THE USE OF INFORMATION TECHNOLOGY AND ITS CONTRIBUTIONS TO THE QUALITY OF EDUCATION FOR VISUALLY IMPAIRED STUDENTS: A CASE STUDY AT THE FEDERAL INSTITUTE OF EDUCATION, SCIENCE AND TECHNOLOGY OF AMAZONAS – HUMAITÁ CAMPUS

O USO DA TECNOLOGIA DA INFORMAÇÃO E SUAS CONTRIBUIÇÕES NA QUALIDADE DO ENSINO DE ALUNOS DEFICIENTES VISUAIS:UM ESTUDO DE CASO NO INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIAS E TECNOLOGIA DO AMAZONAS – CAMPUS HUMAITÁ

EL USO DE LAS TECNOLOGÍAS DE LA INFORMACIÓN Y SUS CONTRIBUCIONES A LA CALIDAD DE LA EDUCACIÓN DE ESTUDIANTES CON DISCAPACIDAD VISUAL: UN ESTUDIO DE CASO EN EL INSTITUTO FEDERAL DE EDUCACIÓN, CIENCIA Y TECNOLOGÍA DE AMAZONAS – CAMPUS HUMAITÁ

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ABSTRACT

This article presents the results of a field research that investigated the contributions of Information Technology (IT) to improving the quality of education for students with visual impairments. The study was an experiment conducted with visually impaired students at the Federal Institute of Education, Science and Technology of Amazonas – Humaitá Campus, involving teachers and students with visual impairments. The methodology adopted was a case study, using direct observation. The results showed that the use of technological resources, such as screen readers, accessible educational software, and adapted digital materials, contributes significantly to the teaching-learning process and to school inclusion. From this perspective, we understand that the insertion of IT in the educational context expands the possibilities of access to knowledge and promotes greater autonomy for students with visual impairments.

Keywords: School Inclusion. Assistive Technology. Visual Impairment. Education. Digital Accessibility.

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RESUMO
Este artigo apresenta os resultados de uma pesquisa de campo que investigou as contribuições da Tecnologia da Informação (TI) na melhoria da qualidade do ensino de alunos com deficiência visual. O estudo foi uma experiencia realizado com alunos deficientes visuais do instituto federal de educação, ciências e tecnologia do amazonas – campus Humaitá., envolvendo professores e estudantes com deficiência visual. A metodologia adotada foi de estudo de caso, utilizando observação direta. Os resultados evidenciaram que o uso de recursos tecnológicos, como leitores de tela, softwares educativos acessíveis e materiais digitais adaptados, contribui significativamente para o processo de ensino-aprendizagem e para a inclusão escolar. Sobre esse prisma compreendemos que a inserção da TI no contexto educacional amplia as possibilidades de acesso ao conhecimento e promove maior autonomia aos alunos com deficiência visual.

Palavras-chave: Inclusão Escolar. Tecnologia Assistiva. Deficiência Visual. Educação. Acessibilidade Digital.

RESUMEN
Este artículo presenta los resultados de una investigación de campo que investigó las contribuciones de las Tecnologías de la Información (TI) a la mejora de la calidad educativa de estudiantes con discapacidad visual. El estudio fue un experimento realizado con estudiantes con discapacidad visual en el Instituto Federal de Educación, Ciencia y Tecnología de Amazonas, Campus Humaitá, con la participación de docentes y estudiantes con discapacidad visual. La metodología adoptada fue un estudio de caso mediante observación directa. Los resultados mostraron que el uso de recursos tecnológicos, como lectores de pantalla, software educativo accesible y materiales digitales adaptados, contribuye significativamente al proceso de enseñanza-aprendizaje y a la inclusión escolar. Desde esta perspectiva, entendemos que la incorporación de las TIC al contexto educativo amplía las posibilidades de acceso al conocimiento y promueve una mayor autonomía para los estudiantes con discapacidad visual.

Palabras clave: Inclusión Escolar. Tecnología de Asistencia. Discapacidad Visual. Educación. Accesibilidad Digital.

1 INTRODUCTION

Throughout the world history of people with disabilities, the blind population was on the margins of society for a long time, because the absence of public policies, as well as their low representation in the organs of the republic, combined with medieval prejudices, ventilated before the population that these individuals were incapable in all senses for work activities and social life.

With the advancement of Information Technology in the world scenario, combined with the Globalization that we are experiencing, the demand for technological solutions is increasingly present in the school environment. However, little is discussed about this demand related to the blinded person who attends educational institutions, about digital inclusion.

The methodological use of Informatics to promote accessibility aims to develop alternative skills for the teaching-learning process of individuals with a specific special need or limitation. It also seeks to detail a discussion that contemplates several factors and overdeveloped competencies inherent to each type of disability.

In this aspect, the influence on the learning of each individual is related to the social context in which he is inserted. Considering that blindness is the least discussed, it was considered necessary to discuss this theme, it is relevant to highlight that the entire extension of the discussion will take place in the current national scenario, with a brief synthesis of the prejudices and segregalist policies that have occurred throughout universal history.

The present discussion takes into account research by several theorists who try in every way to discuss why even though there is a considerable range of legislation related to the matter and inclusive public policies, little is currently verified the protagonism of the blind individual in the educational environment, and therefore little effective digital and social inclusion occurs, which is the main objective of the State to promote. In view of the above, this study seeks to answer the following research question: **How does Information Technology contribute to the quality of teaching of visually impaired students?** The general objective is **to analyze the contributions of IT in the teaching-learning process of visually impaired students.**

2 THEORETICAL FOUNDATION

Blindness throughout Universal History is the object of stereotypes, marked by a feeling of rejection and intolerance based on religious beliefs and total disregard for knowledge.

In antiquity, until the beginning of the Modern Age, blindness was the cause of divine punishment for the family that received a blind individual (the result of the sin of the parents, grandparents or by virtue of the person's own sin, which had blindness as a punishment). The blind individual was subject to cruel and ignorant processes, such as his own sacrifice for being considered useless to the work of that time, abandonment, the death penalty and torture, as in the case of Prussia where the blind were seen as possessed by evil spirits.

The Jewish culture, today spread throughout the world, in the same vein, demonstrates how sin was considered a consequence of blindness, the passage from the Gospel of St. John demonstrates this issue, "And the disciples asked him, saying, 'Rabbi, who sinned, this man or his parents, that he was born blind?' Jesus answered, "Neither he nor his parents have sinned; but it was so that the glory of God might be manifested in him..." (JOHN 9:2-3).

In the nineteenth century, an invention by Louis Braille would completely change the view of the time in relation to the blind, until then, unable to read and work. The invention was inspired by a military code called Night Writing, used by Napoleon Bonaparte's soldiers to communicate silently at night and without a light source. The invention became known as the Braille System, which is still used today.

The Braille System consists of writing and reading, based on 64 symbols in relief, allowing the representation of letters, numerals and accent marks. In Brazil it has been recognized since 1856, it is key in the learning process and contact of the blind person not only in the educational environment, but also in the labor market.

Despite the historical milestone of the creation of the Braille System, in Brazil the blind continued to be underrepresented. Certainly, in recent decades there have been important advances regarding the human and social rights of blind people, recognized, until then, as incapable of work activities. After years of struggle, these individuals begin to enjoy their rights as human beings, holders of guarantees and fundamental rights, as well as specific ones, representing, therefore, a significant advance in the social development of the country.

The Brazilian Magna Carta mentions in 07 (seven) of its 250 (two hundred and fifty) articles on disability, applicable to blind people. With regard to social rights, any discrimination in relation to salary and admission criteria for workers with disabilities is prohibited; the reservation of a percentage of jobs every time a competition is held for the admission of civil servants, pertaining to the three branches of the Republic; ensures social assistance, in addition to specialized educational assistance, which is the obligation of the State and the family to provide, it is observed the concern of the constituent legislator to guarantee the

effectiveness of these rights to people wronged throughout history by irrational beliefs and senses from a logical point of view.

In the same perspective, with the objective of eradicating attitudinal barriers, such as detailing the rules that must be observed to ensure the effectiveness of the rights of people with disabilities, it focuses on a single law, a quasimodo regulatory object, marked by bringing together laws, decrees, ordinances, and attributing responsibility to each author in the inclusive perspective. The Brazilian Law for the Inclusion of Persons with Disabilities (Law No. 13,146, of July 6, 2015) was created, a historical milestone in the struggle for civil and human rights of persons with disabilities, as can be seen in chapter four.

> IV – barriers: any obstacle, obstacle, attitude or behavior that limits or prevents the person's social participation, as well as the enjoyment, enjoyment and exercise of their rights to accessibility, freedom of movement and expression, communication, access to information, understanding, safe circulation, among others, classified as:
> a) urban barriers: those existing on roads and in public and private spaces open to the public or for collective use;
> b) architectural barriers: those existing in public and private buildings;
> c) barriers in transport: those existing in the systems and means of transport;
> d) Barriers in communications and information: any obstacle, obstacle, attitude or behavior that hinders or makes it impossible to express or receive messages and information through communication systems and information technology. (BRAZIL, 2015).

The law proposes a fairer recognition, asserting the dignity of the individual, in addition to requiring an active role of the State. It attests that disability does not incapacitate, but rather society and the space in which the individual is inserted, through social obstacles, attitudinal, architectural, technological, and communicational barriers, which must be eradicated.

Wanting children to be born healthy and without any disability or limitation is a legitimate desire of every father and mother, however nature and destiny do not follow the standards of perfection that we often have in our heads. We can give health, good nutrition, but children are what they are, there are things that we cannot shape or change, this is the case of the theme addressed here, and not everyone is open to acceptance. As a result, the main scope of LBI/2015 is to combat discrimination.

There is no doubt that, among the barriers mentioned above, attitudinal is the one that most negatively interferes in this process, since it prevents people from changing their behaviors and the change in conduct results in the elimination of other obstacles.

3 CONTRIBUTIONS OF INFORMATION TECHNOLOGY IN THE TEACHING OF VISUALLY IMPAIRED STUDENTS

In a globalized world, the use of technology has reached levels that were not expected by the capitalist world itself, as a result, some sectors of contemporary society have not been able to keep up with such a revolution. One of the sectors is the educational environment for people with special needs, especially the blind student.

When talking about the use of technology in the school setting, it is not about the mere use of the computer by students or teachers, it is about the use of technology for inclusive purposes, in the case of students with disabilities. Previously, it was found that the school, even in current times, is endowed with attitudinal barriers by its own agents. In the present context, it is not different, this fact requires special attention.

What is the use of an image projector device to help a blind person teach? The answer is simple, none. Limiting itself to this example, it is observed that the technological barriers, cited in the Brazilian Law of Inclusion of 2015, are clearly being ignored by the agents, which in this example, the teacher, it should be noted that the fault of such a barrier is not always the teacher, but rather the educational institution that does not have materials aimed at such inclusion. It should also be noted that when the teacher is attending higher education, the absence of teaching related to information technology contributes to this situation.

As a result, technologies have not changed the teaching paths in the classroom, nor have they replaced the presence of the teacher. The use of technological tools came in the form of a methodological revolution, to allow not only a solid model of support in daily activities, but also to create an interactive environment and, through its software, make activities that were not possible before accessible to some people, as well as to automate tasks that were developed exclusively through a human.

With regard to people with disabilities, according to the outline in question, information technology has fostered professional growth through the education where it is being applied. It happens that in public schools it is not very widespread, even though there is a large number of laws approved in favor of people with disabilities. From this perspective, it is observed, for example, the use of image projectors, computers without accessibility software, in classrooms, which in the inclusive perspective, takes care of a technological barrier.

4 METHODOLOGY

The research was in the field, with a qualitative and descriptive approach. The study was carried out in 2024 within the scope of the Federal Institute of Amazonas campus Humaitá-AM The research was field, with a qualitative and descriptive approach. The

participants involved were visually impaired students, professors who committed to carrying out this important research and we also had an important participation of scholarship students from the Informatics course in an integrated way. Techniques and methodologies were applied with teachers and class observations to identify the appropriate use of technologies. The answers were analyzed through content analysis (BARDIN, 2011), seeking categories such as: accessibility, inclusion and learning. During the teaching process, several tools were used, such as screen readers, which are software that translate texts and graphic elements of the computer screen into synthesized voice. They allow blind people to use operating systems, programs and websites autonomously, another important NVDA (NonVisual Desktop Access) tool, is a free and open source screen reader, compatible with the Windows system. It reads texts, menus and commands, allowing the student to access digital content, produce texts and browse the internet. Because it is free, it is widely used in public schools, DOSVOX Brazilian system developed by the Federal University of Rio de Janeiro (UFRJ). It allows blind people to interact with the computer through sound commands. It includes a text editor, file reader and even accessible educational games, facilitating learning and digital inclusion, Braille Printers and Materials Braille continues to be fundamental in the process of literacy and literacy of students cegos.Com Braille printers, it is possible to convert typed texts into Braille dots printed on special paper. There are also electronic Braille displays, which allow tactile reading of texts in digital format, connecting to the computer via USB or Bluetooth. These resources allow the student to have access to the same content as their classmates, promoting autonomy and equity in learning. These were the resources used, since the set of these technologies provides the visually impaired student with autonomy, inclusion and equal opportunities, promoting new methodologies and supporting teachers in their pedagogical practices. Throughout the course, the research followed the ethical principles of Resolution No. 510/2016 of the National Health Council, with the free and informed consent of the participants.

5 PRESENTATION AND DISCUSSION OF RESULTS

The present study was developed at the Federal Institute of Technologies, Sciences and Education of Amazonas Humaitá campus focusing on the formative trajectory of a visually impaired student enrolled in the Integrated Technical Course in Informatics. This is a paradigmatic case, insofar as it articulates the challenges of technical professional education — highly dependent on visual and symbolic languages — with the construction of an educational environment mediated by assistive technologies and inclusive pedagogical practices.

The student, the first visually impaired student to enter the course, faced an institutional context that, at the time, lacked accessible infrastructure: there was no screen reading software, Braille printers, tactile materials and servers trained in specific technologies to support visual impairment. This initial lack mobilized teachers and technicians to move to training courses and to reorganize didactic practices, in a movement of institutional and pedagogical learning that transcended the individual case.

The course curriculum — strongly anchored in logic, algorithms, and programming content — imposed significant barriers to the student's full participation. However, with the progressive use of assistive technologies, curricular adaptations and the support of students of the Degree in Computing and Technology at the State University of Amazonas, it was possible to ensure the student academic autonomy, satisfactory performance and successful completion of the course.

The insertion of assistive technology resources — such as screen readers (Virtual Vision, Dosvox), Braille devices and audio description software — reconfigured the way students access knowledge and cognitive processes. As Bersch (2017) points out, assistive technology is not restricted to the functional compensation of disability, but constitutes a device for expanding cognitive and symbolic capacities.

The use of these resources allowed the student to develop new digital reading and writing strategies, adapting to the programming environment and the study of complex languages. In a convergent way, Amirilian (1997) highlights that, in the absence of sight, the blind subject develops alternative symbolic forms of representation, in which visual thinking is replaced by a highly structured verbal and tactile imagination. Thus, technology mediated the transposition of perceptual limitations to the field of abstract thinking, favoring the development of analytical skills compatible with the requirements of the course.

Alegre's (2003) perspective on "blindness and the vision of thought" theoretically illuminates this case, by stating that the absence of physical vision does not compromise the ability to see symbolically. On the contrary, blindness can enhance introspection and the ability to formulate complex mental images, when mediated by appropriate symbolic and technological instruments. In the student's case, assistive technology became the channel through which visual thinking was transformed into conceptual thinking.

The autonomy constituted throughout the training course was one of the most remarkable achievements of the experience. With the mastery of assistive technologies and digital platforms, the student achieved a high degree of independence in the study of theoretical disciplines, in the completion of the course completion work and in internship activities.

This autonomy is supported by the legal principle of the Brazilian Law for the Inclusion of Persons with Disabilities (Law No. 13,146/2015), which defines the right to self-determination and full social participation as axes of citizenship. In the educational sphere, this principle translates into the self-management of the learning process, allowing the student to conduct his trajectory in an active and self-regulated way.

The student's decision to continue her studies in the Distance Education (EAD) modality, after completing the technical course, reinforces this dimension of intellectual emancipation. The virtual environment, by allowing greater control over time, resources and access formats, has enhanced their autonomy and reinforced the link between technology and cognitive freedom, as Gil (2006) argues, when he defines accessibility as "a field of liberation through technical mediation".

The presence of the blind student had a significant impact on the institutional culture, prompting collective reflections on pedagogical practices, teacher training and diversity management. As Oliveira and Silva (2020) point out, the inclusion of visually impaired students, when supported by technological resources and significant curricular adaptations, reconfigures the school ethos, promoting more collaborative environments that are sensitive to human plurality.

This transformation is consistent with the principles of the Universal Design for Learning (UDL), expressed in the guidelines of the Law of Guidelines and Bases of National Education (Law No. 9,394/1996), which advocate the use of multiple forms of representation, engagement and expression. At IFAM, the experience shifted the notion of inclusion from a punctual practice to a training policy, based on principles of equity, accessibility and pedagogical innovation.

Despite the positive results, the experience revealed relevant structural and institutional weaknesses. The absence of specialized equipment — such as Braille printers, tactile displays and licensed screen reading software — constituted a deficit in instrumental accessibility (Queiroz, 2008; Costa, 2009). This limitation is symptomatic of the national scenario, in which the high cost of assistive technologies and the lack of public investment compromise the effectiveness of inclusion policies (Bersch, 2017).

In addition, insufficient teacher training emerged as a persistent obstacle. The need to move civil servants to training courses in assistive technologies, and the subsequent effort to replicate knowledge in pairs, show the absence of an institutionalized program of continuing education in accessibility. As Rabêllo and Masini (2003) state, authentic inclusion requires institutionalization and continuity, and not episodic or voluntarism-dependent actions.

These challenges reveal the gap between legal normativity (Brasil, 2015) and the materiality of inclusion in educational institutions, pointing to the urgency of policies that transform inclusive practices into permanent institutional routines, and not into exceptions.

The results presented here dialogue with the literature that conceives visual impairment not as an absence, but as a singular way of perceiving and constructing the world. Ochaita and Rosa (1995) point out that, for blind children, knowledge is the result of an integration between action, language and representation, which extends to the adult who learns through tactile, auditory and symbolic mediations.

Camargo, Nardi and Veraszto (2008), when analyzing communication barriers of blind students in Physics classes, conclude that the main obstacle to inclusion lies in the lack of adequate symbolic mediation — and not in the disability itself. This finding reinforces that assistive technology acts as a cognitive mediator, and not as a substitute for vision.

Alegre's (2003) theory of "the view of thought" broadens this debate by suggesting that blindness, far from being a mere limitation, constitutes an epistemic condition capable of revealing new forms of intelligibility. This proposition is manifested in the analyzed experience, in which assistive technology not only allowed access to information, but stimulated the development of highly reflective and abstract thinking.

Bersch's (2017) contribution is also central: assistive technology should be understood as part of an articulated pedagogical project, whose intentionality defines its formative effects. Thus, it is not the tool that includes, but the pedagogical sense that guides it.

Experiences such as the Dosvox Project (UFRJ, 2018) and Virtual Vision (Rocha, 2016) illustrate national advances in digital accessibility and training of blind users, demonstrating that the development of public and low-cost technologies can reduce regional inequalities and democratize access to inclusive education.

The trajectory of the blind student at IFAM shows that educational inclusion is a social, cognitive and political process, which goes beyond mere curricular adaptation. The study confirms that the integration between assistive technology, teacher mediation and institutional commitment constitutes the indispensable triad for effective and emancipatory inclusion.

From the interaction between technology and symbolization, the student reconstructed her way of seeing the world, confirming the theses of Alegre (2003) and Amirilian (1997), according to which blindness is not the absence of vision, but another way of seeing, sustained by thought, language and imagination.

In this way, inclusion emerges not as a compensatory policy, but as a production of meaning and shared humanity, in which difference ceases to be an obstacle to become a formative power. The case under analysis reaffirms that technology, when guided by a

humanizing pedagogy, becomes an instrument of cognitive liberation — not only for the student with disabilities, but for the entire school community.

6 CONSIDERATIONS

The determining factor for the writing of this work was the experience of how the blind subject acts in the school, in observation of the students enrolled in the Technical Course in Informatics of the Federal Institute of Amazonas – Humaitá Campus. In view of this, the desire arose to research on the subject, initially to find out why few blind people attend school regularly.

In this bias, the objectives that were all met were established, regardless of their complexities, since it involves pedagogical methodologies that escape the cognitive reach at this school stage.

The research arose from the aspect of Informatics as an aid in the teaching-learning process from an inclusive perspective, given the legislation that obliges the State, the family and the whole society to promote. In the course of the course, it was found that even in the twenty-first century, the century of information and globalization, as defined by some authors, there are still medieval prejudices that prevent a more present protagonism of blind people in school, partly by the agent and, in another sense, by the State itself, which exempts itself from its obligations that it itself has implemented.

In this relevant research, it is explicit that Information Technology (IT) has been consolidated as an essential resource in the promotion of educational inclusion of people with visual impairment. According to Bersch (2017), assistive technologies represent a set of resources and services that aim to provide **independence, quality of life, and social inclusion** to people with disabilities. In the educational context, these resources favor access to knowledge and reduce pedagogical and communicational barriers.

Another relevant point is the positive impact of IT on student **motivation and engagement**. According to Oliveira and Silva (2020), technological tools allow for more interactive and participatory learning, contributing to the formation of critical and autonomous subjects. However, the effective use of these technologies requires **continued teacher training**. Bersch (2017) points out that assistive technology, by itself, does not guarantee inclusion, and the role of the educator in the mediation and adaptation of pedagogical practices is indispensable.

Thus, it can be stated that Information Technology, when applied in a planned and contextualized way, **raises the quality of teaching students with visual impairment**, promoting equity, accessibility and autonomy in the school environment, this was visible

during the research making the students involved finish the school year from access, ensuring their permanence and success in the educational environment.

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