The Impact Of Digital Tools On The Learning Of Students With Special Educational Needs

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Resumo:
This study evaluates the impact of digital tools on the learning of students with Special Educational Needs (SEN). Using a systematic review, we investigate how reading and writing apps, Augmentative and Alternative Communication (AAC) software, adaptive learning platforms and interactive digital games contribute to the inclusion and academic development of these students. Data sources include Google Scholar, Scopus, Web of Science and Scielo, covering studies published between 2017 and 2024. The results show that these technologies not only improve communication and academic skills, but also increase student motivation and engagement. However, challenges such as technical limitations, teacher training and lack of resources are highlighted as significant barriers. Based on these findings, it is recommended to implement public policies that encourage continuous teacher training and improvements in school infrastructure to ensure effective inclusive education. Suggestions for future research include exploring the long-term effectiveness of these tools and comparative studies between different technologies.
Palavras-chave*: Inclusive education; Digital technologies; Special educational needs; Systematic review; Adaptive learning.*

I.   Introdução

In recent years, inclusive education has become a global priority, seeking to ensure that all students, regardless of their special educational needs (SEN) have access to quality education. This movement is supported by various pieces of legislation and public policies that promote equal opportunities and the valuing of diversity in the school environment. Digital technologies have emerged as powerful tools to promote this inclusion, offering new ways of learning and interacting, adapted to students' individual needs.

School inclusion for students with SEN involves not only physical access to schools, but also curricular and methodological adaptation to meet the particular needs of each student. Digital tools, such as educational software, alternative and augmentative communication (AAC) applications, adaptive learning platforms and multimedia resources, have proved effective in this process, contributing to students' autonomy and engagement. This study aims to assess the impact of these digital technologies on the learning of students with SEN, highlighting both the benefits and the challenges associated with their use.

The inclusion of students with Special Educational Needs (SEN) in the regular school environment is a topic of growing importance, backed by legislation such as the Brazilian Inclusion Law (LBI) (Law No. 13.146/2015) (Brasil, 2015) and the National Policy for Special Education from the Perspective of Inclusive Education (PNEEPEI) (Brazilian Government, 2023). Inclusive education must eliminate barriers and guarantee the enrollment of students with disabilities in ordinary schools, according to the guidelines presented by the PNEEPEI (Diversa, 2023). Ainscow (2020) also highlights the importance of these policies to promote a more equitable and accessible education for all students. This study is justified by the need to understand how digital technologies can facilitate the teaching-learning process for these students, promoting a more inclusive and equitable education.

Digital technologies, when integrated into the educational context, offer resources that can overcome physical and cognitive barriers, enabling students to actively participate in school activities, regardless of their specificities. In addition, they promote the individualization of teaching, allowing educators to adapt activities according to the needs and abilities of each student. This study seeks to fill a gap in the literature by systematically investigating the impact of digital tools on the learning of students with SEN, offering a theoretical and empirical basis for educators, researchers and public policy makers.

The general objective of this study will be to evaluate the impact of digital tools on the learning of students with SEN.

The Specific Objectives will be:
● Identify the main digital tools used in education.
● To analyze the benefits observed in the use of these technologies in the learning process of students with SEN.
● Discuss the challenges and limitations faced in implementing these tools in the educational context.
● Establish a comparative analysis between the results of different studies in order to identify relevant patterns and discrepancies.

This article is structured in five main sections:
1. **Introduction:** Presents the topic, the justification, the objectives of the study and the structure of the article.
2. **Theoretical Framework:** Literature review on inclusive education, special educational needs and the use of digital technologies in education.
3. **Methodology:** Description of the type of study, data sources, inclusion and exclusion criteria, data collection procedures and analysis methods.
4. **Analysis and Discussion of Results:** Presentation and discussion of the main findings of the systematic review.
5. **Conclusion:** Summary of the main findings, practical implications for educators and policy makers, and suggestions for future research.

Initially, it is important to point out that inclusive education is not just a goal to be achieved, but a fundamental right guaranteed by international laws and treaties. Technology has played an essential role in transforming the educational environment, enabling students with different types of disabilities to learn more effectively. According to recent studies, digital tools have provided not only pedagogical but also social support, allowing for greater interaction between students and teachers, and between the students themselves (ABREU, 2015; GOTTSCHALK; WEISE, 2023).

Furthermore, it is essential to consider that the digital inclusion of these students is a crucial step towards building a fairer and more equal society. The COVID-19 pandemic has highlighted the importance of digital technologies in the continuity of education, especially for students with SEN, who often face additional barriers in accessing education (DIAS; PINTO, 2020). In this context, the research is justified by the urgent need to identify effective and adaptable practices that can be implemented in different school realities.

Finally, it can be concluded that this study has the potential to make a significant contribution to the field of inclusive education, providing valuable insights into the use of digital technologies. From the identification and analysis of the main tools used, the benefits and challenges observed, and the comparison between different studies, it is hoped that the results can guide future pedagogical practices and public policies aimed at the effective inclusion of students with SEN.

To make it easier to understand and read, this article is structured in such a way as to lead the reader logically through the main aspects of the study. The introduction contextualizes the topic and presents the justification and objectives of the study. The theoretical framework then provides a comprehensive review of the relevant literature. The methodology details the data collection and analysis process. The analysis and discussion of the results presents the main findings of the research and their implications. Finally, the conclusion summarizes the findings, discusses the practical implications and suggests directions for future research.

II. Theoretical Reference

Concepts and Legislation

Inclusive education seeks to integrate all students, regardless of their abilities and needs, into the mainstream education system. According to Mantoan (2018) inclusion goes beyond simple access to school, requiring adaptations to the curriculum, methodology and assessment to meet the needs of all students. The author emphasizes that inclusion must be understood as a fundamental human right, which promotes the dignity and active participation of all individuals in society.

Booth and Ainscow (2020) point out that public inclusion policies are fundamental to guaranteeing the effectiveness of this process. Policies should not only be aimed at creating norms and guidelines, but also at

implementing practices that guarantee effective inclusion. They stress the importance of a holistic approach, involving the school community, families and the students themselves in the inclusion process.

Moran (2007) also contributes to this discussion by emphasizing the importance of pedagogical flexibility and the use of technology to promote inclusion. Moran argues that technology can be a powerful ally in adapting content and methodologies to meet students' individual needs, allowing everyone to have equal access to knowledge.

The 2015 LBI reinforces this commitment, establishing that it is the duty of the state, the family and society to ensure the educational inclusion of students with special educational needs (Brasil, 2015). This legislation establishes clear guidelines for adapting curricula, continuing teacher training and providing adequate resources to meet students' specific needs.

In short, inclusive education is a complex and multifaceted approach that requires an ongoing commitment to adaptation and innovation. Current policies and legislation provide a solid foundation, but practical implementation depends on a deep understanding of students' needs and a commitment to creating truly inclusive educational environments (Mantoan, 2018; Booth; Ainscow, 2020; Moran, 2007).

Special Educational Needs

Students with special educational needs (SEN) can have a number of conditions that require differentiated attention in the school environment. These conditions include physical, sensory and intellectual disabilities, autism spectrum disorders, among others. According to Kauffman and Hallahan (2019) accurately identifying the needs of these students is essential to developing effective teaching strategies. Understanding the specific characteristics of each condition enables the implementation of educational practices that adequately address the particularities of each student.

Physical disabilities include motor limitations and reduced mobility, which may require adaptations to the school's physical environment, such as ramps, elevators and accessible furniture. Students with sensory disabilities, such as visual or hearing impairment, need resources such as Braille printers, electronic magnifiers, Libras interpreters and sound amplification systems (Mantoan, 2018). Intellectual disabilities, on the other hand, involve significant difficulties in intellectual functioning and adaptive behaviour, requiring individualized teaching methodologies and constant reinforcement (Kauffman; Hallahan, 2019).

Autism spectrum disorders (ASD) represent a group of conditions characterized by challenges in social, behavioral and communicative development. For these students, pedagogical strategies that include structured routine, visual communication and behavioral interventions are essential (Kanner, 1943). In addition, students with high abilities or giftedness are also considered part of the target audience for special education, requiring specific enrichment and curriculum acceleration programs to meet their high potential (Renzulli, 2005).

Multifunctional Resource Room and Specialized Educational Assistance

Multifunctional Resource Rooms (SRM) are educational environments equipped with Assistive Technology resources, teaching and learning materials, intended for Specialized Educational Assistance (AEE). These rooms are regulated by various regulations, such as Normative Ordinance No. 13/2007 and Decree No. 7.611/2011, which guarantee technical and financial support for their implementation in public education networks (Brasil, 2011).

SRMs are designed to cater for students with disabilities, global developmental disorders and high abilities, providing a space adapted to their specific needs. These environments are equipped with accessible furniture, laptops, Alternative and Augmentative Communication (AAC) software, adapted keyboards, Braille printers, electronic magnifiers, among other resources (diversa.org, 2023).

The professional responsible for ESA in the SRM is a specialized educator with a degree in Special Education or related areas. Their duties include identifying students' needs, drawing up action plans, producing accessible teaching materials, guiding mainstream teachers and establishing partnerships with different sectors of the school to ensure accessibility (sala de recursos, 2021). In addition, this professional should promote meetings with parents and guardians, encouraging strategies to make the curriculum more flexible and proposing measures with a wide-ranging impact on the institution (lyceum, 2023).

MTRs are essential for educational inclusion, as they allow content and methodologies to be adapted, ensuring that all students have equal access to knowledge. Pedagogical flexibility and the use of technology are fundamental to promoting inclusion, as argued by Moran (2007) who highlights technology as a powerful ally in adapting content and methodologies to meet students' individual needs.

Digital Tools

Digital tools have proved essential for promoting inclusion and personalizing learning in special education. These include reading and writing applications, augmentative alternative communication (AAC)

software, adaptive learning platforms, among others. Ok and Kim (2021) describe several technologies that have proven effective in special education, offering personalized and interactive support.

Scherer (2020) discusses the integration of these technologies into the curriculum, highlighting the challenges and difficulties associated with this process. Moran (2017) suggests the use of adaptive platforms such as Duolingo for Schools and Khan Academy, which allow students to impose their own learning pace. The author also recommends applications for publishing and sharing experiences, such as Wordpress and Google Drive, as well as tools for creating concept maps and digital books.

Santos and Sá (2021) address the challenges of using digital media in education, emphasizing the need to train teachers to effectively use these technologies in their teaching practice. In this sense, Sá and Endlish (2014) highlight the importance of continuing teacher training to deal with the integration of Information and Communication Technologies (ICT) in schools.

Digital tools can promote autonomy and independence for students with special needs. As pointed out by Fachinetti (2017) the computer plays a decisive role in developing the ability to interact, taking advantage of resources such as the internet, digital games and various languages through sounds, videos and simulations.

As shown in the case study carried out by a teacher in the Resource Room of a state school in Mato Grosso, the use of digital games has proved to be an effective strategy for the learning of students with special educational needs (SEN). These games arouse students' interest due to their playful nature, promoting a more engaging and motivating learning environment. The results indicate that interactive digital games not only develop academic skills, but also socio-emotional skills, such as resilience and the ability to overcome failure (Duque, 2024).

However, there are challenges in the implementation and effective use of these technologies in special education. Garcia (2018) points out that the effectiveness of these tools is directly linked to the resolution of challenges proposed by educators and the specific needs of the environment in which the students are inserted.

In short, digital tools offer significant potential for improving special education by providing personalized and interactive support. However, it is essential to invest in teacher training and adequate infrastructure to ensure the effective use of these technologies in the teaching-learning process of students with special needs.

Teachers' Resistance to Using Technology

Teachers' resistance to the use of educational technologies in the learning of students with special educational needs is a significant challenge. According to Duque (2023) this resistance can be attributed to various factors, including a lack of familiarity with the technologies, the absence of adequate training and the perception that the technologies can replace the role of the teacher. In his dissertation, Duque (2023) points out that "using digital resources is no guarantee of learning. Technology is just another tool that needs the talent of the teacher, the interest of the student and the support of the family."

In addition, Duque (2023) points out that teachers' attitudinal barriers are often mentioned as one of the main obstacles to the effective implementation of educational technologies. These barriers include a lack of confidence in their own technological skills, the perception that technologies are complex and the fear that technology could dehumanize the teaching process.

A study by Schuhmacher and Filho (2017) indicates that many teachers are interested in using educational technologies, but feel they lack the necessary knowledge to use them effectively in teaching-learning situations. Duque (2023) highlights the importance of ongoing teacher training, stating that "ongoing training is essential to enable teachers to use educational technologies effectively and in a way that is integrated into the curriculum."

Resistance can also be the result of work overload and a lack of time to explore and integrate new technologies into teaching practice. As Silva (2020) points out, "teachers face an intense workload, which makes it difficult to find time for learning and incorporating new technologies."

To overcome these challenges, it is necessary to invest in ongoing training programs, technical and pedagogical support, and to promote a school culture that values and encourages technological innovation. Duque (2023) suggests that "changing teachers' attitudes towards educational technologies involves understanding that these tools can enrich the teaching-learning process, without replacing the role of the educator."

Benefits and Challenges of Using Digital Technologies for Students with SEN

The use of digital tools in the learning of students with Special Educational Needs (SEN) brings several significant benefits, contributing to the promotion of autonomy, inclusion and active participation of these students in the teaching-learning process. As evidenced by Duque (2024) the inclusion of interactive digital games can provide a more engaging and effective learning experience for students with SEN. As mentioned by Fachinetti (2017) the computer plays a crucial role in developing these students' ability to interact, taking advantage of resources such as the internet, digital games and various languages through sounds, videos and simulations.

Firstly, it is essential to identify the main digital tools used in special education. These include reading and writing applications, Augmentative and Alternative Communication (AAC) software, adaptive learning platforms and interactive digital games. According to Ok and Kim (2021) these tools are essential for supporting learning and promoting the inclusion of students with Special Educational Needs (SEN). Scherer (2020) points out that these resources have been successfully implemented in various educational contexts, providing personalized and interactive support. Recently, Duque (2024) highlighted the effectiveness of interactive digital games, which, in addition to promoting the development of cognitive skills, also help in the socio-emotional development of students, providing an engaging and personalized learning experience.

In addition, digital tools make it possible to adapt content and methodologies to the specific needs of each student. Adaptive learning platforms, such as Duolingo for Schools and Khan Academy, allow students to impose their own learning pace, customizing the content according to their needs (Moran, 2017). In this way, the use of technological resources makes classes more dynamic and interesting, increasing student engagement. As noted by Duque (2024) interactive digital games not only develop academic skills, but also socio-emotional skills, such as resilience and the ability to overcome challenges. Digital technologies foster innovation in education, renewing teaching methodologies to make them more compatible with students who come from a generation known as "digital natives" (Santos; Sá, 2021).

In addition, digital tools also help develop skills such as motor coordination, cognition and communication. For example, by practicing using the computer, students with disabilities interact autonomously, and the command processes improve their motor coordination (Fachinetti, 2017). Assistive technologies, such as screen-reading software, CAA programs and adapted devices, allow students with different types of disabilities to access educational content. These tools are essential for overcoming physical and communication barriers, promoting a more inclusive education (Garcia, 2018).

In addition, the use of digital technologies promotes inclusion, allowing students with SEN to participate more actively in school activities alongside their peers without disabilities. This facilitates the construction of a more inclusive and welcoming school environment (Sá; Endlish, 2014). Digital tools allow students to learn at their own pace, respecting their individual limitations and potential. This is particularly important for students with SEN, who often need more time to assimilate the content (Moran, 2007).

Another significant benefit is improved communication. For students with communication difficulties, digital technologies offer alternatives such as CAA software, facilitating interaction with teachers and peers. This promotes more effective and inclusive communication (Garcia, 2018).

Consequently, the use of these tools helps prepare students with SEN for an increasingly digitalized world, developing essential skills for their future inclusion in the job market (Moran, 2007). Digital technologies facilitate the implementation of hybrid teaching, allowing students with SEN to access content both in the classroom and at home, in a way that is more adapted to their needs. This ensures continuity of learning in different contexts (Santos; Sá, 2021).

Challenges of Using Digital Technologies
Despite the numerous benefits, the implementation and effective use of digital technologies in special education faces several challenges. Duque (2023) identifies teacher resistance to the use of educational technologies as one of the biggest obstacles. This resistance can be attributed to several factors, including a lack of familiarity with the technologies, the absence of adequate training and the perception that technologies can replace the role of the teacher.

Also, work overload and lack of time to explore and integrate new technologies into teaching practice are significant barriers. Silva (2020) points out that "teachers face an intense workload, which makes it difficult to find time for learning and incorporating new technologies."

Inadequate infrastructure is another critical challenge. Many schools, especially in rural and lower-income areas, do not have adequate equipment or reliable internet access. Garcia (2018) points out that inequality in access to technologies creates a significant barrier to the equitable implementation of digital tools.

To overcome these challenges, it is necessary to invest in ongoing training programs, technical and pedagogical support, and to promote a school culture that values and encourages technological innovation. According to Duque (2023) "changing teachers' attitudes towards educational technologies involves understanding that these tools can enrich the teaching-learning process, without replacing the role of the educator."

III. Methodology
This research adopted the systematic review method, as recommended by Gil (2008) which allows for a comprehensive and careful analysis of the existing literature on a given topic. This method is suitable for synthesizing the results of various studies, offering a consolidated and reliable view of the use of digital technologies in special education. Creswell (2014) also highlights the importance of this type of methodology to ensure scientific rigor and the validity of the findings.

The following databases were used for data collection: Google Scholar, Scopus, Web of Science and Scielo. These databases were chosen due to their breadth and relevance in the area of education and technology. Jonsdottir, Jakobsdottir, and Stefansson (2015) highlight the importance of selecting databases that offer broad coverage of peer-reviewed studies, ensuring the quality and representativeness of the articles selected.

The inclusion and exclusion criteria were defined according to the recommendations of Kitchenham (2004) to ensure the relevance and quality of the studies selected:

- **Inclusion:** Studies published between 2018 and 2024, available in English and Portuguese, with a focus on special education and the use of digital technologies.
- **Exclusion:** Studies that do not directly address the impact of digital tools on the learning of students with SEN, opinion articles and non-peer-reviewed publications.

Data collection was carried out in several stages. Initially, a search was carried out in the databases using the keywords mentioned. The titles and abstracts of the articles found were reviewed to check that they met the inclusion criteria. The full texts of the selected studies were then analyzed in detail (Tranfield, Denyer, & Smart, 2003).

The data collected was analyzed using the content analysis techniques described by Bardin (2011). The data was categorized and synthesized to identify patterns and discrepancies in the results of the studies reviewed. The categories of analysis included:

- Types of digital tools used
- Benefits observed in the learning of students with SEN
- Challenges and limitations in implementing these technologies
- Comparison between the results of the studies reviewed

According to Bardin (2011) content analysis is an essential technique for interpreting qualitative data, allowing for an in-depth understanding of the phenomena studied. Data triangulation, as discussed by Denzin (2009) was also used to ensure the validity and reliability of the results. This technique involves combining multiple data sources and methods to obtain a complete and accurate view of the phenomenon studied.

In order to strengthen the discussion on the benefits and challenges of digital technologies in special education, a table summarizing the digital resources and the main authors discussing these topics will be presented. The inclusion of this table aims to provide a clear and organized view of the most relevant tools and the studies that support their applications and impacts, making it easier to understand the technologies highlighted and their respective contributions to the educational field.

Table 1 - Resources and Authors

Digital Resource	Author(s)	Year	Benefits and Challenges
Collaboration and Communication Tools	Fachinetti, T. A. et al.	2017	Social inclusion, skills development
Adaptive Learning Platforms	Moran, J. M.	2017	Personalized teaching, flexible learning pace
Assistive Technologies	Garcia, M. F. et al.	2018	Overcoming physical barriers, promoting autonomy
Alternative Communication Software	Scherer, M. J.	2020	Improved communication, social inclusion
Reading and writing apps	Santos, E. M.; Sá, L. H.	2021	Increased engagement and motivation, accessibility
Interactive Digital Games	Duque, R. C. S.	2024	Improvement of cognitive and socio-emotional skills, immediate feedback

Source: Duque (2024).

In addition, the table facilitates comparison between different studies, highlighting the specific contributions of each to the field of special education. This resource is fundamental for the structured visualization of information, allowing readers to quickly identify relevant tools and understand the context of their uses and implications. The table also serves as an effective means of synthesizing the literature, making it possible to organize and present data in an accessible and informative way.

Firstly, it is essential to identify the main digital tools used in special education. These include reading and writing applications, Augmentative and Alternative Communication (AAC) software, adaptive learning platforms and interactive digital games. According to Ok and Kim (2021) these tools are essential for supporting learning and promoting the inclusion of students with Special Educational Needs (SEN). According to Scherer (2020) these resources have been successfully implemented in various educational contexts, providing personalized and interactive support. Recently, Lima and Santos (2021) highlighted the effectiveness of interactive digital games, which in addition to promoting the development of cognitive skills, also help in the socio-emotional development of students, providing an engaging and personalized learning experience.

Positive Impacts

In addition, the benefits observed in the use of these tools include improved communication, development of academic skills, increased motivation and student engagement. Tobin and Behling (2021) show that students with reading and writing difficulties have made significant progress with the use of specific apps. For example,

Moran (2017) points out that adaptive platforms such as Duolingo for Schools and Khan Academy allow students to learn at their own pace, promoting a more personalized and effective educational experience.

Challenges and limitations

However, it is important to consider the challenges and limitations associated with implementing these technologies. Liu and Huang (2022) identify technical limitations, the need for ongoing teacher training and a lack of resources and institutional support as significant obstacles. Scherer (2020) points out that implementing these technologies requires significant investment in infrastructure and teacher training. In addition, teacher resistance to the use of new technologies, as discussed by Duque (2023) also represents a considerable challenge.

Comparing Studies

When comparing the results of the studies reviewed, there are consistent patterns in the effectiveness of digital tools, although they vary depending on the educational context and the specificities of the students' SEN. Moran (2017) argues that personalizing teaching is one of the main advantages of digital technologies, while Garcia (2018) highlights the importance of overcoming physical and communication barriers. Comparing different studies makes it possible to identify successful practices and areas in need of improvement, providing a solid basis for future research and practical applications. As shown in Table 1 (inserted in the Methodology section) these tools and their respective applications have been detailed, highlighting the main authors and the associated benefits and challenges.

Given these results, it can be said that the adoption of digital tools in special education not only promotes inclusion, but also significantly improves the academic performance of students with SEN. Analysis of the data suggests that the effectiveness of these tools is directly linked to ongoing teacher training and adequate infrastructure. It is therefore essential that public policies and investments are directed towards overcoming the challenges identified, ensuring that all students have equal access to quality education.

Future research

It is suggested that future research explores the long-term effectiveness of digital tools in special education, as well as carry out comparative studies between different types of technology. It is important to investigate how these tools can be optimized to meet the diverse needs of students with SEN and how they can be integrated sustainably and effectively into everyday pedagogical practices.

Practical implications

In view of the findings, it is recommended that public policies be implemented to encourage the integration of digital technologies in special education. It is essential that educators receive adequate and continuous training to use these tools effectively. In addition, it is necessary to ensure that schools have the necessary infrastructure to support the use of these technologies, promoting an inclusive and accessible environment for all students.

IV. Final Considerations

Inclusive education is a fundamental principle to ensure that all students, regardless of their special educational needs, have access to quality education. This study reinforces the importance of creating educational environments that welcome and support diversity, promoting equity and inclusion.

Digital tools have shown enormous potential to transform the learning of students with SEN. They offer unique opportunities for academic and personal development, facilitating the personalization of teaching and interaction in a more meaningful and effective way.

Despite the obvious benefits, it is crucial to recognize and address the significant challenges that accompany the implementation of these technologies. Technical limitations, the need for ongoing teacher training and a lack of resources are all barriers that need to be overcome to ensure the success of inclusive education.

To promote the effective use of digital tools in special education, it is imperative that educators, policymakers and researchers continue to invest in innovative research and practices. Collaboration between these stakeholders is essential to develop strategies that not only implement these technologies, but also maximize their positive impact on the learning and inclusion of students with SEN.

Thus, this study contributes to the understanding of the transformative role of digital tools in special education and highlights the need for an ongoing commitment to meet the challenges and seize the opportunities presented by these technologies.

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