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Research Article

A Critical Review of Educational Games as a Tool for Strengthening Digital Literacy

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ABSTRACT

The digital era is an era where knowledge can be easily obtained anytime and anywhere as long as it is connected to the internet network. To be able to access knowledge requires a special skill called digital literacy skill. Digital literacy skills can be developed in various ways, one of which is through game-based learning. The purpose of this study is to identify the development of the use of games in education that has been carried out by previous researchers related to strengthening digital literacy. The method used to collect data is by a *systematic review*, which is a research method by collecting and summarizing all the best available research on a particular question, using a transparent protocol that can be replicated to find, evaluate, and synthesize relevant research evidence. The results of the study obtained data from the scopus.com database with the keywords *educational games in digital literacy learning* as many as 189 articles and 13 articles that met the inclusion criteria for analysis. The use of educational games to strengthen digital literacy has been carried out in several countries with different types of games with the scope of increasing digital literacy skills, Collaboration and creativity, Finding Information, Critical Thinking, and Social Understanding.

Keywords*: Digital literacy, Educational game, Systematic review*

Introduction

Entering the digital era where its development is so rapid, a deep understanding of science and technology is needed as a rationale for solving various problems in society (Al-Qaysi et al., 2020). The digital era is a time when information is easily and quickly obtained and disseminated using digital technology. Digital technology is defined as technology that uses a computerized system that is connected to the internet (Kementerian Pendidikan dan Kebudayaan, 2016). The ability to master digital technology is very much needed to keep up with every development of the times

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(McKenna, 2019; Rahman et al., 2021). The development of digital technology has a great impact, especially on the education sector (Martinez, 2018; Traverso et al., 2014).

The development of technology in the digital era makes knowledge accessible anywhere, not necessarily through classroom learning (Traverso et al., 2014). Digital literacy is an important foundation that must be mastered as part of 21st-century skills (Chan et al., 2017; van Laar et al., 2017). Digital literacy is defined as an individual's ability to use technology appropriately as an information management tool, creating and presenting new forms of information in solving problems in everyday life (Hamutoğlu et al., 2019). To be able to understand digital literacy, it takes a skill to read and interpret the meaning of digital texts, digital images, symbols, and graphics and be able to use technology as an information management tool in the digital era (Hague, 2010; Pow, 2011).

Digital literacy skills can affect the quality of student developmental education (Caverly et al., 2019). Indonesia as one of the countries with unequal access to technology, makes the literacy, numeracy, and science levels of Indonesian students in the low category. This can be seen from the data from the 2018 PISA study which shows that the literacy, numeracy, and science levels of the Indonesian state are in the top 10 and bottom out of 29 countries (OECD, 2018). The Ministry of Education and Culture responded positively to the PISA results by formulating strategic steps to achieve equal distribution of Indonesian education and committing to overcoming the weaknesses that PISA found in 2018 (Kemendikbud, 2019). The use of information and communication technology in learning in the digital era is a special concern for the government in improving the quality of education in Indonesia (Kemendikbud, 2019). One of the technological devices that can be used in the learning process services smartphone (Csibi et al., 2019).

The use of smartphones in learning makes it easier for students to find additional information from the material that has been obtained in class (Traverso et al., 2014).. However, the use of smartphones in learning can also have a negative impact. (Heflin et al., 2017; Traverso et al., 2014). The negative impacts of using smartphones include smartphones being used to access social media (Santhi & Rajesh, 2020), and playing games excessively (Cha & Seo, 2018). Playing games if applied in learning can have a positive impact on students (Patton et al., 2020). Learning using games makes students more active and enjoys learning more (Kapralos et al., 2015).. Activeness will make students better understand the lesson compared to passive students (Magoc, 2011).

The use of games in learning has been widely studied in research in recent years, but the use of games to strengthen digital literacy has not been widely discussed in depth. To name a few, (Philpot et al., 2005) use games in the learning process in the classroom to grow students' skills and confidence. In contrast to (Philpot et al., 2005) who use games in the learning process, (Wang, 2008) uses games as an evaluation tool of the learning process by utilizing games for assessment in the form of formative tests in class.

Identifying the development of the use of games in learning will help educators, curriculum developers, and educational technology developers in mapping and designing better learning models or strategies to meet educational needs in the digital era. The digital era is developing so fast, a learning model or strategy is needed that is following technological developments as the demands of 21st-century skills. Technology that is developing so rapidly must be followed by all parties so that Indonesian education is not far behind other developed countries.

Therefore, the purpose of this study is to identify the development of the use of games in education that has been carried out by previous researchers. For this reason, the research questions in this study are 1) What types of games have been developed to strengthen digital literacy; and 2) can games that have been used in learning in various countries be used in Indonesia?

Methods

This research method uses a systematic review. A systematic review is a summary of all the best available research on a particular question, using a transparent, replicable protocol to find, evaluate, and synthesize relevant

research evidence. The aim of the systematic review is to provide a careful summary of all the main research available in response to the research question (Clarke, 2011).

Inclusion Criteria

To focus the research, limitations were placed on the literature search. Articles as reviewed literature are limited to the Scopus database from 2003-2021. The search for articles on the page was scopus.com carried out in October 2021 using the keyword in English "educational games in digital literacy learning". The data is taken from the Scopus database with a focus on "Document Type Articles". The data were grouped and selected based on the title and abstract containing the words educational games and digital literacy and 13 articles were selected based on the latest publications. The following article selection process is shown in Figure 1.

Results

The results of a literature search in the Scopus database with the keyword "educational games in digital literacy learning" show a search result of 187 literature documents containing the words "educational AND games AND in AND digital AND literacy AND learning". The literature search was conducted in the period from 2003 to 2021 or in the last 20 years. The following data from the literature search results by year are presented in diagram 1.

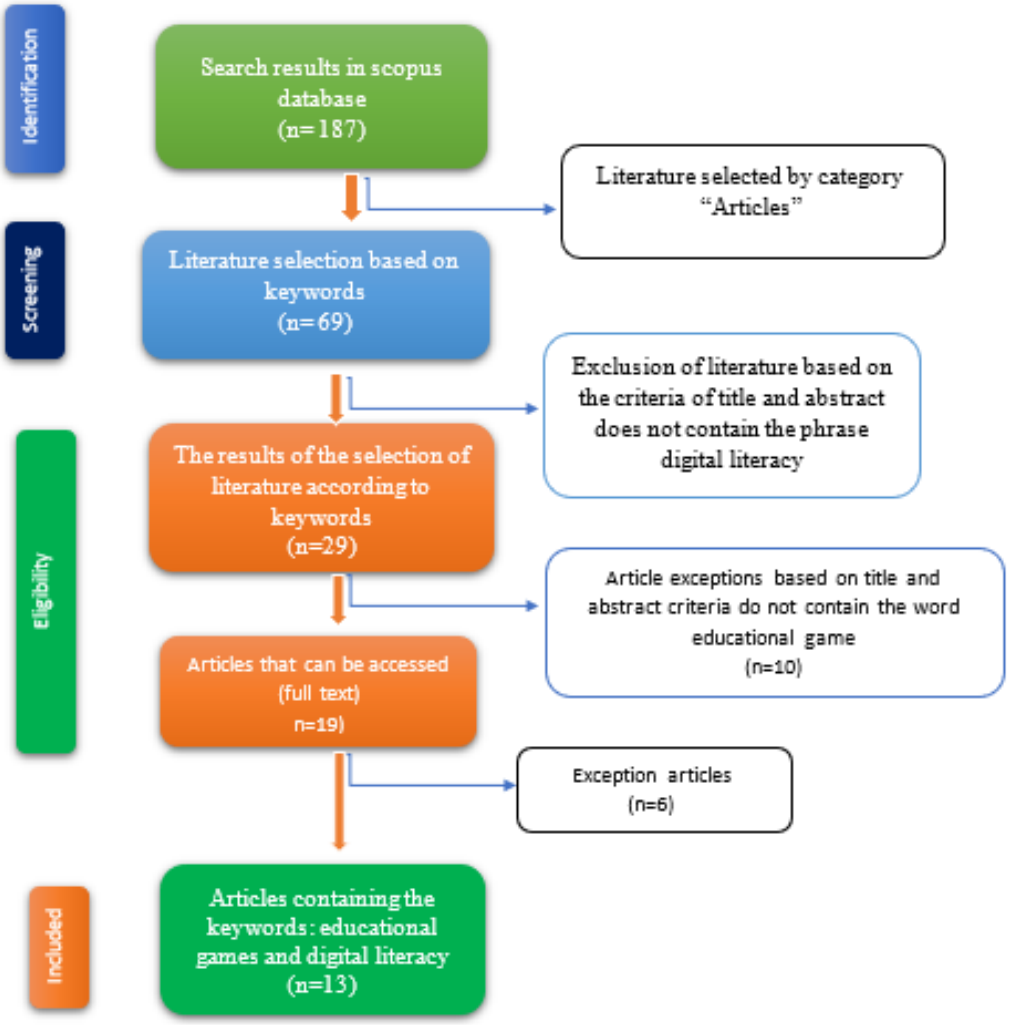

Figure1. Article Selection Process

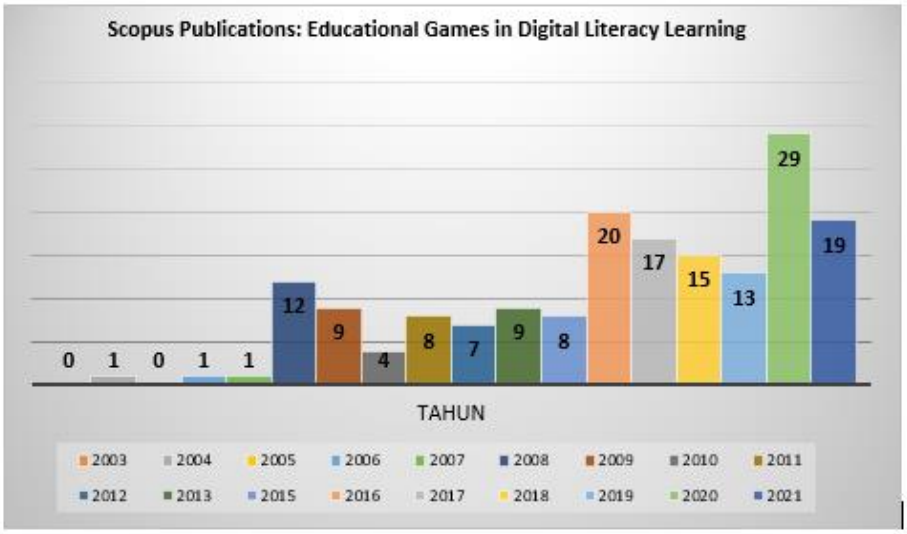

Diagram 1. Scopus publication data for the years 2002-2021 with the keyword's educational games in digital literacy learning

From 188 data from the literature search results from the Scopus database consisting of various categories (articles, proceedings, and books) then the literature is focused on literature with the type of article document. The search was continued by selecting articles based on titles and abstracts that contained words/phrases in digital literacy and eliminating articles that did not meet the criteria. The results of the selection of articles are then reselected using words/phrases educational game and eliminating articles that do not meet the criteria. Articles that were selected based on the criteria in the title or abstract containing the words/phrases, educational games, and digital literacy were searched for the full article (full text). Of the 16 articles containing the word/phrase of educational games and digital literacy, 13 articles were found for review. Following are the results of a review of 13 articles related to digital literacy and educational games.

Table 1. Findings and recommendations for the use of educational games

No	Article	Results/Findings	Recommendations
1.	Appropriation of adaptive literacy games into the German elementary school classroom (Pflaumer et al., 2021)	use of Navigo games through interaction with tablets, can teach students digital literacy skills	Support required technology in schools, and training for teachers in digital literacy skills is needed.
2.	Contextualized game-based intervention for the digital literacy for the Pacific Islands (Reddy et al., 2021)	issue of the digital divide still exists in the Pacific Islands and digital literacy to be one solution to bridge the gap and create a digital culture in the Pacific Islands	to bring digital literacy to the classroom or integrate with curriculum and pedagogy that there is a global challenge, especially for developing countries such as the Pacific Islands
3.	Incorporation of a game-based approach into the EFL online classrooms: students' perceptions (Almusharraf, 2021)	the use of game Kahoot, able to grow a positive attitude of students towards a game-based approach to learning	a technical skill required for any technology-based activity.

No	Article	Results/Findings	Recommendations
		English, educational competition in the classroom reduces distractions and fosters the quality of teaching and learning beyond what should be	
4.	Designing a Programming Game to Improve Children's Procedural Abstraction Skills in Scratch (Rose et al., 2020)	The programming game Pirate Plunder can be used to teach elementary school children (ages 10 and 11) to use procedural abstraction in Scratch projects.	Three recommendations for educational game design: 1) Use Learning Pathways and Limiting Success Conditions to Introduce Complex Learning Content 2) Increase Student Investment Through Customizable Avatars 3) Improve Evaluation of Educational Games
5.	An evaluation of the introduction of games-based construction learning in upper primary education using a developed game codification scheme for scratch (Hainey et al., 2020)	Games-based construction learning (GBCL) is an effective mechanism for teaching programming concepts using Scratch at all levels of basic education	Curriculum for Excellence (CfE) in Scotland is advised to use non-traditional teaching approaches and encourage the development of digital literacy skills
6.	Wordsearch, an educational game in language learning (Goumas et al., 2020)	Wordsearch games can facilitate foreign language learning because they can memorize words, provide internal learning motivation and can be effective f in remembering vocabulary.	Wordsearch game design can be added with multimedia elements so that the game can help in language learning more efficiently.
7.	Virtual world global collaboration: an educational quest (Hill & Knutzen, 2017)	Case study findings illustrate the value of collaboration in digital game-based learning environments (DGBL) through scaffolding knowledge and skills in virtual worlds	Early adopters of virtual worlds in education can pave the way for best practices in the future
8.	Reducing digital divide effects through student engagement in coordinated game design, online resource use, and social computing activities in school (Reynolds & Chiu, 2016)	Digital literacy development models can measurably reduce the effects of the digital divide	Better understanding of practice is needed the best regarding the development of digital literacy which can further inform pragmatic educational technology recommendations.

No	Article	Results/Findings	Recommendations
9.	Exploring media literacy and computational thinking: A game maker curriculum study (Jenson & Droumeva, 2016)	Gender affects significant differences in attitudes towards computers and programming. more specifically on	Further case studies on the use of online game generators with a wider scope are needed to determine the level of effectiveness.
10.	From Mario to FIFA: What qualitative case study research suggests about games-based learning in a US classroom (Gerber et al., 2014)	A game-based curriculum created through a connected learning framework allows students to engage in a constellation of connections between digital media, text traditional, peer, and teacher mentors	Future research needs to understand the relationship between pedagogical perspectives and game design. Games that are made specifically for educational purposes can be useful in Games-based learning (GBL) if they are well designed to include the learning objectives of the content to be studied without losing the game mechanics that make the game successful.
11.	Fighting baddies and collecting bananas: Teachers' perceptions of games-based literacy learning (Gerber & Price, 2013)	Findings show that limited understanding of video games and the virtual world does not prevent teachers from practicing from wanting to create interesting learning units using videogames as a learning tool.	Further research is needed to understand the impact of game-based learning and what happens when it is fully used by teachers in the classroom, and how absorption and the ability to maintain and develop game-based units are enforced in the classroom environment.
12.	Process drama and digital games as text and action in virtual worlds: Developing new literacy in school (O'Mara, 2012).	Introducing games as texts to be studied with other texts is very generative, the use of digital games in schools can be one way for teachers to take advantage of their student's interests and skills in the development of other skills	Building a virtual world and exploring it with students is the most interesting and rich model of teaching and learning
13.	Digital literacy for the disengaged: Creating after-school contexts to support boys' game-based literacy skills (Steinkuehler & King, 2009)	Online games can improve students' digital literacy through synthesizing information inside and outside the game.	It takes investment in computer equipment that can be used to use games in digital literacy and various other interests.

The data from the research review based on the researcher's country of origin, types of games and digital literacy skills studied are shown in table 2 as follows.

Table 2. Types of games and digital literacy skills

No	Author	Country	Types of games	Digital literacy skills
1.	(Pflaumer et al., 2021)	Germany	iRead Game Navigo	Collaboration and creativity
2.	(Reddy et al., 2021)	Fiji	Game-based online quizzes modulated digital literacy intervention Program (DLIP)	Finding Information Critical Thinking
3.	(Almusharraf, 2021)	Saudi Arabia	Game-based quiz Kahoot!	Critical Thinking Collaboration and creativity
4.	(Rose et al., 2020)	United Kingdom	Game-based block Pirate Plunder	Critical Thinking
5.	(Hainey et al., 2020)	United Kingdom	Games-based construction learning (GBCL)	Critical Thinking
6.	Goumas et al., (2020)	Greece	Game Wordsearch Puzzle	Finding Information
7.	(Hill & Knutzen, 2017)	Texas		
8.	(Reynolds & Chiu, 2016)	Canada	Game-based learning (GBL) the Quest	Critical Thinking Social Understanding Collaboration Finding Information
9.	(Jenson & Droumeva, 2016)	Canada	Game Maker	Critical Thinking
10.	(Gerber et al., 2014)	United States	Commercial-off-the-shelf (COTS) Game	Critical Thinking Social Understanding
11.	(Gerber & Price, 2013)	United States	Commercial-off-the-shelf (COTS) Game	Critical Thinking Social Understanding
12.	O'Mara, (2012)	Australia	Game maker	Critical Thinking
13.	(Steinkuehler & King, 2009)	United States	WoW Game	Critical Thinking Social Understanding

Discussion

a. Types of Game in Strengthening Digital Literacy

Game is a technology product that growing rapidly. The game is developed with the target users from teenagers to adults. Games make users addicted to wanting to continue playing them. The development of digital era technology makes games a part of learning. As support in digital literacy learning, research by (Steinkuehler & King, 2009) uses the World of Warcraft (WoW) game to improve students' critical thinking. In addition to game design that allows users to think critically, WoW games also allow users to communicate through online discussions.

Various types of games that can be used to improve critical thinking skills and improve social skills include Commercial-off-the-shelf (COTS) games, and Game-based learning (GBL) the Quest. In addition to improving critical thinking skills and online social communication, games can also be used to improve information finding skills (Wordsearch Puzzle games), and collaboration skills (iRead Navigo games). These types of games can help improve students' digital literacy skills based on research that has been done (Pflaumer et al., 2021; Reddy et al., 2021; Reynolds & Chiu, 2016).

Games designed specifically for specific learning purposes or referred to as serious

games, are reality (simulation) or fantasy-based, entertaining, interactive, and competitive (Oprins et al., 2015). The results of the review of 13 articles, 3 studies use serious games in digital literacy learning including (Reddy et al., 2021) with Game-Based Quiz Online Modulated Digital Literacy Intervention Program (DLIP) which is designed for the purpose of remediation programs or online interventions. which improves the individual digital literacy of learners.

b. The Use of Games in Strengthening Digital Literacy

Use of games in strengthening digital literacy began to develop in 2008 with the discovery of 12 Scopus indexed journal publications by searching using the keyword educational games in digital literacy learning. Of the 12 studies related to the use of educational games in digital literacy learning, 3 articles explain the use of games in the learning process (Kam et al., 2008; Mitgutsch, 2008; Saridaki et al., 2008).

The development of games in learning experienced fluctuating changes from 2008 to 2014 were based on the data in diagram 1 it tends to decrease until in 2015 it experienced a significant increase. From 2015 to 2021 the use of educational games in strengthening digital literacy began to be widely used with various targets for increasing students' digital literacy skills. Some targets for strengthening digital literacy skills using educational games include Collaboration and creativity, Finding Information, Critical Thinking, and Social Understanding.

c. Application of Game-Based Learning in Indonesia

Learning in Indonesia has basically started to apply games in learning both in class and at home. However, from the search for articles on the Scopus database, no research has been found regarding the use of educational games for digital literacy learning. Judging from several types of educational games for digital literacy learning in several countries, the minimum requirements needed to use games as a tool in strengthening digital literacy in Indonesia are sufficient in several places.

Conclusion and Recommendations

To use educational games in strengthening students' digital literacy, with a type of serious game is needed that must be designed and designed to target several digital literacy skills. Games that have been developed and used in various studies as a reinforcement of digital literacy, so far have only included 4 digital literacy skills out of 7 existing digital literacy skills, namely Collaboration and Creativity, Finding Information, Critical Thinking, and Social Understanding. The use of educational games that have developed in several countries can basically be used in Indonesia with some adjustments such as language switching to make it easier for students to use in Indonesia. For research related to the development of educational games in strengthening students' digital literacy, researchers must determine from the beginning the specific goals to be achieved regarding some of the students' digital literacy skills. This is important so that the game developed becomes a serious game that can improve some digital literacy skills when students play the game.

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