

## Digital Tools for Children with Reading Difficulties

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### Abstract

Numerous literature reviews and meta-analyses have examined the effectiveness of technology-based interventions in enhancing the reading skills of students facing difficulties in this area. However, given the rapid advancements in technology, it is crucial to review the most recent studies and their implementation methods in order to support students who are performing below their peers. This paper aims to consolidate the latest published research on technology-based interventions designed to improve reading abilities in children with reading difficulties. Fluency skills were the primary focus of the majority of technology-based interventions, with computer programs being the most commonly employed tool.

**Keywords:** Technology-based; Digital tools; Reading interventions; Reading difficulties; Reading Fluency; Literature review

### 1. Introduction

The skill of reading is a highly complex process and holds a prominent position in scientific research. It has been approached from various disciplines such as cognitive psychology, linguistics, neuroscience, and educational science, both in theoretical and applied contexts (Makebo et al., 2022). Reading fluency refers to the ability to read accurately, quickly, and with appropriate expression and prosody (Tzivinikou, 2019). Although reading fluency is often associated with rapid and automatic word recognition, research indicates that this ability encompasses much more than simple decoding. Reading fluency is a critical factor in the development of reading skills and the improvement of reading comprehension. Many students with reading difficulties face challenges in effectively reading text (Whitney & Ackerman, 2022).

According to the National Assessment of Educational Progress (2019), the latest report indicates that in 2017, approximately 65% of fourth-grade students in the United States were performing below the proficient reading level. Attaining proficient reading skills is crucial for elementary school-age students, particularly as they transition from learning to read to reading to learn in fourth grade. Failing to achieve mastery in reading at an earlier grade can increase the risk of academic struggles and potentially lead to a higher risk of dropping out of school.

An insufficient reading level prevents students from having the ability to read and understand school subjects. Proficient reading skills are especially important for subjects like history and social studies. These subjects often require students to comprehend and analyze complex texts, understand historical events and concepts, and engage critically with social issues. Without strong reading abilities, students may struggle to grasp the content, make connections, and effectively participate in classroom discussions. Developing proficient reading skills early on is crucial for students to succeed academically in subjects like history and social studies (Kakoura & Tzivinikou, 2023).

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New technologies are increasingly prevalent worldwide. Mobile devices, in particular, are widely used for learning purposes both inside and outside the classroom and have proven to be quite beneficial (Bennett et al., 2017). Specifically, for the development of reading fluency, educators can utilize digital tools, software, and even the internet itself. Students are utilizing technological resources more and more for reading instruction, both outside the classroom (Sonnenschein et al., 2023) and within it (Akbar et al., 2015). When given a choice, students prefer to engage in these activities online or on their mobile devices rather than listening to the teacher or reading printed materials in the classroom, as suggested by Toste et al. (2020). Thus, technology is becoming an integral part of education.

The National Institute of Child Health and Human Development (NICHD) has identified and categorized five types of reading interventions: phonemic awareness, phonics, vocabulary, fluency, and reading comprehension (NRP, 2000). These interventions target different aspects of reading skills. The interventions can be further classified into two categories based on the nature of the skills they address. The first category is code-based skills, which include phonemic awareness, phonics, and fluency. The second category is meaning-based skills, which encompass vocabulary and comprehension (Gough and Tunmer, 1986). Code-based skills highlight the significance of explicit and direct instruction, focusing on elements such as phonemic awareness, phonics, and fluency. On the other hand, meaning-based skills emphasize language development, listening, and reading comprehension (Al Otaiba et al., 2018). Various instructional interventions have been developed to address these approaches. However, the integration of technology-based interventions has shown promising effectiveness in improving reading outcomes.

Technology devices and applications have been widely employed to facilitate student learning. According to the Institute of Education Sciences (2009), 97% of schoolteachers and SEN teachers were using desktop computers in their classrooms at that time. It can be reasonably assumed that the percentage has increased even further since then, reflecting the continued integration of technology in educational settings. In 2019, a study conducted by Project Tomorrow found that 75% of school-age students expressed a preference for digital learning. This indicates a strong inclination towards using technology in the education system. These technologies have had a profound impact on the teaching and learning process, leading to more effective and efficient outcomes.

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## 2. Digital reading: a trend or significance?

The use of digital devices as reading tools has become increasingly significant, particularly as schools adopt paperless classrooms worldwide (Giebelhausen, 2015; Shishkovskaya, Sokolova, & Chernaya, 2015). These paperless classrooms offer readers the ability to adjust text size, highlight essential passages, and search for related terms outside of the text with just a click. Consequently, it is not surprising that as early as 2009, 97% of students had access to a computer in their classroom (National Center for Education Statistics, 2013), reflecting the widespread integration of technology in educational settings. The use of digital devices and access to the internet at home have significantly increased over the past four decades, rising from 8% of families with children in 1984 to 95% of families with children aged 3 to 18 in 2017 (Sonnenschein et al., 2023). This surge has led to a substantial shift in how families interact with technology and the internet within their homes.

Furthermore, even beyond the classroom environment, there is an increasing engagement in online reading by individuals. Contrary to Proulx's (1994) prediction, Zickuhr, Rainie, Purcell, Madden, and Brenner (2012) discovered that 43% of Americans and 48% of individuals aged 18 to 29 read lengthy texts such as newspapers or books digitally—a number that is expected to grow significantly (Stevens et al., 2017). These statistics raise a fundamental question regarding how the utilization of digital reading materials may potentially influence our perceptions of reading and the resulting comprehension, for better or worse. So, as indicated earlier, there is a clear and increasing prevalence of digital reading in the lives of students and their teachers. One of the reasons for this trend is the wide range of devices now available for digital reading, including computers, mobile devices like iPads, Kindles, and softwares (Chaidi & Drigas, 2023). This availability offers individuals multiple options for engaging in digital reading. Last, but not least, research has shown that as children progress into the middle years of elementary school, they are likely to use digital devices more extensively for educational purposes (Sonnenschein et al., 2023).

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## 3. Digital tools and reading fluency

The results of the literature review conducted by Alqahtani (2020) over the past decade indicate that reading skills were not equally addressed in the studies included. In this literature review, 42% (n=19) focused on reading fluency skills, with only one study examining vocabulary skills, while the other three skills were distributed almost equally. It is noteworthy that the majority of researchers have explored fluency skills more extensively than other skills.

The results of the literature review conducted over the past decade demonstrate that the majority of researchers have focused more on fluency skills than other skills (Alqahtani, 2020). They have utilized digital tools such as The Sight Words: Kids Learn app, (Musti-Rao et al., 2015), Reading RACES (Council et al., 2019), Read Naturally Software (Keyes et al., 2017), FlashCard Program (Steenbeek-Planting et al., 2013), Reading Accelerated (López-Escribano, 2016), K12 Timed Reading (Mize et al., 2019), Great Leaps Digital Reading Program (Whitney & Ackerman, 2022), Sebran (Chaidi & Drigas, 2023), Alearning, (Kakoura & Tzivnikou, 2023), to explore digital interventions aimed at developing effective reading approaches for improving reading skills in children with reading difficulties. However, the results of this review indicate the need for further research.

Students who struggle with reading, but do not have an official diagnosis of Learning Disabilities may lag slightly behind their peers, and they may simply require a bit more time to achieve average performance. Others may need more systematic instruction to progress smoothly or may have experienced inadequate previous instruction in reading (Tzivnikou, 2015, 2019).

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#### 4. Reading fluency and evidence-based strategies

According to National Reading Panel (2000) and Tzivnikou (2019) there is a general consensus among researchers that reading fluency is developed through regular reading practice. However, there is ongoing debate and no consensus on the most effective form of practice. Various approaches have been proposed, such as having students engage in oral reading of passages with guidance and feedback. Some popular programs in this category include repeated reading, neurological impress, paired reading, shared reading, and assisted reading. These procedures aim to enhance reading fluency, but their effectiveness may vary depending on individual students and their specific needs. An alternative approach to developing reading fluency is to promote extensive independent reading with minimal guidance and feedback. This approach encourages students to engage in sustained silent reading (SSR), Drop Everything and Read (DEAR), Accelerated Reader (AR), and various incentive programs that aim to increase the amount of recreational reading. These programs encourage students to read voluntarily and independently, fostering a love for reading and providing opportunities for practice and exposure to a variety of texts. While this approach may lack explicit guidance and feedback, it is widely used and has shown benefits in promoting reading fluency and overall reading development. Many of these approaches do not have formal names but are implemented as requirements for students to engage in unsupervised independent reading either at school or at home. This report has examined the evidence regarding the effectiveness of both guided oral reading procedures and approaches that aim to increase students' reading volume.

Studies that used digital tools with evidence-based strategies was the one which conducted by Whitney and Ackerman (2022) and examined the outcomes of a digital tool, named the Great Leaps method, to enhance reading fluency. The Great Leaps program incorporates evidence-based practices such as repeated reading, immediate error correction, modeling, and graphical representation of student performance to improve oral reading fluency in elementary students with significant reading difficulties. Many of these practices and strategies were also employed in the digital tool, named Alearning, a research conducted by Kakoura & Tzivnikou (2023). The results demonstrated that the Great Leaps Digital Reading Program was effective in improving oral reading fluency, both within the program's reading passages and across grade levels. The findings of Whitney's study align with the results of the Kakoura's research that utilized a similar digital reading tool: Alearning.

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#### 5. Conclusion

Last but not least, we emphasize the significance of all digital technologies in the field of education and especially in language problems domain, which is very effective, productive, facilitates and improves the assessment, the intervention, and the educational procedures via mobile devices that bring educational activities anywhere [31-34], various ICTs applications that are the main supporters of education [35-41], and AI, STEM, and ROBOTICS that raise educational procedures to new performance levers [42-52] and games [53-55]. Additionally, the improvement and blending of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [56-82], as well as with environmental factors and nutrition [28-30], accelerates and improves even more educational practices and results, especially in children with reading disabilities, treating.

More specifically the integration of digital technologies in the field of special education has proven to be highly productive and successful (Drigas et al. al., 2019). The use of mobile devices has facilitated and enhanced educational procedures in various ways. These technologies provide opportunities for personalized learning, individualized instruction, and access to a wide range of educational resources and apps (Chaidi & Drigas, 2022). Mobile devices offer

flexibility and mobility, allowing students with special needs to engage in learning activities both in and outside of the classroom. Additionally, digital technologies provide innovative tools for communication, organization, and assistive features that support students with disabilities in their educational journey. Overall, the incorporation of digital technologies, particularly through mobile devices, has greatly contributed to improving educational experiences for students with special needs (Drigas et al, 2019).

Although some studies suggest that reading on paper provides better comprehension and less eye strain compared to reading on screens (Mizrachi, 2014; Güneş, 2016), the amount of time spent on digital reading activities continues to increase day by day. This trend is evident in the results of the qualitative data from the present study, where students not only improved their reading fluency but also increased their motivation for reading, time spent reading, and enthusiasm for reading. The fact that digital texts are often shorter and that finding specific information within the text is convenient are among the reasons why readers prefer digital media (Larson, 2010). Reading on digital devices such as tablets, computers, and laptops has an impact on students' development and their perception of reading. Interacting with digital devices requires the use of hands and specifically fine motor skills, for example, for scrolling the page, selecting text, or zooming in and out using a touchpad or mouse. This can enhance students' motor skills and allow them to actively engage with the text and adjust it to their needs each time.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The Authors proclaim no conflict of interest.

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