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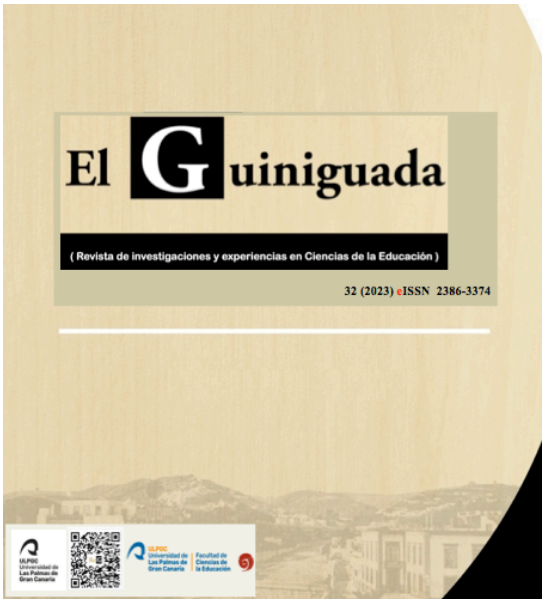

A Systematic Review of Serious Games for Children's Reading Skills' development

Una revisión sistemática de juegos serios para el desarrollo de las destrezas lectoras de los niños

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Una revisión sistemática de juegos serios para el desarrollo de las destrezas lectoras de los niños

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RESUMEN

Este artículo revisa la eficacia del uso de juegos serios en la enseñanza de la lectura en los últimos quince años (2007-2022). Para asegurar un procedimiento riguroso y sistemático, se utilizaron PRISMA, CASP y la escala PEDro y se efectuó una investigación exhaustiva siguiendo criterios específicos en las bases de datos ERIC, ProQuest, Scopus, Springer y Web of Science.

Tras una organización sistemática en Microsoft Excel y JASP, se seleccionaron 21 estudios para un análisis detallado. Estos estudios fueron analizados en profundidad para sintetizar resultados y extraer conclusiones significativas.

Los resultados de la revisión sugieren que los juegos serios pueden ser realmente beneficiosos para los alumnos en la enseñanza y aprendizaje lector. Sin embargo, es crucial proceder con cautela al seleccionar y utilizar juegos específicos, asegurándose de que los juegos seleccionados han sido evaluados minuciosamente en cuanto a su eficacia educativa y su adecuación a los objetivos de aprendizaje.

PALABRAS CLAVE

DESTREZAS LECTORAS, ENSEÑANZA DE LA LECTURA, REVISIÓN SISTEMÁTICA, VIDEOJUEGOS.

ABSTRACT

This article provides a review of serious games' use efficacy in reading instruction throughout the previous fifteen years (2007-2022).

To ensure a rigorous and systematic procedure using PRISMA, CASP and PEDro scale, a thorough search was conducted using specific criteria. ERIC, ProQuest, Scopus, Springer and Web of Science were the databases examined.

Following the systematic organisation using Microsoft Excel and JASP, a total of 21 studies were selected for detailed examination and were deemed suitable for inclusion. The selected studies were subjected to a comprehensive analysis to synthesise their findings and draw meaningful conclusions.

The findings from the review suggest that serious games can indeed be beneficial for students in the context of reading instruction and learning. However, it is crucial to proceed with caution when selecting and utilising specific games, ensuring that the selected games have been thoroughly assessed for their educational effectiveness and alignment with learning objectives.

KEYWORDS
READING SKILLS, READING INSTRUCTION, SYSTEMATIC REVIEW, VIDEO GAMES.

INTRODUCTION

In recent years, serious games have gained increasing attention as a promising tool for enhancing children's learning experiences. Among the different educational objectives that serious games can target, the development of reading skills has emerged as a key focus area. At school, university, or non-formal level, digital educational interventions are not an exception to the extremely rapid speed of technological development that occurs across the globe. Reading is not the exception, and it is one of the most essential keys to academic achievement and a critical aspect of allowing individuals to engage effectively in society. Reading is also one of the most important factors to academic success. Similarly, upon entering high school, many students not capable of acquiring the class-level skills necessary to learn or study effectively. Owing to this, the risk of those students dropping out of the education system prematurely increases, which can lead to underemployment and economic problems (Akl et al., 2010). Reading problems may be aided by a number of different approaches, which are reassuring given the societal importance and far-reaching effects of this issue (Alcivar et al., 2019). Serious games offer an interactive and engaging way to support children's reading skills, and they can provide tailored feedback and adaptive challenges to support children's learning progress.

However, the number of game-based intervention tools designed to enhance reading is growing. Game-based therapies provide several benefits that are not shared by conventional techniques. It is essential to remember that they usually call for a smaller number of educators and have the potential to provide young people with a welcoming atmosphere. In addition, they make it easier to use a reading instruction approach in a methodical way with all of the students, which lessens the influence of individual variances on the classroom environment. Finally, they are often designed to alter the speed of their lessons in accordance with the development of the pupils, which makes it possible to provide individualized attention (Alsubaie et al., 2018).

This systematic review aims primarily to contribute with an overview of the prior research on this topic to guide the direction of the research that will be conducted in future investigations in this area, investigate the role of serious games in developing reading skills of children and to help to probe significance games' role could have in increasing decoding and comprehension abilities of students. By synthesizing the existing evidence on serious games and reading skills, this review can also identify research gaps and opportunities for future studies in this area.

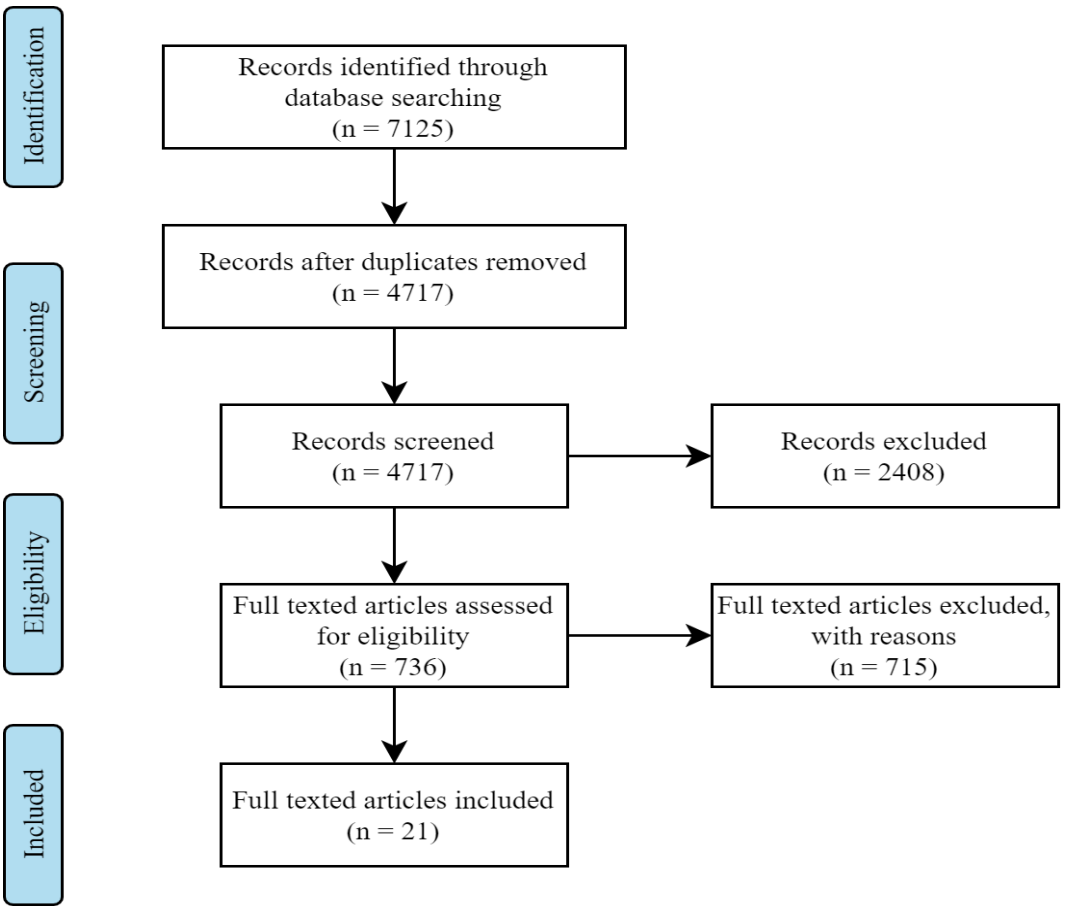
METHODOLOGY

A systematic review of the papers was conducted using the method outlined by Higgins and Green (2008). This involves determining the review's explicit goals, developing item selection criteria, and using a predetermined research technique. The Critical Appraisal Skills Programme (CASP, 2022) was used to give a framework for analyzing the research (Denyer & Tranfield, 2009). The procedure followed the PRISMA guidelines as shown in Figure 1. In this study, the 2020 version of The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021) for the Qualitative Evidence Synthesis (QES) was used.

A 5-stage review process in the research was adapted followed as proposed by Salvador-Ullauri, Acosta-Vargas & Luján-Mora (2020). The authors received no financial support for the research, authorship, and/or publication of this article. The authors declare that they have no conflicts of interest.

Figure 1

PRISMA Diagram of Study



Source: Elaboration by the authors adapted from PRISMA

Inclusion and Exclusion Criteria

Publications that were subjected to peer review and used a variety of keywords were included in the study. Papers were required to focus on particular technological interventions targeted at increasing reading skills. Interventions have been broadly categorised as fostering reading at the initial word level (decoding, or the mapping of phonemes and graphemes), its precursors (phonological awareness), other skills namely fluency and comprehension and complementary motivation and attention. Supporting reading at the word level refers to the mapping of phonemes and graphemes. It was acceptable for an article to state, as a goal of the technical intervention described in the article, that it sought to enhance reading or one of its fundamental components. In the following Table 1, detailed criteria are presented.

Table 1

Inclusion and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Articles should be written in English or Spanish language	Articles written in languages other than English and Spanish
Articles should contain role of serious games or educational games	Articles not including serious games or educational games
The included studies should be either peer reviewed journals, papers or dissertations	Newspaper articles or any non-scientific publication
Articles associated with reading skills of children	Articles dealing with other than reading skills of children
Publication year between 2007-2022	Publication year other than 2007-2022

Search Strategy

This research was conducted using ERIC, ProQuest, Scopus, Springer, and Web of Science. The key phrases were refined by utilising the keywords from the publications, along with an iterative approach that was led by consultation with an academic research librarian. In order to gather all the ideas for articles that were pertinent to the search, the search phrases were merged using the Boolean operators "AND" and "OR." The phrases "video games for education," "e-learning," "m-learning," "mobile learning," "apps," "game," "serious games," "gamification" and "reading skills of children" are the search keywords that were used.

Data Collection

In Microsoft Excel and JASP, the study developed a form for the collection of data. The study used PRISMA guidelines and PEDro scale to systematize the review. Thus, the latter was put to use on the 21 studies that had been chosen.

Data Analysis

The study processed the data using descriptive statistics in Microsoft Excel and JASP.

RESULTS

The description and synthesis of the studies is presented in Table 2 below.

Table 2

Synthesis and description of the Studies

SR NO	STUDIES	SYNTHESIS
1.	Abidin et al. (2019)	The study used the child-centred design (CCD) methodology. Prototypes have been tested, and heuristic assessments have been conducted using them. These low-fidelity prototypes were intended to provide researchers with a sneak peek and aid them in creating high-fidelity prototypes.
2.	Anastasiadis et al. (2018)	This study looks at the idea of "serious games" in the classroom and the impact they have had. The increasing needs and expectations of students for more engaged and interesting learning experiences are

		also briefly described. Additionally, it deals with the characteristics and features of "serious games" and the part motivation plays in helping students learn new material. It discusses the approach of teaching using video games and lists some of the benefits of doing so.
3.	Cano et al. (2018)	The project, which supports both qualitative and quantitative techniques, was developed around the pragmatic paradigm, and the theoretical grounding was taken from action research. Using the lenses of narrative inquiry and a creative approach to methodological research, the study was able to collect data using a variety of methods, such as questionnaires, interviews, observations, and conversations with focus groups. The vast majority of students already did pretty well when given only their professors' methods of education, and some students even showed a modest improvement when games were introduced as teaching aid.
4.	Carrión et al. (2017)	The study investigates the activities that are connected with game design approaches and serious educational games, focusing on those that are related to players who have cognitive capacities that are not typical. The methodology of the research investigates the ways in which educational advancement and the teaching-learning process are relevant to the creation of video games. The research points to a general development focus that should be built on an approach that is user-centred, interactive, and flexible enough to fit any kind of gamer.
5.	Casillas et al. (2021)	This article discusses the instructional video game "Saving the Word." Its main goal is to increase elementary school kids' reading comprehension skills, handled by using the "fill in the blank" exercise that serves as the game's main gameplay mechanic. The mechanism has been presented and taught in a way that was easy for the kids to understand and enjoy it.
6.	García-Redondo et al. (2019)	The effects of a serious game aimed at individuals with attention deficit hyperactivity disorder (ADHD) and a specific learning problem are examined in this study. The intervention consisted of a total of 28 sessions, which lasted 10 minutes each. The participants used a total of ten different games. The findings of the posttest for the experimental group and the control group were substantially different from one another, showing that there had been an improvement regarding attention performance measures, particularly visual attention, after the intervention.
7.	Gaytán-Lugo et al. (2014)	Technology has already garnered a lot of favor in Mexico, as seen by the surge in the popularity of video games over the last several years in this country. This paper presents the idea and conclusions of a contextual investigation followed by usability testing on four video games with groups of third grade students from multiple urban public schools in Colima, Mexico. The survey asked students in the third grade about their desire to play video games, their reading habits, and other behaviors connected to technology, showing positiveness.
8.	Gaytán-Lugo et al. (2015)	Numerous research on reading comprehension in Mexico have yielded uninspiring results. The promotion of "serious games," or

		video games that entertain and educate their users, is one of the numerous techniques and tactics that have been used to address such numbers. This research presents the design and usability testing of a serious game aimed at encouraging and enhancing third-graders' reading comprehension skills.
9.	Hernández Rentería et al. (2019)	This article discusses the development of a serious game as a tool that may assist in improving one's ability to comprehend what they have read. The incentive system built into video games, particularly for younger players, may be an engaging way to improve reading comprehension.
10.	Khowaja & Salim (2019)	The efficacy of the Single Subject Research Design (SSRD) withdrawal design in improving receptive vocabulary discrimination in children with autism was evaluated before and after using the prototype in an experimental evaluation study. The SG prototype's pre- and post-evaluations show that playing the game helped children with ASD acquire vocabulary words and that they continued to learn words at the end of the first two weeks after the intervention was stopped, and the game was taken away.
11.	Khowaja et al. (2018)	A literature review on the language development of kids with ASD and the most recent Serious Games Design Frameworks was conducted to identify the components. There is a link between the four components—behaviors linked to autism, tactics, instructional techniques, and modalities—and the manner in which language is acquired by children with ASD.
12.	Martins et al. (2015)	The so-called "serious games" are best understood in the context of the "enjoy learning" concept. It is possible that the concept of serious games, which is related to education, will be implemented in the future of education alongside the use of all technological tools currently available to students, teachers, and schools in order to improve the efficiency of education. In this context, the study provided the Total Challenge, a game with an emphasis on education that stimulates the children's capabilities.
13.	Nugraha et al. (2022)	The goal of this research is to show how game difficulty dynamization may be used within a game created to improve toddlers' reading skills. It does this by using Dynamic Difficulty Adjustment and Procedural Content Generation. To find out whether the game offered an adequate balance of fun and educational possibilities, experiments with a total of 32 toddlers were conducted. According to the average value of the enjoyment factor, the game may produce materials at various degrees of difficulty while keeping a good balance between the fun and educational elements.
14.	Nunes et al. (2016)	This article discusses the process of creating three-dimensional virtual environments, often known as 3D VEs, for the purpose of assisting ill children in their educational pursuits. The design process often continues to be the exclusive responsibility of the draughtsman and is constructed around the initial requirements setup, despite efforts to build "serious games" for the educational benefit of children who are hospitalized.
15.	Pérez-Quichimbo et al.	The goal of this project was to create an interactive video game

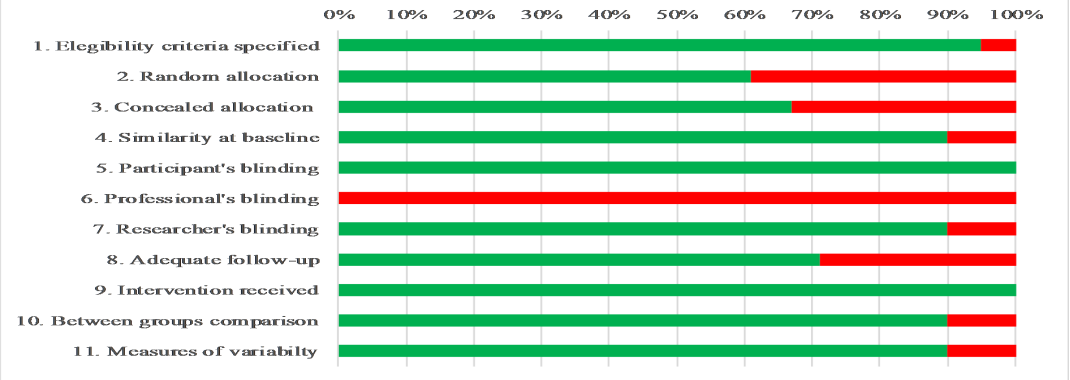
	(2021)	based on a methodology for using tools to facilitate teaching and learning. One of the game's distinguishing features was how participatory it is. The MeISE software development technique made it simpler to construct educational software for those children who have dyslexia, since it looked at the most frequent learning issues found of both reading and writing in dyslexic students. The case studies show that playing the video game encourages kids to participate in intervention and improves their reading and visual skills.
16.	Pucha et al. (2022)	According to the results, the inability of children to acquire reading abilities is caused by a lack of didactic resources, a lack of understanding about strategies, a lack of practice activities, and a poor integration of creative tactics that stimulate collaborative learning in the classroom. With the assistance of a serious game strategy that was developed from mobile apps for the improvement of reading skills, students would be able to maintain their interest and develop these abilities, which are necessary to continue in the educational process.
17.	Sørensen (2009)	This article discusses the challenges that must be overcome to design an instructive layout for serious games. *The Serious Games on a Global Market Place* (2007–2010) project, started by the Danish Council for Strategic Research, connects a learning game for teaching social science in secondary school with an online game-based platform for teaching in elementary schools.
18.	Sørensen & Meyer (2007)	The project *Serious Games on a Global Market*, centred on language learning and instruction, is the subject of the study. The report uses information from two recent studies that looked at how children's digital activities in non-school settings were influenced by game-based activities. The prototype of the digital educational platform was developed using this theoretical framework. Authors argue that game-based activities can be a valuable resource for language learning, particularly when they are designed to be interactive, engaging, and relevant to the learners' interests and experiences. They also emphasize the importance of considering both formal and informal learning contexts when designing game-based language learning activities. Finally, they suggest that game-based activities can be used to promote fruitful thinking, real language interaction, and student engagement.
19.	Sucena et al. (2019)	The purpose of this article was to raise knowledge of Portuguese orthography by presenting an interactive spelling programme that is kid-friendly and focuses on correcting misspellings. In this article, an overview of the game's features and some early positive results gathered in a classroom environment are presented.
20.	Toma et al. (2016)	In contrast to the conventional scenario, which consists of a reading followed by a self-explanation of the input narrative text, experiments with preliminary validation show that the suggested educational scenario is well accepted by users and useful. Hence, the suggested educational scenario was created.
21.	Vasconcelos et al. (2017)	This project's goal is to develop the learning game *Aprendendo com Tarefas,* which will make it simpler for kids with intellectual

		impairments to learn to read and write. Education experts and people who work in the field of education agreed that the alphabetization technique for kids with intellectual disabilities was a good idea.

Both the research methodologies and the findings were somewhat varied. Conversely, training greatly improved reading fluency, spelling and the ability to name individual letters. These interpretations can lead to the assumption that they are because the reading is made in Spanish, a language that is more phonetic and read aurally, contrary to what happens in English. As seen in Figure 2, the review assessed the potential for predisposition in every one of the examinations that were used for the review by utilising the PEDro apparatus. Thus, the PEDro scale was used in order to conduct the risk of bias analysis. Concerning potential conflicts of interest, only one of the studies reported any, and those conflicts were well handled. This research was the only one to mention any potential conflicts of interest in its findings. It is important to note that seven of the studies did not have a "conflict of interest" statement.

Figure 2

Risk of Bias Results



Source: Elaboration by the authors

DISCUSSION AND CONCLUSION

This systematic review, was aimed to identify the qualities of serious games that are effective in developing children's reading skills. A Qualitative Evidence Synthesis (QES) was conducted to synthesise the findings from multiple primary quantitative and qualitative studies to provide a more robust and useful understanding of the issues addressed by primary research.

The review identified several qualities that are shared by effective serious games for children's reading skills development. These qualities include engaging gameplay, clear learning objectives, appropriate leveling, and positive feedback mechanisms. It was found that serious games that incorporate these qualities are more effective in promoting children's reading skills development. Besides, it is important to reflect on the suitability of the materials that often underpin a large part of the educational action (Suárez-Robaina & Sánchez, 2013).

Five examinations incorporated a generally safe of predisposition, an intervention length of over 15 hours, and a pooled test size of more than 128; subsequently, they

had the option to find essentially medium-sized impacts. In addition, the findings of these studies are the most enlightening with regard to the assessment of effectiveness. Future research should aim to model its experimental design after these studies, which reveal the experimental design that should be used (Martins et al., 2015).

The vast majority of intervention programmes have been executed on personal computers, but only a small number of studies have been conducted on mobile devices such as smartphones, tablets, and video game consoles. This may come as a surprise, considering the major benefits that mobile technologies provide over desktop computers in terms of usability and motivation. Due to significant time delays in creating the programme, testing its pace, and publishing these evaluation results, this percentage will change over time and subsequent research should take into account the inclusion of this content. In this regard, digital technology may be particularly well-suited for providing language-independent reading programs as it can reach a global audience. Such programmes can be distributed with very few adjustments. Regarding the type of language skills developed, the majority of studies provided phonological or direct reading instruction.

Explicit reading instruction is more successful than other methods (De Almeida et al., 2022; Ehri, 2005, 2022; González-Frey & Ehri, 2021; Rehfeld et al., 2022; Vazeux et al. 2020), and hence it ought to be advocated as the default method. On the other hand, indirect instruction may also have benefits in some circumstances. For example, it can be useful as a form of early intervention for young children at risk of future reading difficulties. Thus, young children seem to be more likely to benefit from the programme. Notably, investigations included in this review used pooled procedures, indicating a certain level of evidence for such interventions and highlighting the need for additional research about the viability. In addition, the class was originally designed for kids in primary school who desired to improve their language abilities or brush up on their existing knowledge of the language reading. Other age groups, such as toddlers, high school students, and adults, have received little research attention. The duration of each intervention was quite variable. This seems to be a reasonable assumption because it is not clear from the data whether longer interventions lead to better outcomes. Nevertheless, studies have found that extremely short interventions are associated with lower percentages of positive outcomes.

Furthermore, although it was required for all research to include a control group, not every study used the same control group, which presents a significant challenge when attempting to interpret the findings. While the majority of the trials employed passive language activities as a control, the majority of the interventions were provided in addition to, rather than alongside, typical classroom teaching. Furthermore, the active language tasks employed in the few studies that were conducted revealed a smaller percentage of significant outcomes. Studies without such controls, however, may, at best, draw the conclusion that the strategy under investigation was successful.

In conclusion, the conducted review found that there are more and more studies showing the effectiveness of utilising videogames or programmes to improve reading ability. Several qualities that are shared by serious games effective children's reading skills were identified. These qualities can be used to guide the development of effective serious games for children's reading skills development. However, more research is needed to address the limitations identified, particularly with regard to sample sizes, evaluation methods, and long-term effects. Future research should be better organised for randomised controlled trials with larger sample numbers to

answer the question of whether or not and how a game-based intervention adds value to present and effective procedures. All things considered, the results of this systematic review suggest that serious games are a promising tool for enhancing children's reading skills as a main or complementary approach to traditional reading instruction.

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