figure 2. Number of Papers by Year

As explained earlier, by using basic and additional inclusion and exclusion criteria, this study only considered papers that were related to elementary school students with research findings. Of the 20 papers, 19 were from scientific journals and only one was from conference proceedings. Figure 2 below shows the number of articles to be analyzed by publication year. Most of the studies were conducted in 2021 (5 studies). When looking at the countries where the studies were conducted, most of them were from Taiwan (3 studies), while other countries were represented by one or two studies. Another synthesis of results is presented in Table 3, which lists the papers coded ID1, ID2, to ID20. In the next chapter, the findings from the SLR will be discussed in the context of the predefined research questions.

Table 3. Summary of Selected Studies

Study (year)	Context	Digital Tools	Type of Research	Major Findings	Sources
ID1 (Cheng et al., 2013)	• Taiwan • Grade 4 elementary school students • Environmental Education	Proprietary application	• Quantitative • Experimental Research	Positive: • This application is suitable for both male and female students. • Provide convenience and motivate students.	Australasian Journal of Educational Technology
ID2 (Idris et al., 2020)	• Malaysia • Grade 3 elementary school students • English	Kahoot!	• Quantitative • Quasi-experiment with a pre-post test	Positive: • Can explore grammar. • Strengthen learning about the verbs in the simple present tense.	International Journal of Learning, Teaching, and Educational Research
ID3 (T. Alshammari, 2020)	• Saudi Arabia • Grade 6 elementary school students • Arabic Language Learning	Proprietary system	• Quantitative • Experiment (pre-posttest, attitude survey)	Partly positive: • Increase learning outcomes and students' motivation. • However, no effects were found regarding attention level and trust level.	TEM Journal
ID4 (Mansur et al., 2019)	• Indonesia • Grade 5 elementary school students • Ecosystem Education	Proprietary application format .exe	Research and Development	Positive: • Can increase learning motivation • Learning becomes fun	International Conference on Education Technology

Study (year)	Context	Digital Tools	Type of Research	Major Findings	Sources
ID5 (Sánchez-Rivas & Ruiz-Palmero, 2019)	• Spain • Elementary school teacher concentrating on natural sciences • Natural Science	Proprietary mobile applications	• Quantitative • Experimental Research	Positive: • Gamification boosts teacher's motivation • Increase activities on teacher's assessment	Educational Sciences: Theory & Practice
ID6 (Hwang et al., 2014)	• Taiwan • Grade 6 elementary school students • Natural science	Proprietary application created through "Kodu" that can be executed on Xbox or personal computer	• Quantitative • Experimental Research	Positive: • Effectively improve the thinking process • Creative • Motivate students	Educational Technology Research and Development
ID7 (Hung et al., 2014)	• Taiwan • Grade 5 elementary school students • Mathematics	Proprietary system in the form of a digital book	• Quantitative • Quasi Experiment	Positives: • Improve student's self-efficacy • Increase motivation and learning achievement	Journal of Computers in Education
ID8 (Craig et al., 2016)	• America • 7-11 years old students in elementary school • Child Psychology	Proprietary application through the Zoo U program	Quantitative study	Positive: • An effective method for improving children's social skills • Enhance social knowledge	Journal of Child and Family Studies

Study (year)	Context	Digital Tools	Type of Research	Major Findings	Sources
ID9 (Khamparia et al., 2020)	• India • Grade 1 elementary school students • Natural science	"SmartLearn" microworld game	Quantitative study Quasi Experiment	Positive: • Improve personality to foster interpersonal skills • Reduce anxiety	Education and Information Technologies
ID10 (Bang et al., 2023)	• Southern California • Grade 1 elementary school students • Mathematics learning	My Math Academy	Quantitative study	Positive: Students who use My Math Academy make significant learning progress in mathematics.	Early Childhood Education Journal
ID11 (Anunpattana et al., 2021)	• Japan • Primary school (All subjects) • F2f mode	Kahoot! Quizzes	Mixed methods Quantitative (Kahoot! and Quizzes results) Qualitative (interviews with students)	Positive: • Challenges have a positive impact on student's motivation • Increase learning activities	Heliyon
ID12 (Liu & Zhang, 2015)	• China • Grade 3 elementary school students • English Learning	Application of iPad-based digital learning games	Qualitative study	Positive: Motivating students' interest in learning, helping them identify, classify, and summarize.	International Journal of Online Engineering
ID13 (Zafeiropoulou et al., 2021)	• Greece • Grade 5 elementary school students • Physics	Augmented Reality Game-Based Learning	Qualitative and Quantitative	Positive: • Improve the learning process • Influence motivation • Students are positively engaged	Computers

Study (year)	Context	Digital Tools	Type of Research	Major Findings	Sources
ID14 (Pareto, 2014)	• Swedish • Grade 2, 4, and 6 elementary school students • Learn Arithmetic	Proprietary system Teachable Agent	Quantitative study Quasi Experiment	Positive: • Students can operate the game well • Students can reflect on learning	International Journal of Artificial Intelligence in Education
ID15 (O'Rourke et al., 2017)	• Perth • Grade 4 and 5 elementary school students • Improving Automaticity in Mental-Maths	Handheld game Consoles (HGCs)	Quantitative study Quasi Experiment	Positive: • HGCs contributed to mathematics learning outcomes • Increase motivation • Positive efficiency.	Australian Journal of Teacher Education
ID16 (MORENO & VALDERRAMA, 2015)	• Medellín, Columbia • Grade 4 and 5 elementary school students with ADHD special needs • Mathematics	Erudito Platform	Quantitative study Quasi Experiment	Positive: • Increase motivation, break hyperactive tendencies • Increase students' learning outcomes	Revista Brasileira de Educação Especial
ID17 (Bouzid et al., 2021)	• Morocco • Grade 5 and 6 elementary school students • Arithmetic Mathematics	Computer-based game-prototype	ADDIE Development	Positive: • Enhance students' classroom experience • Reduce students' mathematical anxiety • Enhance the classroom experience	International Journal of Modern Education & Computer Science

Study (year)	Context	Digital Tools	Type of Research	Major Findings	Sources
ID18 (Hooshyar et al., 2021)	• Estonia • Grade 5 elementary school students • Informatics learning	Proprietary system Computer Game	Quantitative study Quasi Experiment	Positive: • Increase conceptual understanding • Increase computational thinking skills	Journal of Educational Computing Research
ID19 (Komalawardhana et al., 2021)	• Thailand • Grade 4 elementary school students • Integrated Learning	Proprietary application	Quantitative study Quasi Experiment	• Increase students' learning outcomes • Differences between game-based and conventional learning	International Journal of Mobile Learning and Organizations
ID20 (Del Moral Pérez et al., 2018)	• Valencia, Spain • Grade 2 and 3 elementary school students • Mathematics, science, and language	Proprietary application	Quantitative study	Improvement in Logical-Mathematical, Naturalistic, and Linguistic Learning of Elementary School Students	Journal of New Approaches in Educational Research (NAER Journal)

RESULTS AND DISCUSSION

1. Q1: How is the integration of educational games in elementary school learning?

Learning is integrated through core activities (ID3, ID6, ID7, ID13, and ID20) and final activities (ID1, ID2, ID5, ID8, ID9, ID11, ID15, ID17, and ID19). While ID4, ID10, ID12, ID14, ID16, and ID17 integrate educational games at the beginning, core, and end of the learning process. The ID6 study integrates educational games into a peer-assessment-based learning method. ID7 uses the DGBL learning approach to combine educational games. The duration of time for integration is determined by the teacher's learning design. The process of integrating educational games lasts one academic school year (ID5), three consecutive months (ID14, ID15), two consecutive months (ID3, ID8), one month (ID6), seven days (ID1, ID4,) and one day (ID2, ID7, ID9, ID10).

Several studies (ID1, ID2, ID5, ID8, ID9, ID11, ID15, ID17, and ID19) used educational games integrated into online quizzes that could be used to assess students' understanding. Research ID1 integrated quizzes in a digital game monopoly. Research (ID3, ID6, ID7, ID13, and ID20) developed educational games in the form of learning materials such as research ID7 developed a digital book containing learning materials. Some studies (ID4, ID10, ID12, ID14, ID16, and ID17) integrated materials and quizzes through gamification. For example, ID4 developed eight videos of learning materials uploaded in the gamification application along with twenty questions used to measure students' understanding of the material.

After dividing the studies into categories based on teaching methods, the studies were further grouped by subject. Most of the studies show the use of gamification in one subject only, but some studies explain the use in several subjects or thematically. The most common subjects for which educational games were developed were mathematics with seven studies and natural science with six studies.

The integration of educational games in elementary schools includes mathematics in as many as seven studies (ID7, ID10, ID11, ID14, ID15, ID16, ID17). In the subject of natural science, six studies have been conducted (ID1, ID5, ID6, ID8, ID9, ID13). This was followed by the subject of language with three studies (ID2, ID3, and ID12), integrated learning (ID4, ID19, and ID20), and ICT learning (ID18). In general, educational games are widely used in elementary education for various subjects. They can be used in face-to-face, hybrid, or online classes.

At the level of elementary school, educational games are designed for lower-grade and higher-grade elementary school students. The lower grade is categorized as seven to nine years old in grade one to three. A total of six educational games were developed for the lower grade (ID2, ID8, ID9, ID10, 1D12, and ID20). Eleven educational games were developed at the higher grade (ID1, ID3, ID4, ID6, ID7, ID13, ID15, ID16, ID17, ID18, and ID19). ID5 took elementary school teachers as the subject of the research. ID10 tried to see the effectiveness of educational games on elementary school students and kindergarten students. ID11 and ID14 tried to develop educational games that can be used by all levels of elementary school students.

2. **Q2: What tools are used to create educational games in elementary schools?**

In the article analysis, it was seen that some researchers created their applications (ID3, ID7, ID14, ID18) while other researchers used publicly available digital tools and platforms (ID2, ID8, ID9, ID10, ID13). For example, ID14 used the Teachable Agent application, which was developed in elementary school to make arithmetic learning more interactive. ID18 used Computer Games to practice informatics learning in elementary school. Some researchers used digital tools, applications, and platforms that are commonly used in schools, such as Kahoot! (ID2 and ID11) and Augmented Reality (ID13), meanwhile some researchers used very specific applications such as Zoo U (ID8), Smart Learn (ID9), and My Math Academy (ID13).

3. **Q3: What kind of research has been done on educational games in elementary schools and what was the purpose?**

Of the 20 studies observed, there were four types of research conducted including quantitative (ID1, ID2, ID3, ID5, ID6, ID7, ID8, ID9, 1D10, 1D14, ID15, ID16, ID18, ID19, and ID20), qualitative (ID12), development (ID4 and ID17), and mixed method (ID11 and ID13). Most researchers examined the effect of educational games on learning motivation (ID1, ID3, ID4, ID11, ID12, ID13, ID15, ID16). Six papers (ID6, ID8, ID10, ID18, ID19, and ID20) analyzed the impact of gamification on improving the thinking process, i.e., whether students learn more successfully, while ID7 examined the effect of educational games on improving students' confidence. Furthermore, ID9 and ID17 analyzed the impact of educational games to reduce anxiety in mathematics learning. The result in article ID2 explored the use of language in educational games and ID14 developed educational games to reflect on education.

Most studies were conducted in schools with student numbers varying from 30 students (ID3 and ID9) to 988 (ID10), and some studies were divided into experimental and control groups. Some studies also involved parents (ID8) and there was a study involving 217 teachers (ID5).

4. Q4: Do educational games have a positive impact on elementary school students?

Most studies conclude that educational games have a positive impact on students in terms of learning in elementary school and increase students' motivation to learn. For example, ID13 showed that My Math Academy significantly improved mathematics learning ability compared to students who did not use it. Teachers surveyed confirmed that My Math Academy was easy to use in their classrooms and was recognized as a valuable learning resource that complements the existing curriculum to increase students' engagement, motivation, and confidence in learning mathematics.

The most interesting studies that show positive outcomes of gamification are highlighted. For example, five papers (ID7, ID3, ID15, ID19, ID20) showed positive and more successful learning achievement, while eleven papers (ID2, ID3, ID4, ID5, ID6, ID7, ID10, ID12, ID13, ID15, ID16) showed a positive impact on motivation. Positive results for students with special needs were found in one study (ID9). In addition, the study ID2 revealed that Kahoot! gamification designed through its engaging features can improve language skills and increase students' motivation to learn. The findings suggested that Kahoot! is a relevant teaching tool for today's digital generation and educators to explore language skills. Similarly, the experimental study in ID7 showed that a game-based e-book learning model effectively improved learning achievement, self-efficacy, and motivation in learning mathematics for elementary school students.

Similarly, ID13 revealed that the ARGBL application has the potential to be an easy-to-use educational tool to improve not only the teaching of physics experiments in elementary schools but also the learning process by positively influencing students' motivation and engagement. In line with digital integrated learning, ID20 showed that there was an improvement in the logical-mathematical, naturalistic, and linguistic learning of elementary school students.

DISCUSSION

Learning media contributes a lot to the learning process in the classroom, one of which is educational games. Learning media can increase 70% of information to be remembered, compared to the information obtained from lectures (Unwin

& McAleese, 2015). Learning media can help students understand the material systematically, and make it easier for students to learn (Moonti & Gani, 2023). In addition, educational games bring psychological benefits to the learning process (Bujak et al., 2013). Educational games can help students understand the material because it is following the characteristics of students who like to play. Similarly, another study claimed that video games can improve students' cognitive skills such as memory skills and reaction speed (Mayer et al., 2019).

Today, in the digital era, students are surrounded by high technology that teaches them to adapt. As said by Keengwe, Onchwari & Agamba (2014), the way to teach the digital generation about the digital world is by integrating technology into teaching and learning activities according to students' interests, one of which is through educational games. Ciampa (Ciampa, 2014) says that students enjoy learning by using technology because it is interesting and fun. One of the media used is the integration of digital games. The utilization of multimedia will have a big impact on students' enthusiasm for learning (Liew et al., 2017). However, the utilization of technology such as educational games is rarely used in elementary schools. Although technology is moving quickly, not all of them can be applied in teaching and learning activities (Keengwe et al., 2014).

Concerning the first research question, the results showed that educational games are used for students in a variety of subjects from different fields. Educational games are designed and implemented in different ways. The implementation of educational games varies from online, offline, and hybrid. Educational games in this finding are integrated into learning in the form of materials and quizzes. Quizzes are implemented in the form of homework, knowledge tests, and exercises. This finding supports one of the recent reviews that described a wide variety of educational games in schools during the COVID-19 pandemic (Nieto-Escamez & Roldán-Tapia, 2021). It is interesting to note that some educational games implemented in elementary schools are focused on supporting students with special needs. Cook and Odom (2013) illustrated that educational games can be implemented for students with special needs by identifying their developmental characteristics.

Regarding the digital tools used to develop educational games (Q2), this study did not find that one digital tool was used more often for educational games than the others. It was confirmed that popular and publicly available e-learning platforms,

both free and paid, can implement game design elements if used effectively. These platforms are not only intended for gamification but also have game-like features and design elements, making their use more engaging and interactive (Soboleva et al., 2018). Some researchers have developed and implemented their tools. However, it is important to note that these tools focused more on gamification use in the teaching process rather than being complex educational games (Rugelj, 2015). In other words, these tools are simply designed to utilize game design elements to make the learning experience more engaging.

The results of this study showed that most papers use quantitative research methods, sometimes mixed with qualitative research (Q3). Studies on educational games varied in the use of research methods, including the use of instruments such as pre-post surveys, questionnaires, interviews, quasi-experiments with skill tests, quiz results, classroom observations, and gamification system scores. Almost all of the reviewed studies mostly used quantitative research methods to test the effectiveness of the designed educational games. This is following the opinion of Hui et al. (2015) that it was easier to analyze the effectiveness of media by using quantitative research methods.

In general, the reviewed studies focused more on exploring the effects of motivation and satisfaction on learning success. However, some studies analyzed the impact of gamification on the achievement of learning outcomes for students in inclusive schools. This finding was in line with another study that highlighted the potential of educational games and tested their impact on children with special needs in inclusive elementary schools (McLeskey et al., 2014). Finally, regarding the impact of gamification on students (Q4), most studies concluded that gamification has a positive impact on students, especially in terms of learning motivation. This was in line with the findings of previous research (Dichev & Dicheva, 2017; Nieto-Escamez & Roldán-Tapia, 2021), but it was important to emphasize that none of the studies noted a negative impact of gamification on students.

A visible phenomenon from the findings of this study was the teachers' competence in developing educational games. The phenomenon that can be revealed was that teachers have their personal computers, but rarely being used to enhance teaching and learning activities. As mentioned in the research conducted by Kurt (2013), teachers used technology for administrative purposes, not for teaching. Teachers sometimes

used their computers to display images and videos. Kafyulilo & Keengwe (2014) have also conducted research with the result: Some teachers used computers for teaching and learning purposes, while most of them used computers for administrative purposes. Teachers have limited time and ability in developing interactive multimedia. Therefore, they need to cooperate with technology experts to develop interactive multimedia that suits the students' characteristics. Teachers must adapt and start believing that integrating technology in the classroom is an effective way to improve the quality of education in the 21st century (Caena & Redecker, 2019). Kafyulilo & Keengwe (2014) also recommended teachers, school administrators, and stakeholders integrate technology. The application of technology requires cooperation with other elements to conduct high-quality education to improve students' achievement.

CONCLUSION

This study concludes that the integration of gamification in elementary school education has a significant positive impact, particularly in enhancing student motivation and learning outcomes. The analysis reveals that gamification is predominantly utilized in mathematics education, with occasional applications in science. It facilitates the creation of learning resources and formative assessments in both face-to-face and hybrid learning environments. Educational games, supported by digital tools such as apps and e-learning systems, have been shown to improve student engagement and motivation without any reported negative impacts.

While the study highlights the benefits of gamification, it also identifies gaps in the research, particularly regarding its implementation in inclusive elementary schools and its psychological effects on students. Future research is recommended to explore these areas, as well as to establish more tailored approaches to gamification based on the age of students, subjects, and learning objectives. Limitations of this review include the restricted range of bibliographic databases searched and the potential exclusion of relevant studies due to differing terminologies. These limitations should be considered when interpreting the results. Overall, this study provides a strong foundation for educators and policymakers to integrate gamification into elementary education, particularly in mathematics and science, to enhance the learning experience in the 21st century.

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