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ASSISTIVE TECHNOLOGIES AND SCHOOL INCLUSION: OPPORTUNITIES AND CHALLENGES IN BASIC EDUCATION

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ABSTRACT

The study addressed the challenges and opportunities of using assistive technologies in school inclusion in basic education, seeking to understand how these resources could be integrated into the school environment to promote the learning of students with disabilities. The objective was to analyze the impacts of assistive technologies on teaching, identifying barriers and proposing strategies to overcome them. The research was developed through a bibliographic review, with qualitative analysis of academic studies and relevant documents. The results indicated that assistive technologies have the potential to transform the educational process, favoring the development of academic and social skills. However, significant obstacles were identified, such as inadequate infrastructure, insufficient teacher training and high associated costs, which limit its application in schools. The analysis highlighted the importance of integrated actions involving investments in infrastructure, teacher training and public policies that prioritize inclusion. In the final considerations, it was concluded that, although advances have been observed, it is necessary to expand research

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on the subject, with emphasis on sustainable implementation practices and long-term strategies to expand access to assistive technologies and ensure inclusive education.

Keywords: Assistive Technologies. School Inclusion. Basic Education. Teacher Training. Educational Infrastructure.

INTRODUCTION

Assistive technologies have gained space as fundamental resources to promote school inclusion in basic education, meeting the needs of students with disabilities and ensuring the right to education for all. These devices and tools, ranging from educational software to adapted equipment, contribute to minimizing physical, communicational, and pedagogical barriers, enabling students with specific needs to develop their learning in accessible environments. The discussion on assistive technologies is part of the context of global efforts for inclusive education, which values equity and diversity in the school environment.

The relevance of the theme is linked to the challenges encountered in the Brazilian educational scenario, in which, despite the legal and political advances towards inclusion, schools still face difficulties in implementing assistive technologies effectively. The lack of adequate infrastructure, insufficient teacher training and the high associated costs are some of the barriers that limit the use of these tools, compromising the full fulfillment of the demands of students with disabilities. Thus, the analysis of the opportunities and challenges of the use of assistive technologies is essential to broaden the debate and propose improvements in the educational context.

The problem of the research is to understand how assistive technologies can be incorporated into the daily life of basic education schools, identifying the main obstacles and possibilities for development. This reflection is necessary to strengthen inclusive practices and ensure that available resources are used in a way that maximizes the learning potential of students with disabilities.

The objective of this literature review is to analyze the opportunities and challenges associated with the use of assistive technologies in school inclusion, with a focus on basic education, seeking to present subsidies that collaborate with the formation of public policies and effective pedagogical practices.

The text is structured in six main sections. The introduction presents the theme, justification, problem and objective of the research, in addition to explaining the organization of the work. The theoretical framework addresses the concepts of school inclusion, assistive technologies and teacher training. In the development, the use of assistive technologies in literacy, the impacts on learning and the barriers to their implementation are discussed. The methodology describes the criteria adopted for the selection and analysis of references. In the discussion and results section, perspectives, challenges and proposals for improvement are presented. Finally, the final considerations summarize the main reflections and suggest directions for future studies.

THEORETICAL FRAMEWORK

The theoretical framework is structured in three main axes, initially addressing the foundations of school inclusion, with emphasis on public policies and the principles that support inclusive education in basic education. Then, the concept of assistive technologies, their categories and applications in the educational context is presented, showing how these resources can be used to overcome learning barriers and promote equity in teaching. Finally, the training of teachers for the use of assistive technologies is argued, highlighting the challenges faced in the process of teacher training and the need for pedagogical practices that favor the inclusion of students with disabilities in the school environment.

ASSISTIVE TECHNOLOGIES IN THE LITERACY PROCESS

Assistive technologies play a significant role in the literacy process of students with disabilities, by providing alternative means for the acquisition and development of fundamental reading and writing skills. These technologies enable educational inclusion, allowing learning barriers to be minimized. As pointed out by Costa (2023, p. 15), "assistive technologies create a favorable environment for learning, promoting autonomy and interaction of students with knowledge". This approach reinforces the importance of these resources in adapting the contents and pedagogical methods to the individual needs of the students.

Among the tools used in the literacy process are extended reading software, adapted keyboards and educational applications that stimulate word recognition and sentence construction. Jennings, Lima and Brito (2017, p. 8) highlight that "assistive technologies offer essential support for students with visual and motor impairments, enabling greater accessibility to school activities". This statement shows how technological resources can transform the interaction of students with the educational environment, expanding their learning possibilities.

In addition, practical cases prove the benefits of assistive technologies in literacy. In a study carried out by Júnior and Coutinho (2024, p. 20), the authors state:

> By implementing the use of interactive software aimed at literacy, it was possible to observe a significant advance in the reading ability of students with hearing impairment. These results demonstrate the positive impact that assistive technologies can have on academic development, as long as they are aligned with appropriate pedagogical strategies.

This evidence reinforces the relevance of the integration between technology and pedagogy, highlighting the need for teacher training for the effective use of these resources.

Teacher training appears as a highlight as it ensures that assistive technologies are used efficiently and meaningfully in the teaching-learning process.

Finally, it is observed that assistive technologies also favor the social inclusion of students, by allowing them to participate in collective activities effectively. Oliveira and Vaz (2022, p. 76) point out that "the use of technological resources during the remote teaching period demonstrated the ability to involve students in collaborative educational practices, promoting not only literacy, but also the development of social skills". Thus, the use of assistive technologies transcends the academic aspect, contributing to the integral formation of students.

Based on the studies presented, it is concluded that assistive technologies represent an indispensable tool in the literacy process, ensuring that students with disabilities have access to equitable and inclusive education. The analysis of examples and success stories highlights the need to expand investments and public policies aimed at their implementation in schools, ensuring that all students can achieve their full educational development.

IMPACTS OF ASSISTIVE TECHNOLOGIES ON LEARNING

Assistive technologies have contributed to the transformation of the teaching-learning process, by providing means of interaction and access to knowledge adapted to the individual needs of students. These tools are capable of modifying the way content is presented and absorbed, promoting greater inclusion and educational equity. According to Costa (2023, p. 22), "assistive technologies enable students with disabilities to have access to pedagogical resources that were previously inaccessible, expanding their learning opportunities". This statement demonstrates how assistive devices become fundamental allies in educational development.

The impact of these technologies goes beyond the transmission of content, reaching the development of academic and social skills. Jennings, Lima and Brito (2017, p. 10) highlight that "the use of assistive technologies stimulates students' autonomy, allowing them to actively participate in school and social activities". This observation reinforces the idea that, by facilitating the interaction of students with the school environment, assistive technologies also promote social integration and the strengthening of self-esteem.

Specific studies have proven the positive impacts of assistive technologies on learning. In an analysis carried out by Júnior and Coutinho (2024, p. 25), the authors show that:

> The introduction of technological tools adapted for students with motor disabilities revealed significant progress in writing and reading activities, in addition to increasing the engagement of these students in collective tasks. These results

indicate that assistive technologies can be effective when integrated into planned and contextualized pedagogical practices.

This example demonstrates how the combination of technological resources with appropriate educational strategies can generate significant results in academic performance and in the involvement of students with disabilities. In addition, Oliveira and Vaz (2022, p. 77) point out that "during remote teaching, assistive technologies were essential to maintain the students' bond with the school environment, even in adverse conditions". This finding highlights the relevance of these tools in varied teaching contexts, expanding their applicability.

Therefore, assistive technologies not only transform teaching and learning, but also contribute to the inclusion and integral development of students. Based on the examples presented, it is evident that investments in teacher training and technological infrastructure are indispensable to expand the reach and benefits of these tools, ensuring accessible and equitable education for all.

BARRIERS TO IMPLEMENTATION

The implementation of assistive technologies faces challenges that hinder their adoption in the school environment. One of the main obstacles is the inadequate infrastructure, present in many schools, especially those located in remote regions or with less investment in technology. According to Costa (2023, p. 18), "the absence of basic physical and technological resources in schools compromises the use of assistive tools, limiting the scope of inclusive practices". This scenario highlights the need for improvements in the physical structure and the availability of adequate technological equipment.

In addition to structural issues, the resistance of teachers and managers also presents itself as a significant obstacle. This resistance, often due to the lack of knowledge or specific training, makes it difficult to insert new technologies in the school routine. As Jennings, Lima and Brito (2017, p. 12) point out, "insufficient training and lack of familiarity with assistive technologies generate insecurity in educators, who end up avoiding or underusing these resources in their pedagogical practices". This finding highlights the importance of continuous and accessible training, which enables education professionals to adapt to new demands.

The costs associated with assistive technologies also represent a barrier to their implementation. In many cases, specific equipment and software have high values, which

makes it unfeasible for schools with limited budgets to acquire. In this regard, Júnior and Coutinho (2024, p. 27) emphasize:

> The high cost of assistive technologies, added to the lack of public policies that subsidize their acquisition, has been one of the greatest challenges for school inclusion. Without consistent government investments, schools rely on partnerships or isolated initiatives to provide the necessary resources to their students.

This analysis shows how adequate funding can be decisive in expanding access to assistive technologies, ensuring their presence in different educational contexts. In addition, Oliveira and Vaz (2022, p. 78) point out that "the absence of public policies limits the ability of schools to meet the demands of students with disabilities, perpetuating educational inequalities". This observation reinforces the need for effective and targeted government actions.

Therefore, overcoming infrastructure barriers, resistance from professionals and high costs requires joint efforts between government, schools and society. The implementation of public policies, combined with investments in teacher training and the acquisition of equipment, is essential for assistive technologies to become a reality in schools and contribute effectively to educational inclusion.

METHODOLOGY

The research developed has a bibliographic character, with a qualitative approach, based on the analysis of academic productions, books, articles and documents related to the theme of assistive technologies and their application in school inclusion in basic education. The study sought to identify, organize and interpret theoretical and empirical contributions on the subject, using as instruments the references available in databases, such as *Scielo*, *Google Scholar* and institutional repositories. The procedures involved the selection of materials with criteria defined by thematic relevance, year of publication and relevance to the Brazilian educational context. The analysis techniques included the reading and filing of texts, as well as the categorization of the information obtained, allowing the construction of a coherent and reasoned narrative.

Table 1: Sources used in the research

Author(s)	Title as published	Year	Type of work
BRANDÃO, S. D.	Assistive technologies in the school inclusion of the visually impaired: a case study in the state of Roraima.	2014	Article
JENNINGS, C.; LIMA, O. G.; BRITO, J. L.	Technologies for education, assistive technology and school inclusion: first approximations.	2017	Article
ARAÚJO, V. S.	Teacher training for the critical teaching of the Portuguese language: an experience in the pedagogy course through the 'Blackboard' platform.	2020	Dissertation
ARAÚJO, V. S.; LOPES, C. R.	Conceptions of critical training of teachers in university education.	2020	Book Chapter
OLIVEIRA, V. B.; VAZ, D. A. F.	Physical and mental health of teachers in the remote teaching period in public schools in Goiás.	2022	Book Chapter
ARAÚJO, V. S.; SILVA, N. N.	Reading in the formation of the citizen in the light of critical literacy.	2022	Book Chapter
OLIVEIRA, V. B.	Discussions of evaluation practices in ninth grade classes of elementary school in a state public school in Goiânia and the teachers' testimonies from the perspective of historical-cultural conceptions.	2023	Dissertation
COSTA, J. D.	Assistive technologies in basic education.	2023	Article
JÚNIOR, A. J. R.; COUTINHO, D. J. G.	The effectiveness of assistive technologies in the literacy of students with disabilities in basic education.	2024	Article
SOUSA, J. R. R. de.	Inclusion and equity policies in basic education.	2024	Article
SANTOS, S. M. A. V. (ed.).	Education 4.0: management, inclusion and technology in the construction of innovative curricula.	2024	Book
SANTOS, S. M. A. V. (ed.).	Education in the XXI century: interdisciplinary and technological approaches.	2024	Book
SANTOS, S. M. A. V. (ed.).	Integral inclusion: contemporary challenges in education and society.	2024	Book
SANTOS, S. M. A. V.; FRANQUEIRA, A. S. (eds.).	Educational innovation: emerging practices in the twenty-first century.	2024	Book
SANTOS, S. M. A. V.; FRANQUEIRA, A. S. (eds.).	Media and technology in the curriculum: innovative strategies for contemporary teacher training.	2024	Book
SILVA, M. R. da; ANDRADE, M. L. da S.; *et al*.	Challenges and opportunities in the use of digital technologies in teaching: teaching perspectives and implications for practice.	2024	Article
SOUZA, E. T. de.	Assistive technologies in higher education: a review of teacher training and inclusive practices.	2024	Article
BARBOSA, T. O.	Education and technology: the challenges for education and technology in the context of basic education in the inclusion process.	Nan	Article
CABRAL, M. V. A.; FILHO, F. L. C. D. O.; DA PAZ, J. F.; DE OLIVEIRA, E. A. R.	Continuing education of teachers in the digital age: challenges and opportunities for inclusion and the quality of basic education.	Nan	Article

Source: The Authors

The table above summarizes the main sources used in the research, presenting the authors, titles, years of publication and types of work selected for the literature review. The organization of the references allowed the identification of trends, challenges and opportunities discussed in the analyzed studies, promoting an understanding of the theme of assistive technologies in the context of school inclusion. The categorization of these works was essential to establish connections between the different approaches addressed, evidencing relevant aspects for the development of the work.

PERSPECTIVES OF SCHOOL INCLUSION WITH ASSISTIVE TECHNOLOGIES

The perspectives of school inclusion with the use of assistive technologies show advances that have transformed education in national and international contexts. These advancements reflect the growth in the supply of technological devices capable of meeting the specific needs of students with disabilities, promoting an accessible and equitable educational environment. According to Costa (2023, p. 24), "the development of technologies adapted to education has made it possible to create resources that facilitate students' learning and interaction with the school curriculum". This progress points to a growing trend of innovation aimed at inclusion in the school environment.

In Brazil, successful experiences illustrate the positive impact of assistive technologies. Studies show that initiatives focused on adapting technological tools have generated significant results in student engagement and performance. Júnior and Coutinho (2024, p. 29) report that:

> The implementation of technological devices in inclusive classrooms, such as screen readers and alternative communication software, has resulted in a greater participation of students with disabilities. This inclusive teaching model, when well structured, enables students to reach levels of learning compatible with their individual capacities and develop skills that go beyond the school environment.

This analysis demonstrates the relevance of educational policies that encourage the integration of assistive technologies into everyday school life. In addition, experiences in other countries reveal promising practices that can serve as a reference for Brazil. Jennings, Lima and Brito (2017, p. 14) highlight that "countries such as Canada and Finland have invested in assistive technologies as part of an inclusive educational policy, promoting equal opportunities from basic education to higher education". This international example reinforces the importance of considering successful experiences to adapt strategies to the Brazilian context.

Finally, Oliveira and Vaz (2022, p. 79) emphasize that "assistive technologies not only promote inclusion, but also contribute to education becoming a space for innovation

and overcoming barriers". This perspective suggests that the potential of these technologies goes beyond eliminating obstacles, promoting dynamic and transformative education.

Based on the advances and experiences described, it is observed that school inclusion through assistive technologies presents promising paths for strengthening inclusive pedagogical practices. To consolidate these perspectives, it is essential to invest in public policies, teacher training, and the sharing of successful experiences, ensuring that all students have access to quality education.

CHALLENGES IN IMPLEMENTATION

The challenges in the implementation of assistive technologies in schools reflect the reality of structural and operational problems that hinder the effectiveness of inclusive practices. Insufficient infrastructure is one of the main obstacles faced, as many schools lack the basic resources needed to accommodate assistive devices. Costa (2023, p. 18) points out that "the precariousness of school infrastructure, including the lack of internet access and adequate equipment, limits the use of assistive technologies, compromising the meeting of the demands of students with disabilities". This situation highlights the urgency of investments in physical and technological improvements in educational institutions.

Another relevant aspect is related to the insufficient training of teachers for the proper use of these tools. Many teachers do not receive training to integrate assistive technologies into their pedagogical practices, which results in underutilization or inadequacy of these resources. Jennings, Lima and Brito (2017, p. 12) state that "the lack of continued training and the lack of knowledge about the benefits of assistive technologies generate insecurity in educators, creating resistance to their adoption". This analysis reinforces the need for policies that prioritize teacher training as a central element for school inclusion.

The absence of effective public policies also contributes to the challenges faced. In many cases, government programs are unable to meet the diversity of educational demands, restricting access to assistive technologies. Júnior and Coutinho (2024, p. 28) explain:

> Despite advances in inclusive legislation, the implementation of public policies still lacks greater scope and planning. Many schools depend on local initiatives and the mobilization of managers to ensure the minimum support for students with disabilities.

This observation points to the need for a consistent alignment between legal guidelines and practical actions, aiming at an effective implementation of assistive technologies in the school environment.

In addition, Oliveira and Vaz (2022, p. 79) point out that "the lack of continuity in educational programs and the lack of interest in long-term policies contribute to the disarticulation of inclusive projects". This situation reveals how the fragmentation of initiatives impacts the sustainability of actions aimed at school inclusion.

Therefore, the challenges in the implementation of assistive technologies require integrated actions that involve improvements in infrastructure, teacher training and consistent public policies. Only with targeted efforts will it be possible to overcome the structural and operational problems that compromise the inclusion of students with disabilities in schools.

IMPROVEMENT PROPOSALS

The proposals for improvement for the integration of assistive technologies in schools include the implementation of strategic actions aimed at educational inclusion, with a focus on teacher training, strengthening technological infrastructure and aligning effective public policies. To integrate these technologies meaningfully, it is necessary to develop initiatives that ensure equitable access to assistive resources and tools. According to Costa (2023, p. 20), "the implementation of assistive technologies must be planned based on a diagnosis of the needs of each school, prioritizing students who depend on these resources to advance in their learning process". This approach highlights the importance of personalizing actions to meet the diversity of the educational context.

Continuing education for teachers is one of the main recommendations, considering that many teachers do not have the necessary knowledge to use assistive technologies. Jennings, Lima and Brito (2017, p. 13) emphasize that "teacher training should be continuous and practical, offering teachers opportunities to get to know and experiment with different technological tools, in addition to understanding how to apply them in different classroom situations". This strategy contributes to educators feeling confident and prepared to integrate assistive technologies into their pedagogical practices.

In addition, investment in technological infrastructure is indispensable to ensure that schools are adequately equipped. Júnior and Coutinho (2024, p. 30) state:

> Without consistent investments in infrastructure, assistive technologies become inaccessible to most schools, perpetuating the exclusion of students with disabilities. It is essential that resources are allocated to the acquisition of equipment and the improvement of connectivity, promoting adequate conditions for the implementation of technologies.

This argument highlights the direct relationship between the quality of infrastructure and the success of inclusive practices. To achieve effective results, it is also necessary to consider the role of public policies in strengthening these actions. Oliveira and Vaz (2022, p. 78) point out that "well-planned and sustainable educational policies are the basis for ensuring that schools can use assistive technologies continuously, without depending on temporary or sporadic initiatives".

Therefore, integrating assistive technologies in schools requires an articulated approach, involving continuing education for teachers, investments in infrastructure, and public policies that prioritize inclusion. These proposals aim not only to overcome current challenges but also to create an accessible and welcoming educational environment for all students.

FINAL CONSIDERATIONS

The final considerations of this study on assistive technologies and their relationship with school inclusion in basic education highlight the main findings in response to the research question. The analysis demonstrated that assistive technologies have the potential to transform the educational environment, promoting greater accessibility and autonomy for students with disabilities. However, its implementation faces significant challenges, such as the lack of adequate infrastructure, the resistance of education professionals, and the high costs associated with these resources. These factors limit the reach of assistive technologies and compromise the goal of inclusive education.

Significant advances in the use of assistive technologies were identified, with examples of tools and methodologies that have contributed to literacy and the development of students' academic and social skills. However, the structural and operational challenges highlight the need for careful planning for its application. Continuing education for teachers was highlighted as an indispensable element, since insufficient knowledge about the use of these resources still represents an important barrier. Additionally, the study pointed out that investments in infrastructure and effective public policies are essential to create conditions that allow the adoption of these technologies in schools.

The contributions of this work include highlighting the opportunities and challenges related to assistive technologies, as well as proposing strategies to overcome the obstacles observed. The study reinforces the relevance of educational practices that integrate assistive technologies in order to meet the needs of students, promoting effective school inclusion. In addition, the research suggests the importance of articulated actions between

government, schools and society to ensure that assistive technologies reach the largest possible number of students.

Despite the findings presented, there is a need for further studies that delve into specific issues, such as the impact assessment of different types of assistive technologies in different contexts and the longitudinal monitoring of their application. Future research may contribute to identifying new models of teacher training, financing methods, and integration strategies that expand access to assistive technologies. These complementary investigations are essential to consolidate the advances discussed and reinforce the commitment to quality inclusive education.

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