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Tecnologia Assistiva no Curso Técnico de Revisão de Textos no Sistema Braille

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Resumo
No Brasil, o conceito de Tecnologia Assistiva é caracterizado como o uso de recursos e/ou serviços que garantam a autonomia e independência da Pessoa com Deficiência. Este trabalho objetivou investigar como o conceito de Tecnologia Assistiva está presente no Projeto Pedagógico do Curso Técnico de Nível Médio de Revisão de Textos no Sistema Braille, pioneiro e único no Brasil, e oferecido pelo Instituto Benjamin Constant, instituição que demarcou o uso de tecnologia específica para a pessoa com deficiência visual considerada atualmente como Tecnologia Assistiva. O projeto pedagógico foi analisado em seu conteúdo conforme proposto por Lawrence Bardin. Concluiu-se que o conceito de Tecnologia Assistiva, como proposto pelo Comitê de Ajudas Técnicas, por ser amplo demais, propicia a ênfase ao termo "recurso", associado diretamente a "tecnologias", promovendo a exclusão dos demais termos que compõem o conceito, fundamentais para o processo de ensino e aprendizagem da pessoa com deficiência visual e essenciais para a promoção de sua funcionalidade.

Palavras-chave: Deficiência Visual. Educação Especial. Educação Profissional. Instituto Benjamin Constant. Tecnologia Assistiva.

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Assistive Technology in the Text Revision Technical Course in the Braile System

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Abstract
In Brazil, the concept of Assistive Technology is understood as the use of resources and/or services that ensure the autonomy and independence of Persons with Disabilities. This study aimed to investigate how the concept of Assistive Technology appears in the Pedagogical Project for the Middle Level Technical Course on Braille System Text Revision, a pioneer and unique Course in Brazil, offered by Instituto Benjamin Constant, an institution that inaugurated the use of specific technology for the visually impaired person which is currently considered as Assistive Technology. The content of the pedagogical project was analyzed according to Lawrence Bardin. This study showed that the concept of Assistive Technology, as proposed by the Technical Assistance Committee, for being too broad, emphasizes the term "resource", directly associated with "technologies", promoting the exclusion of the other terms that make up the concept, a fundamental one for the teaching and learning process of visually impaired people, and essential for the promotion of their functionality.

Keywords: Visual impairment. Special Education. Professional Education. Benjamin Constant Institute. Assistive Technology.

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Tecnología de Apoyo en el Curso de Revisión de Textos en el Sistema Braille

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Resumen
En Brasil, el concepto de Tecnología de Apoyo se caracteriza como el uso de recursos y/o servicios que garantizan la autonomía e independencia de las Personas con Discapacidad. Este trabajo tuvo como objetivo investigar cómo el concepto de Tecnología de Apoyo está presente en el Proyecto Pedagógico del Curso Técnico de Nivel Medio sobre Revisión de Textos en el Sistema Braille, pionero y único en Brasil, y ofrecido por el Instituto Benjamin Constant, institución que demarcó el uso de tecnología específica para la persona con discapacidad visual actualmente considerada como Tecnología de Apoyo. Se analizó el proyecto pedagógico en su contenido propuesto por Lawrence Bardin. Se concluyó que el término Tecnología de Apoyo, tal como fue propuesto por el Comité de Asistencia Técnica, por ser demasiado amplio, enfatiza el término "recurso", asociado directamente a "tecnologías", promoviendo la exclusión de los demás términos que componen el concepto, fundamental para el proceso de enseñanza y aprendizaje de las personas con discapacidad visual y fundamental para la promoción de su funcionalidad.

Palabras clave: Discapacidad visual. Educación especial. Educación profesional. Instituto Benjamin Constant. Tecnología de Apoyo.

Introdução

Assistive Technology (AT) is a relatively new term in Brazil, used for just over a decade, and can be generically characterized as resources and/or services that enable people with disabilities to achieve autonomy and independence in various activities. Due to the complexity surrounding disability and its implications (adopted model, clinical and legal definitions, specific educational needs, barriers, social participation, among others), the formulation and systematization of the AT concept are still evolving, involving professionals with diverse backgrounds (SARDENBERG & MAIA, 2019).

Initially, in accordance with the Committee on Assistive Technologies (CAT), three international documents were consulted to support the formulation of the Brazilian concept: The Americans with Disabilities Act (ADA), Empowering Users Through Assistive Technology (EUSTAT), and the National Secretariat for the Rehabilitation and Integration of Persons with Disabilities (SNRIPD). Due to the lack of consensus in the international references consulted to develop the AT concept, the terms 'Assistive Technology,' 'Technical Aids,' and 'Support Technology' could be used initially until the Brazilian concept was approved, as these terms were already in use in academic settings, disability movements and organizations, government institutions, research institutes, and the commercialization of products for this audience (BRASIL, 2009).

The concept of Assistive Technology (AT) was defined in 2007 by the Committee on Assistive Technologies (CAT) as:

> [...] an area of knowledge with interdisciplinary characteristics that encompasses products, equipment, devices, resources, methodologies, strategies, practices, and services aimed at promoting functionality related to the activities and participation of individuals with disabilities or reduced mobility, with the goal of enhancing their autonomy, independence, quality of life, and social inclusion (BRASIL, 2009, p. 9).

After the unanimous approval of this concept in a plenary meeting and its registration as the most appropriate definition, its use was recommended in all documentation produced by the Committee for human resource training, research, and Brazilian theoretical frameworks (BRASIL, 2009).

Although the concept was approved more than a decade ago, in Brazil, the establishment of an educational institution in Rio de Janeiro marked the use of specific technology for individuals with visual impairments, currently considered as Assistive Technology (AT), which enabled access to education for these students. This institution is the Imperial Institute of Blind Boys, now Instituto Benjamin Constant (IBC), which has used the Braille System since its founding in 1854 (IBC, 2021).

As the IBC is the first institution for individuals with visual impairments in Latin America, this study aimed to investigate how the concept of AT is present in the Pedagogical Project of the Technical Course in Braille Text Revision, developed by the teachers of this course, which is exclusively for students with visual impairments and is pioneering and unique in Brazil. It is noteworthy that since its inauguration in the mid-19th century, the Institute's regulations and statutes have included education and professional training through specific resources, methodologies, strategies, practices, and services for these individuals.

Instituto Benjamin Constant: A Brief History

Since its inauguration on September 17, 1854, through Decree No. 1,428 of September 12, 1854, the Imperial Institute of Blind Boys, as it was known at the time, already utilized the Braille System as a reading and writing resource for blind individuals, as stated in Article 33 of the decree: “The Institute will follow, until further notice from the Government, the raised-dot method of Mr. Louis Braille, adopted by the Institute of Paris” (BRASIL, 1854). That same year, the Braille System was officially recognized in France by the *Institut National des Jeunes Aveugles* de Paris as the reading and writing system for blind individuals. However, its creation by Louis Braille occurred about three decades earlier, specifically in 1825.

The decree establishing the Institute outlined its objectives, including primary instruction, moral and religious education, music teaching, some secondary education branches, and industrial trades. Shortly after, in 1857, the IBC had a pioneering typographic workshop in Brazil, employing special types with raised dots imported from France. In 1863, it produced its first work in Braille, "História Cronológica do Imperial Instituto dos Meninos Cegos" (Chronological History of the Imperial Institute of Blind Boys) (IBC, 2008).

Nearly a hundred years after its founding, in 1939, the typographic workshop evolved into the Braille Section, equipped with machines imported from France and England. Three years later, in 1942, the IBC began producing the "Revista Brasileira para Cegos" (RBC) (Brazilian Journal for the Blind), aimed at adults with visual impairments. The IBC Braille Press, established in 1943, is now the largest specialized Braille printing facility in the country.

In 1949, with the publication of Ordinance No. 504 of September 17 by the Ministry of Education and Health, the IBC was authorized to distribute Braille books free of charge throughout Brazil. By the late 1950s, the production of the "Revista Pontinhos," aimed at a juvenile audience, began. The RBC and *Pontinhos* remain the only two Braille magazines in Brazil (IBC, 2008).

In the 1980s, the Braille Press acquired new machinery compatible with computers, leading to gradual growth in Braille material production. In the early 2000s, the IBC started adapting educational and supplementary books into enlarged print. Besides the Braille Press, now called the Braille Printing Division (DIB), the Division of Development and Production of Specialized Material (DPME) adapts and produces various types of tactile materials to facilitate the learning of students with visual impairments. Both the DIB and DPME are characterized as Assistive Technology (AT) services, defined by the CAT as those that

> aim to develop practical actions that maximize the functional results desired by individuals with disabilities in using appropriate technology. These include individualized assessment for the selection of suitable resources; support and legal guidance for granting AT; coordination of AT use with rehabilitation, education, and vocational training services; user training for knowledge and use of AT; technical assistance; and research and development of new technologies (BRASIL, 2009, p. 28).

In 2018, through Ordinance No. 318 of April 3, 2018 (in effect), the internal regulations of the IBC were amended. This regulation expanded the institutional competencies to offer Technical Professional Education at the secondary level, in both articulated and subsequent forms, for individuals with visual impairments. It also provided for the creation of the Department of Postgraduate Studies, Research, and Extension, responsible for promoting and conducting *lato sensu* and *stricto sensu* postgraduate courses, extension activities, and professional development in the field of Visual Impairment (BRASIL, 2018).

This regulation broadened the potential use of technology for individuals who are blind or have low vision, both in education and rehabilitation. This is evident in Article 14, which discusses the competencies of the Division of Development and Production of Specialized Material (DPME):

> I – Develop, adapt, and produce educational-pedagogical materials on the topic of visual impairment;
> II Conduct studies and research in collaboration with other units of the Institution, aiming at the development, application, and dissemination of methodologies, technologies, and educational materials related to visual impairment;
> III – Adapt, record, edit, and review audiobooks and accessible digital books;
> IV – Print and bind specialized materials;
> V – Distribute specialized materials, audiobooks, and accessible digital books to institutions that serve individuals with visual impairments (BRASIL, 2018, p. 4).

The IBC offers the following stages of Basic Education for blind and low-vision students: Early Childhood Education (preschool) for children aged 4 to 5 years and 11 months; Elementary Education

(both initial and final years); and Technical Professional Education at the Secondary Level, in the integrated and concurrent/subsequent modalities. The curriculum provided is in accordance with the National Common Curricular Base (BNCC) and is supported by specialized resources in the field of visual impairment. Additionally, the institution offers diverse curricular components to address the unique needs of the students (IBC, 2021).

At the higher education level, since 1991, the IBC has offered specialization in service through the Medical Residency Program in Ophthalmology, aimed at training ophthalmologists specialized in the diagnosis, treatment, and prevention of various causes of visual impairment. This program has been accredited by the Ministry of Education (MEC) since 2001. Additionally, in 2021, the *lato sensu* postgraduate courses were in the implementation phase, and the Professional Master's Course in Teaching on the Topic of Visual Impairment, with two research lines (Line 1: Body, Subjectivities, Cognition, and Language; Line 2: Knowledge and Teaching Practices in the Education of People with Visual Impairment), began its activities in the second semester of 2021.

The Technical Course in Text Revision in Braille

The Technical Course in Text Revision in Braille, unique in Brazil, has been offered by the IBC since 2019, in either concurrent or subsequent modalities to Secondary Education. It aims to prepare individuals for the profession of Braille text reviser, where the professional checks for potential errors in the adaptation and transcription process of Braille across various physical media, such as paper, aluminum, and PVC, addressing the growing demand from both public and private educational systems, as well as other needs within civil society. The course lasts three years and has a maximum workload of 1,200 hours.

This course is included in the National Catalog of Technical Courses of the Ministry of Education (MEC) under the Educational and Social Development axis and covers,

> **support technologies** for educational and social activities aimed at social inclusion, respect for cultural differences, respectful community coexistence, preservation of heritage, and improvement of quality of life. It is based on reading and production of technical texts, statistics and logical reasoning, science and technology, social technologies, entrepreneurship, cooperativism and associativism, communication and information technologies, interpersonal development, legislation and public policies, technical standards, occupational health and safety, socio-environmental responsibility and sustainability, quality of life, and professional ethics (BRASIL, 2021c, n.p. Authors' emphasis).

In our view, the course is presented as an assistive technology for individuals with visual impairments, aimed at their educational and social activities. It supports social inclusion and improves quality of life, thereby configuring itself as an assistive technology service according to the concept defined by the CAT, because it

> aims to develop practical actions that maximize the functional outcomes desired by the person with a disability through the use of appropriate technology. These include individualized assessment for selecting suitable resources; legal support and guidance for granting assistive technology; coordination of assistive technology use with rehabilitation, education, and vocational training services; user training for knowledge and use of assistive technology; technical assistance; and research and development of new technologies. (BRASIL, 2009, p. 28)

We understand that in the pedagogical project of the analyzed course, assistive technology (AT) is present not only due to the CAT's proposal but mainly because the IBC is an institution that, since its inception, has pioneered the use of specific technology for individuals with visual impairments. This prompted us to investigate how the concept of AT has been adopted by the project developers and, consequently, by the Institute itself, and how it is represented in these documents.

Method

The research conducted is qualitative (POUPART et al., 2016), a method that allows interaction with the research object, enabling a deeper understanding of social reality. Minayo and Gomes (2015, p. 21) assert that this approach "works with the universe of meanings, motives, aspirations, beliefs, values, and attitudes." The adopted paradigm is social constructionism, in which, as explained by Gergen (2009, p. 303),

> the terms with which we understand the world are social artifacts, historically situated products of exchanges between people. From a constructionist perspective, the process of understanding is not automatically driven by natural forces but is the result of an active, cooperative endeavor among people in relationship.

The Pedagogical Project of the Braille Text Revision Course at IBC was analyzed, and the content was categorized using Content Analysis as proposed by Bardin (2016). The author describes that a good set of categories should possess the following qualities: mutual exclusivity: each element can only be present in one category or subcategory; homogeneity: a quality dependent on the principle of mutual exclusivity, and in this case, a single classification principle should organize the analysis; relevance: a category is relevant when it fits the material being analyzed; objectivity and fidelity: very

important principles from the start of the method, requiring the analyst to specify what determines an element's inclusion in a category; and productivity: a set of categories is considered productive when it allows for a high number of inferences and new hypotheses.

Guided by these rules, two categories were constructed. The first, 'Education', was composed of four subcategories: (1) Specificities of the educational process for people with visual impairments, covering historical aspects and content related to the education of blind or visually impaired students at various educational stages and barriers that hinder or prevent their social participation on equal terms with others; (2) Rehabilitation, encompassing educational processes developed throughout life for people who have lost or are losing vision outside of school age; (3) Teacher Training, covering both initial and ongoing training offered at IBC or externally; and (4) Teaching Work, detailing the peculiarities of teachers' work with students with visual impairments.

The second category, 'Technology', was composed of three subcategories: (1) Educational Technology, encompassing resources used by teachers to facilitate the teaching-learning process; (2) Information and Communication Technology, involving the diverse potential of these technologies as facilitators of inclusion for visually impaired individuals; and (3) Assistive Technology, including products, equipment, devices, resources, methodologies, strategies, practices, and services that enable or enhance the functionality of visually impaired individuals in various environments, promoting independence and social inclusion.

For the scope of this article, only the results related to the Technology category were presented, specifically the subcategories Information and Communication Technology and Assistive Technology. This and the other categories and subcategories are part of a broader research on how the concept of Assistive Technology has been appropriated in the educational field since its formulation by the CAT, which is ongoing.

We use the acronym CTRB to refer to the Braille Text Revision Technical Course.

Results

In the subcategory **Information and Communication Technology**, we observed the overlap between ICT and Assistive Technology. The excerpt below illustrates this overlap in the analyzed course project:

> Assistive Technology in the Text Revision Technical Course in the Braile System
> Currently, we are in a period where the advancement of new technologies needs to be explored for the dissemination of this reading system, avoiding that the conveniences of merely auditory formats replace the more elaborate Braille content. Audiobooks and information technology are important, but they do not replace reading in the Braille system (...) (CTRB, 2019, p. 43, Authors' emphasis).

In the specific case of visual impairment, e-books, the use of ICT, web research, and information technology described in the projects are characterized as AT, assistive ICT (UNESCO, 2014), ICT as AT (CAMPOS; PEDROSA, 2016), or ICT from the perspective of AT (OLIVEIRA; MILL, 2016), as digital means will enable functionality for people who are blind or have low vision in the educational context. There is a noticeable profusion of terms used to describe AT, disregarding the dynamic nature of this process. If we consider these same examples for a person with lower limb disabilities, such as congenital malformation or amputation, they would only be seen as ICT or TE, just as for anyone else without a disability.

This fact can also be observed in the curricular component "Basics of Braille Transcription," which includes as one of its competencies/skills the installation and configuration of the Index Basic D-V4 Braille Printer for use with the *Braille Fácil* program, allowing Braille printing, and the Monet software used for drawing graphs on the Braille printer. While the software and program are not characterized as AT because they are used by sighted individuals, the Braille printer itself is considered AT due to its specific purpose for Braille printing, whereas the computer is ICT. However, the way it is used by people with visual impairments is what characterizes it as AT.

In the subcategory of **Assistive Technology**, AT is recognized as one of IBC's objectives, as an institution specialized for individuals with visual impairments, as expressed in the following excerpt:

> Regarding IBc's objectives
> **I - Develop, produce, and distribute specialized materials**;
> **II - Produce and distribute printed materials in Braille and in formats for low vision**; [...] (CTRB, 2019, p. 14, Authors' emphasis).

Both the development and production of specialized material are characterized as an assistive technology service, carried out by the Specialized Technical Department. This is because they relate to products, strategies, and methodologies developed by specialized teachers and technicians that concretely facilitate the conceptual formation, a fundamental condition for the development of students with visual impairments. This service includes: adaptation, transcription, revision, and printing of Braille books; research for adaptation, revision, and printing of enlarged print books; the production of grafo-tactile materials made from PVC film and their corresponding enlarged print versions; and audiobooks, recorded and edited in spoken book format.

In the Pedagogical Project of the Technical Course, assistive technology is addressed in various ways, as illustrated in the following excerpt:

> Thus, a person is considered blind if they need to use the Braille system or auditory resources in place of reading and writing in print and also require additional resources for mobility in unfamiliar places, such as a cane, a companion (which can be another person or a guide dog), or technological resources for spatial perception. (CTRB, 2019, p. 6, Authors' emphasis).

In defining Visual Impairment, the course project approached it from a functional perspective and identified two main drawbacks arising from this sensory deprivation: the inability to access print reading and writing and difficulty with independent mobility. Therefore, Assistive Technology (TA) is required to achieve functionality in these activities. In the previously highlighted excerpt, TA refers to resources such as the Braille system; the long cane; the sighted guide (a human technology used by the visually impaired person as a strategy for dependent mobility); and the guide dog (an animal technology that facilitates independent mobility). It is important to note that the technological resources used by these individuals for spatial perception encompass a wide range of possibilities, including Braille and enlarged print signs, auditory traffic signals, tactile paving, and TIC used as TA, such as mobile device applications.

The course provided additional specific didactic resources for students with low vision to facilitate access to knowledge, as detailed in the following excerpt:

> (...) Resources for students with low vision to facilitate access to knowledge include: Optical resources: prescribed by a specialist doctor, consisting of magnifying glasses and optical systems; Non-optical resources: recommended by a specialist teacher, including contrast, lighting, and enlargement; Electronic resources: recommended by a doctor or specialist teacher, significantly enlarging letters and shapes, and consisting of video magnifiers (Closed-Circuit Television – CCTV), electronic magnifiers, and handheld magnifiers. Whenever possible, educational texts will be adapted, following a minimum standard that covers a larger number of people, as visual needs are specific and individualized. Factors considered include: font, size, number of characters per line, line spacing, space between words and letters, paper and ink color, paper opacity, and illustrations. For blind students or those with very reduced visual acuity, materials will be provided in Braille, digitized, or audio format. Whenever necessary and possible, three-dimensional educational materials with different textures and consistencies for tactile recognition will also be used**.** (CTRB, 2019, p. 51, Authors' emphasis).

Although the Projects of these three courses use the expression "to facilitate access to knowledge," we believe that the more appropriate verb would be "to enable," as without these optical,

non-optical, or electronic resources used either alone or in combination, access to information through the visual system would not be possible. The previously highlighted fragment shows the interdisciplinarity encompassing Assistive Technology (AT) in clinical and educational settings, involving both the medical professional and the specialist teacher in prescribing and adapting the recommended resources.

Regarding assessment, the Course aimed to provide AT to students, addressing their specific needs and allowing them to choose what would be most convenient for them:

> Students will have the right to take their assessments with the assistance of a reader, on a computer, in Braille, or in enlarged print or other image magnification resources, according to their individual needs (CTRB, 2019, p. 75, Authors' emphasis)

In the course project, it is noted the breadth of what is characterized as AT (Assistive Technology) to meet the specific educational needs of students with visual impairments, covering a spectrum that includes blindness, low vision, and monocular vision: the reader, a human technology that enables students with visual impairments to access printed information; the computer, in this case, an ICT from the AT perspective; and the Braille system to assist students who are educationally blind users of this system, and printed materials in enlarged print or other image magnification resources for students with low vision.

The Technical Course in Braille Text Revision, by its very nature and definition, is considered AT, as we can denote from the following excerpts:

> The quality of Braille transcription and revision work still requires much professionalization, deeper knowledge of the inherent difficulties of this reading system, and mastery of the means to provide the necessary accessibility to the produced texts. Ultimately, the knowledge and citizenship of people with visual impairments are directly linked to the cultural products made available through the use of this technique (CTRB, 2019, p. 43, Authors' emphasis).

> Social inclusion and inclusive education policies have led various institutions across different sectors of society to create positions for Braille reviewers. The private sector is also increasingly demanding material in Braille. Despite each federal unit having its own legislation on the topic, there are several federal proposals that will require the existence of Braille-printed materials in hotels, restaurants, shopping centers, entertainment venues, theaters, and other public spaces that require accessibility for people with visual impairments (CTRB, 2019, p. 44, Authors' emphasis).

> Qualify students to recognize and correctly apply Braille notation for Portuguese, the Technical Standards for Braille Text Production, the Unified Mathematical Code for Portuguese, the Braille Chemical Notation for use in Brazil, Braille Notation for

> Information Technology, and Braille Stenography for Portuguese; Qualify students to identify errors in Braille writing, layout, and other aspects, directing them for correction by the Braille transcriber; Qualify students to read and recognize tactile graphics, adaptations, and image descriptions transcribed into Braille**.** (CTRB, 2019, p. 48, Authors' emphasis).
>
> The Braille Text Revising Technician is the professional who reviews materials printed in Braille, ensuring their correct notation in both Portuguese and scientific notations. This role involves identifying inconsistencies and discussing solutions and improvements in the preparation of these materials (CTRB, 2019, p. 51, Authors' emphasis).
>
> Students will have access to the Louis Braille library of the institution, which has a Braille collection for all age groups. Each student will receive auxiliary materials for each curricular unit, transcribed and printed in Braille. During their internship period, they will also have access to books from the National Textbook Program (PNLD) and the National School Library Program (PNBE) (CTRB, 2019, p. 80, Authors' emphasis).

The excerpts above characterize Braille Revision as an AT service, which involves the adaptation, transcription, revision, and printing in Braille. At IBC, this service also includes the editing, printing, and distribution of Brazil's only two Braille magazines, RBC and *Pontinhos*.

In the components of the aforementioned course, AT is mentioned in various ways, even though the term itself is not explicitly used. In Technical Standards I, one of the competencies to be developed is to "recognize the different stages, methodologies, and routines of Braille production" (CTRB, 2019, p. 54). This is the first time the term methodology appears in the Project. In the syllabus for Soroban I and II, the term is used again, this time referring to the Methodology of the highest relative value, also known as Moraes Methodology, which refers to Joaquim Lima de Moraes's adaptation for using the soroban by visually impaired individuals, and the Methodology of the lowest relative value (Bahia Methodology). According to the project, the soroban is used as a tool in mathematical operations and activities. It is important to note that, like the geoboard, this educational technology is only considered AT in the context of visual impairment.

In the course components Technical Standards II and III, Braille Revision Techniques I, II and III, Drawings, Graphs, and Tables in Mathematics, Braille Chemical Notation I and II, Stenography, Adaptation Criteria, and Basic Braille Transcription Principles, the syllabi and/or skills/competencies characterize the scope of what AT service involves, as illustrated by the following sequence of excerpts:

> Understanding Braille transcription, its preparation and conception. Recognize the different types of printing (single-sided or double-sided), their implications, and

when to apply them correctly; Analyze the cover and all pre-textual content of educational and supplementary books; Analyze the textual content of Braille materials, being able to identify inconsistencies and irregularities (CTRB, 2019, p. 59).

Understand Braille transcription of legal texts. Recognize the different methods of transcribing footnotes in Braille materials. Recognize the various methods for transcribing exam questions, exercises, and similar content; Analyze the pagination of Braille-printed material; Correctly apply chapter separation according to the criteria exemplified in the Technical Standards. Recognize the various ways to transcribe Braille poetry, verses, songs, rhymes, etc. (CTRB, 2019, p. 64).

Role of the proofreader in the Braille transcription process. Stages of Braille text revision. Specificities of Braille revision in the production of Instituto Benjamin Constant. (CTRB, 2019, p. 6).

Recognize different types of drawings used in the mathematical context. Recognize geometric figures, as well as their names and properties. Recognize the representation of a chart. Recognize the different ways to represent a table; recognize and differentiate between bar charts and column charts. Recognize the graph of functions. (CTRB, 2019, p. 65).

Recognize different reading modalities in Braille revision. Provide concise feedback through revision notes. Review page breaks, summaries, and pagination; Review stereotypes by analyzing aluminum plates. (CTRB, 2019, p. 67).

Identify simple and compound substances in the Braille System; Differentiate atomic number from mass number; Understand the reading and writing of ions and chemical reactions; Correctly represent electrons and arrows in various chemical reactions; Use Chemical Braille notation with the Braille slate or Braille typewriter and in the Braille Fácil software. (CTRB, 2019, p. 67).

Identify different chemical bonds. Understand the reading and writing of carbon chains and three-dimensional structures. Use mathematical equations in Chemistry; Use Chemical Braille notation with the Braille slate or Braille typewriter and in the Braille Fácil software. (CTRB, 2019 p. 68).

Recognize the possibilities of abbreviation and stenography in the Braille System for the Portuguese language; Recognize different modalities of abbreviations, stenography, and abbreviated stenography. Read and write abbreviated and stenographed Braille. (CTRB, 2019 p. 69).

Conceptualization, classification, and function of educational resources and materials used by people with visual impairments. Conceptualization and characterization of texturization involving necessary materials and accessories. Review of adapted materials printed in thermoform. Recognize the importance of bidimensional and/or tridimensional educational materials and resources. Understand the use of Braille texts along with textures in specialized materials. Review matrices and materials printed in thermoform (CTRB, 2019, p. 70).

Study the criteria for adapting texts and books into Braille and the application of the main Braille notations used in Brazil, as well as the Technical Standards for Braille text production. Understand the necessity of applying adaptation criteria in Braille

> transcription. Recognize the adaptations and their different applications in each subject; Assist the adapter/transcriber in preparing adaptations, considering their applicability in tactile reading. (CTRB, 2019, p. 71).
>
> Understand the Braille transcription process, the role of the transcriber, and the contributions of the revision work. Recognize the commands, settings, functionalities, and characteristics of the *Braille Fácil* and Monet software programs. (CTRB, 2019, p. 72).
>
> Recognize the Braille notation for the English language and the differences from our language. Recognize symbols used in English Braille (CTRB, 2019, p. 73).

These excerpts reflect much of the process of adaptation, revision, and printing in the Braille system, highlighting the essential role of two professionals who work in partnership: the transcriber and the Braille text reviser.

In this service scope, texts are produced considering the Braille Grade 1, 2, or 3. In Grade 1 Braille, each letter in a word is written out fully. In Grade 2, there are specific abbreviations for representing conjunctions, prepositions, pronouns, prefixes, suffixes, and commonly used letter groups. The primary goal of Grade 2 Braille is to minimize the volume of printed books in this system and to facilitate more efficient reading and writing. Grade 3 is characterized by a series of more complex abbreviations, requiring a deep knowledge of the system and well-developed tactile sensitivity from the visually impaired reader. (BRASIL, 2006). All this division is characterized as methodology and TA strategy.

In Brazil, as early as the 19th century, teachers and students at the Imperial Institute for Blind Boys were already concerned with the codification of Braille into an abbreviation system to facilitate text production. From 1920, blind teachers who created and used Braille abbreviations began to share them with their students. A little over two decades later, in 1942, Professor José Espínola Veiga from IBC developed a more structured abbreviation code, which in 1945 was regulated by Ministerial Ordinance No. 552, dated November 13, which governed the use of Braille, naming it "Official Braille for the Portuguese Language" (BRASIL, 2006).

Over the course of half a century, various discussions aimed to systematize Braille Grades 2 and 3, but it was only in 1999 that the Brazilian Braille Commission was created by the Ministry of Education (MEC). This effort culminated in 2000 with the signing of the Brazil/Portugal Collaboration Protocol in the Areas of Use and Application Modalities of the Braille System. The joint work of these two countries resulted in two publications: "Braille Notation for the Portuguese Language" (2002) and "Braille Notation for Informatics" (2005), which have been of great utility to

professionals and users of the Braille System in both countries and other Portuguese-speaking countries, both with updated versions (BRASIL, 2006). According to IBC,

> It is a system of extraordinary universality through which blind individuals can read and express themselves in all languages that use the Western alphabet, in the simplest and most practical way with the use of the slate and stylus, equivalent to pencil and paper
>
> Used by sighted individuals now also through existing technological supports, which, thanks to the development of information technology, have made communication increasingly inclusive for people with visual impairments. (2021, n.p., Authors' emphasis)

We observe a convergence between DICT (Digital Information and Communication Technology) and TA (Assistive Technology) through the use of computers to enable accessibility in communication and enhance functionality for individuals with visual impairments, thus characterizing it as TA. From the analysis of the Technology category, we identify the intertwining between ICT and TA and the dynamic nature of this process for users with visual impairments.

Final considerations

This study aimed to investigate how the concept of Assistive Technology (TA) was incorporated by the project developers and, consequently, by the Instituto Benjamin Constant (IBC), a pioneering institution for the education of individuals with visual impairments in Latin America, founded in 1854 and considered a national reference center in this field. The investigation focused on how TA is reflected in the Pedagogical Project of the Technical High School Course in Braille Text Review, exclusively for individuals with visual impairments.

We highlight the pioneering role of IBC in four aspects: (1) the use of a specific technology for the education of individuals with visual impairments, the Braille system, which has been employed since the school's founding in 1854; (2) the development of TA services in the typographic workshop since 1857 and more recently through the Division of Development and Production of Specialized Material; (3) the offering of Technical High School Courses exclusively for individuals with visual impairments, with the Technical Course in Braille Text Review being the first and only of its kind in Brazil; and (4) the offering of a Professional Master's Degree in Education focusing on Visual Impairment.

Regarding the Pedagogical Project of the Technical High School Course in Braille Text Review, we identified that TA was primarily addressed as a resource, leading to a simplification of the concept and not fully covering its other possibilities as proposed by the CAT. We emphasize that didactic resources, additional materials specifically for individuals with visual impairments, and specific adaptations for these students, present in the analyzed projects, are characterized as TA, even though they were not identified as such but only listed. We understand that this simplification is directly related to the formulation and systematization of the TA concept, which is still in the process of being effectively adopted by the interested groups.

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