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INCLUSIVE PROGRAMMING: TEACHING EXPERIENCE WITH DEAF STUDENTS AT EPES

PROGRAMAÇÃO INCLUSIVA: EXPERIÊNCIA DE ENSINO COM ESTUDANTES SURDOS NA EPES

PROGRAMACIÓN INCLUSIVA: EXPERIENCIA DE ENSEÑANZA CON ESTUDIANTES SORDOS EN LA EPES

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ABSTRACT: This article presents an account of a pedagogical experience developed at the School of Programming and Entrepreneurship of Saquarema (EPES), in partnership with Casa Brasil, aimed at including deaf students in programming education. The study sought to describe and analyze the pedagogical strategies employed by an instructor/teacher in teaching programming to deaf adolescents, highlighting actions that promoted accessibility, engagement, and equity of participation in a collaborative learning context. Among the resources used, the customization of block-based codes, manual representation, and visual mediation of abstract concepts stand out, applied through platforms such as Scratch and Thunkable. The analysis shows that inclusion in programming education requires didactic flexibility, sensitive listening, commitment to equity, ongoing training in Brazilian Sign Language (Libras), and the production of accessible materials that enhance the participation of deaf students in meaningful technological practices.

KEYWORDS: Computing. Deafness. Accessibility. Students. Teaching methodology.

RESUMO: *Este artigo apresenta um relato de experiência pedagógica desenvolvida na Escola de Programação e Empreendedorismo de Saquarema (EPES), em parceria com a Casa Brasil, voltada à inclusão de estudantes surdos no ensino de programação. O estudo teve como objetivo descrever e analisar as estratégias pedagógicas empregadas por uma Instrutora no ensino de programação para adolescentes surdos, destacando as ações que promoveram acessibilidade, engajamento e equidade de participação em um contexto de aprendizagem colaborativa. Entre os recursos utilizados, destacam-se a personalização de códigos em blocos, a representação manual e a mediação visual de conceitos abstratos, aplicados em plataformas como Scratch e Thunkable. A análise evidencia que a inclusão no ensino de programação requer flexibilidade didática, escuta sensível, compromisso com a equidade, formação continuada em Libras e produção de materiais acessíveis que ampliem a participação dos estudantes surdos em práticas tecnológicas significativas.*

PALAVRAS-CHAVE: *Computação. Surdez. Acessibilidade. Estudantes. Metodologia de ensino.*

RESUMEN: *Este artículo presenta un relato de una experiencia pedagógica desarrollada en la Escuela de Programación y Emprendimiento de Saquarema (EPES), en colaboración con Casa Brasil, orientada a la inclusión de estudiantes sordos en la enseñanza de programación. El estudio tuvo como objetivo describir y analizar las estrategias pedagógicas empleadas por una instructora/profesora en la enseñanza de programación a adolescentes sordos, destacando las acciones que promovieron la accesibilidad, el compromiso y la equidad en la participación dentro de un contexto de aprendizaje colaborativo. Entre los recursos utilizados, se destacan la personalización de códigos por bloques, la representación manual y la mediación visual de conceptos abstractos, aplicadas en plataformas como Scratch y Thunkable. El análisis evidencia que la inclusión en la enseñanza de programación requiere flexibilidad didáctica, escucha sensible, compromiso con la equidad, formación continua en Lengua de Señas Brasileña (Libras) y la producción de materiales accesibles que amplíen la participación de los estudiantes sordos en prácticas tecnológicas significativas.*

PALABRAS CLAVE: *Computación. Sordera. Accesibilidad. Estudiantes. Metodología de enseñanza.*

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INTRODUCTION

This article presents an experience report developed at the School of Programming and Entrepreneurship of Saquarema (EPES), in partnership with Casa Brasil, involving inclusive practices in the teaching of programming for deaf adolescents enrolled in mainstream classes. In a society undergoing constant digital transformation, in which emerging technologies reshape professions and generate new forms of social interaction, preparing young people for the present and the future requires more than mastery of specific techniques: it demands fostering curiosity, critical thinking, and the capacity to design innovative solutions.

In this context, digital inclusion goes beyond mere access to devices and technological resources. It represents an opportunity for agency, in which learning programming is linked to the development of an entrepreneurial mindset and to active participation in contemporary society (Kenski, 2012). When this perspective encompasses deaf students, the transformative impact is even greater: communication barriers are dismantled, individual talents are valued, and the assurance is strengthened that no one will be excluded from educational and professional opportunities in the twenty-first century.

However, despite the growing interest in training programs in programming and entrepreneurship for adolescents, the effective inclusion of deaf students in such environments remains a challenge. Many of these students face communication barriers and limited access to content in predominantly oral contexts, which can constrain their participation and creative expression. Thus emerges the central problem guiding this report: how to ensure the inclusion of deaf adolescents in digital learning projects, promoting equitable conditions for participation and authorship in programming activities?

EPES, inspired by UNESCO's guidelines for twenty-first-century education—"learning to know, to do, to live together, and to be" (Unesco, 2010, p. 31)—seeks to integrate digital inclusion, entrepreneurial thinking, and youth protagonism. To ensure that deaf students could participate actively in programming activities alongside their hearing peers, a specific pedagogical plan was developed, incorporating both communicational and methodological adaptations. Among the strategies implemented were the use of Brazilian Sign Language (Libras), lip-reading, accessible visual materials, and intuitive platforms such as Scratch and Thunkable, which facilitate comprehension through visuality and experimentation.

This approach enabled deaf adolescents to express their ideas, develop original projects, and collaborate with their classmates, thereby strengthening both autonomy and a sense of belonging within the group. Accordingly, the general objective of this article is to describe and analyze the pedagogical strategies employed by an EPES instructor in teaching programming to deaf adolescents, highlighting the actions that promoted accessibility, engagement, and equitable participation in a shared learning environment.

In addition to showcasing innovative practices in digital accessibility, the study seeks to contribute to the broader discussion on the inclusion of deaf students in technological education, indicating pathways for the development of pedagogical practices that uphold everyone's right to meaningful learning and creative expression in the digital world.

Inclusion and pedagogical mediation in programming education for deaf adolescents

Inclusive education has, over recent decades, consolidated itself as a fundamental human right and a central dimension of educational policy. According to Booth and Ainscow (2012), promoting inclusion involves transforming school cultures, policies, and practices so that all students actively participate in the learning process. It is an approach that recognizes differences as inherent to the human condition and proposes structural and curricular reorganization aimed at equity, accessibility, and belonging.

In the case of deaf students, educational inclusion involves challenges that go beyond mere physical presence in the classroom. Although Libras is essential for communication and for the construction of deaf identity, it presents limitations when it comes to expressing technical, scientific, and abstract terminology. Concepts in fields such as technology, mathematics, or programming often lack direct equivalents in Libras, which may create gaps in conceptual understanding and in the development of sequential reasoning. According to Nascimento (2009), the organization of morphemes in Libras reveals structural specificities inherent to its visual-spatial modality, distinguishing it from oral-auditory languages and influencing the ways in which thought and language interact. This characteristic may increase the complexity of mediating abstract concepts, especially in areas such as programming, which require mastery of logical and symbolic sequences.

Moreover, studies in the field of deafness indicate that deaf individuals tend to develop thinking processes that are more oriented toward the concrete than toward the abstract or hypothetical (Araújo, 2005; Chen, 2006; Marchesi, 2004). Given this characteristic, the use of visual instructional materials, illustrative diagrams, explanatory videos, and pictographic representations becomes essential, allowing deaf students to understand complex content and express their ideas meaningfully while fully engaging with the pedagogical mediation offered by the teacher.

According to Strobel (2008), full access to learning depends on pedagogical strategies that consider visuality as the structuring axis of the deaf experience. This implies creating teaching environments that value not only linguistic translation but also symbolic mediation through images, colors, movements, and spatial relations. For deaf adolescents, this type of

mediation broadens the possibilities for meaning-making and stimulates logical and creative thinking—fundamental aspects in programming education.

Pedagogical mediation, therefore, plays a central role in this process. Vygotsky (1998) emphasized that the development of higher psychological functions occurs through social interaction and through the mediation of symbolic tools. In contemporary contexts, these tools include digital resources and visual languages capable of bridging scientific knowledge with the sensory and cognitive experiences of learners. Thus, teaching practice must articulate multiple languages and instructional supports, ensuring that diverse learning modalities are addressed.

For Bacich and Moran (2018), the integration of digital technologies and active methodologies represents a promising path toward inclusive practices, as it shifts the focus from transmissive teaching to participatory learning. Digital environments that enable experimentation, collaboration, and creation—such as those involving block-based programming—foster meaningful understanding and the development of cognitive and socioemotional competencies. However, to make this effective for deaf students, accessible resources and materials that translate abstract concepts into concrete visual representations, intentionally mediated by the teacher, are indispensable.

According to Lacerda (2006), the inclusion of deaf students requires strengthening pedagogical mediation, which acts as a bridge between content, language, and the student's cultural context. This mediation goes beyond translation: it involves planning strategies that expand the understanding of scientific and technological concepts. In this sense, the creation of adapted instructional materials—such as infographics, animated diagrams, and visual tutorials—should not be seen as compensatory measures but as pedagogical actions that guarantee equity.

Inclusive education policy, as described by Oliveira (2005) and reaffirmed by Brazil (2008), presupposes structural and methodological changes within schools so that the student is included rather than merely integrated. This shift requires educational innovation throughout the system, fostering practices that enable collective engagement and promote social transformation. Inclusion, therefore, must be understood as a dynamic process that articulates the right to learn with the institutional duty to teach in accessible and meaningful ways.

Thus, programming education for deaf adolescents requires an approach that combines accessibility, creativity, and pedagogical mediation. Inclusive practices must enable these students to understand the foundations of computational logic, express their ideas through visual languages, and participate actively in collaborative projects. This pedagogical perspective breaks with the notion of minimal adaptation and proposes a learning model grounded in equity and innovation, in alignment with the goals of the United Nations 2030 Agenda (2015b), which advocates for quality, inclusive, and equitable education for all.

METHODOLOGY

This study is framed as an experience report, a qualitative research modality grounded in the description and reflective analysis of practices carried out in specific contexts of professional or social engagement. Qualitative approaches seek to understand phenomena in their complexity and meaning, emphasizing the perspectives of subjects and the contexts in which actions unfold. In this sense, experience reports constitute a legitimate methodological resource for systematizing educational practices, especially when connected to processes of social intervention and human development (Minayo, 2012).

According to Lüdke and André (2013), reporting pedagogical experiences enables the critical reconstruction of lived practice, fostering knowledge production grounded in practice and contributing to the advancement of reflections on teaching practice. Similarly, Gil (2019) highlights that this technique promotes the articulation between theory and practice by revealing strategies, challenges, and outcomes of actions implemented in educational contexts. Thus, the experience report becomes an investigative tool for sharing empirically constructed knowledge supported by an analytical and reflective lens.

The experience described herein was developed within a social project focused on Inclusive Programming education for deaf students at the Escola de Programação e Empreendedorismo de Saquarema (EPES). From this perspective, the report seeks to present the processes, pedagogical strategies, and accessible resources employed, as well as reflect on the learning outcomes and challenges faced during the activities. As Yin (2016) and Bardin (2011) assert, the systematization of concrete experiences allows for the identification of emerging analytical categories and contributes to consolidating innovative practices in the educational field.

Accordingly, this report adopts a descriptive-analytical approach in which practical experience is interpreted through theoretical frameworks related to inclusive education, communicational accessibility, and programming teaching methodologies, articulating theoretical foundations with empirical observations.

Context and Participants

EPES, in partnership with Casa Brasil and located in the Região dos Lagos, on the coast of Rio de Janeiro, Brazil, is an institution dedicated to fostering citizenship and providing professional training for young adolescents. The project consists of a training initiative designed to develop and educate youth from the age of 14 in programming languages with entrepreneurial applications in the municipality of Saquarema. The program spans 24 months, divided into four terms, and aims to deliver knowledge and adequate technical training to enable

the implementation of innovative ideas, support young people interested in programming in developing entrepreneurial competencies, and facilitate their entry into the job market. The initiative contributes to the consolidation of new ventures and local initiatives, strengthening the regional economy through the training of qualified professionals and capable managers.

The project currently serves 300 adolescents, supported by 14 instructors, one pedagogical coordinator, and one director. It also includes staff in reception, administrative services, and cleaning. In terms of infrastructure, the institution has five classrooms equipped with 12 computers each, in addition to an instructor's desk, a computer, and a TV screen for instructional support. The facilities also include an auditorium with capacity for approximately 100 people, a meeting room for teachers, an administrative office, a space called the "incubator," where instructors provide individualized support to students who experience difficulties in class, and a reception area. All facilities are located in the central region of Saquarema, inside a shopping mall, which ensures convenient parking for staff and a safe environment for students.

Ethical Aspects

Although this is an educational experience rather than an experimental research study, all activities were conducted in accordance with ethical principles governing work with human participants, ensuring confidentiality, free and informed consent, and protection of participants' identities, as established by Resolution No. 510/2016 of the National Health Council (Brasil, 2016). The project was reviewed and approved by the Ethics Committee of the Adventist University Center of São Paulo, under opinion No. 7.028.982 and CAAE 80618324.6.0000.5377.

An Experience Report

The experience described here was developed at EPES through innovative educational proposals focused on the development of competencies in technology and entrepreneurship. The institution serves students with diverse profiles, including those with disabilities, and has sought to implement pedagogical practices aligned with the principles of inclusion, accessibility, and student protagonism. The practice was carried out by an Instructor who worked directly with one of the Programming classes. Sensitive to the needs of students—particularly those with disabilities—the Instructor developed strategies that enabled the active participation of all learners, respecting their learning pace and communication needs. She describes how she experienced this process:

> As an Instructor, I had a transformative experience when I met two deaf students at EPES and recognized the need to adapt my classes to ensure their inclusion. I created colorful and dynamic visual materials to facilitate comprehension and active participation. The students' joy and engagement on the first day were deeply rewarding, demonstrating the value of inclusive pedagogical strategies. (EPES Instructor, 2025)

In this program, two deaf students took part in the activities. The first, identified in this report as Lucas (a fictitious name), is 16 years old, has partial deafness, and uses a hearing device. He demonstrates excellent comprehension through lip-reading and follows the classes independently, without the need for a Libras interpreter. The second student, referred to as Rafael (also a fictitious name), is 17 years old, has profound deafness, and does not use oral communication or lip-reading; his primary mode of interaction is Libras, mediated by an interpreter. For this student, the use of adapted and visually structured materials is essential for following class content and completing proposed tasks.

The Instructor began by carefully observing each student's communication profile. Based on this, she developed strategies that prioritized visual clarity in content presentation, such as hand-drawn illustrative block diagrams, slides with explicit organizational logic, and supportive graphic resources. According to the EPES Instructor (2025), "*Personalizing the lessons with hand-drawn materials was essential to ensuring the inclusion of deaf students in programming*." These adjustments facilitated comprehension of the concepts taught in class and strengthened the engagement and participation of the deaf students.

Several meaningful moments emerged throughout the process. At first, the Instructor expressed concern about the students' difficulties in understanding the content, particularly Rafael. As the interventions progressed, both students began to follow the lessons more effectively, displaying greater confidence, involvement, and satisfaction with their learning. The experience highlighted the importance of sensitive listening and pedagogical adaptation in inclusive teaching processes, particularly in fields such as programming, which are traditionally considered challenging for students with disabilities.

In this regard, Mantoan (2003) argues that school inclusion requires acknowledging differences as inherent elements of the educational process, which implies transforming traditional pedagogical practices and breaking with exclusionary models. Similarly, Sassaki (2010) emphasizes that inclusion materializes through pedagogical actions that eliminate learning barriers and ensure full access to the curriculum, requiring teachers to adopt a reflective posture, active listening, and a commitment to educational equity.

Description of the Experience

The starting point of the inclusive process for the two deaf students occurred during a class activity involving the use of the Scratch application—a block-based programming language similar to a building game, commonly used for creating games. Scratch is a visual programming platform developed by the MIT Media Lab, using colorful interlocking blocks to represent commands and logical structures. Unlike traditional text-based programming languages, Scratch offers an intuitive interface that resembles puzzle pieces, facilitating comprehension of fundamental programming concepts.

The block structure is organized into distinct categories, identified by colors, such as motion, looks, sound, events, control, sensing, operators, and variables. Each block has a specific function and can be connected to others, forming logical sequences known as scripts. These scripts run in a top-to-bottom order, allowing users to immediately visualize the effects of their instructions on the project's characters (sprites) and scenarios. This programming format promotes learning through experimentation, as users can test, adjust, and refine their sequences in real time, thereby developing problem-solving skills and logical thinking.

In educational settings, Scratch's block-based programming serves as an accessible resource for beginner students. Employing a visual language minimizes dependence on written text, enabling all learners to understand how commands operate and actively participate in the creation of interactive projects, games, and animations.

In this context, the first project created by the class was *Runner x Bot*, in which the students themselves designed the characters and their interactions. In the game, the robot moves in a disjointed manner, and the player must dodge it to avoid being hit, thereby preventing the loss of lives or points. To ensure proper functioning, the codes were carefully organized in blocks within the application, guaranteeing full playability. Figure 1 below illustrates this structure.

Figure 1
Runner x Bot

Note. Tech4Me Teaching Material.

During the development of the activities, the Instructor noticed that, although the content was available in the material provided to the class, the deaf students experienced difficulties in understanding how the block-based programming underlying the games functioned. This finding highlighted the need to adjust the pedagogical approach in order to ensure the full participation of these students in the creation process. The Instructor confirms this context by reporting:

> I was in the classroom, using the Scratch application with the students, when I realized that the deaf students were facing some difficulty in understanding how the blocks worked. Even though the content was right there, something seemed to be missing… something that would make comprehension clearer, faster, and more accessible so that the games would function properly. (EPES Instructor, 2025)

This observation led the Instructor to reassess her pedagogical practice. Upon returning home, she sought to translate the digital and abstract language of the blocks used in the application into a more accessible format for the students, creating physical and visual representations using paper, colored pencils, and chromatic categorization. As she explained: "I transformed digital and abstract content into something physical, concrete, and visually organized. Because I knew that if they had this material in their hands, they could review it on their own, at their own pace, with greater autonomy" (EPES Instructor, 2025).

The material produced by the Instructor, although simple, became essential to the deaf students' learning process. The game was built step by step by the group of learners, and each stage was presented in PowerPoint slides. However, for the deaf students, this stepwise organization hindered their understanding of the process. To overcome this barrier, the Instructor reproduced each stage on individual sheets of paper, arranging them into a single continuous sequence. This resource enabled the students to visualize the entire chain of project phases, facilitating their understanding of concepts that previously had seemed nearly impossible to follow.

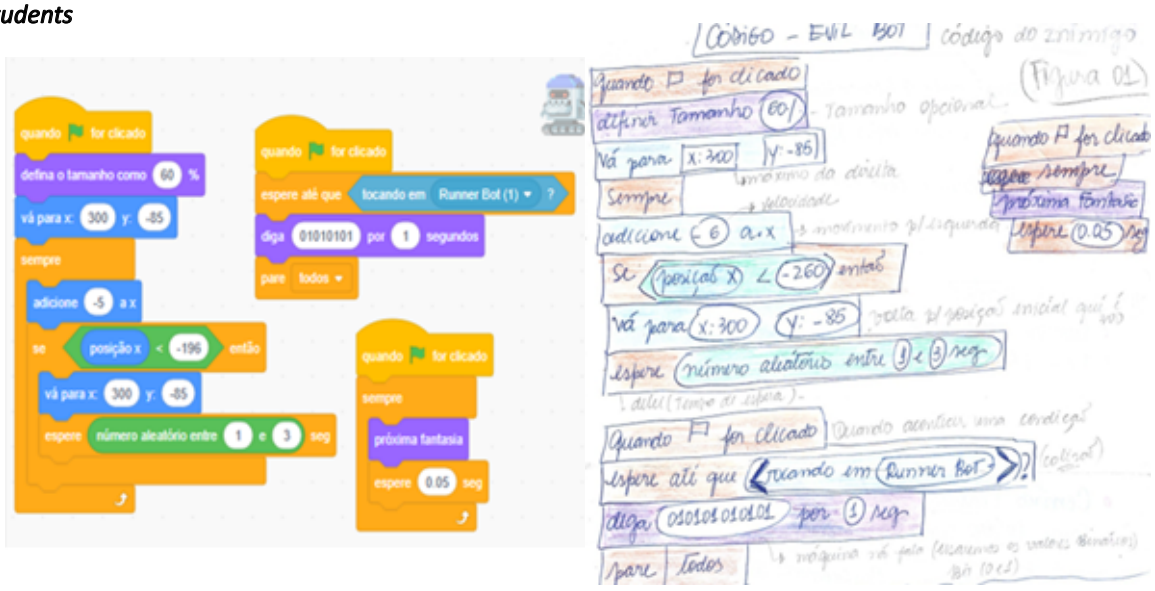
This initiative aligns with the principles of inclusive pedagogical practices, which advocate for adapting instructional resources to accommodate different learning styles and rhythms (Almeida & Monteiro, 2023). Figure 2 below illustrates the Instructor's proposed adjustment to her teaching strategy.

Figure 2
First code of the Runner x Bot game from the adopted material and the adaptation for use by deaf students

Note. Tech4Me Teaching Material and Instructor's elaboration.

After using the code developed by the Instructor (Figure 3), the students were challenged with additional activities that, besides assessing their understanding of the content, contributed to the consolidation of their learning.

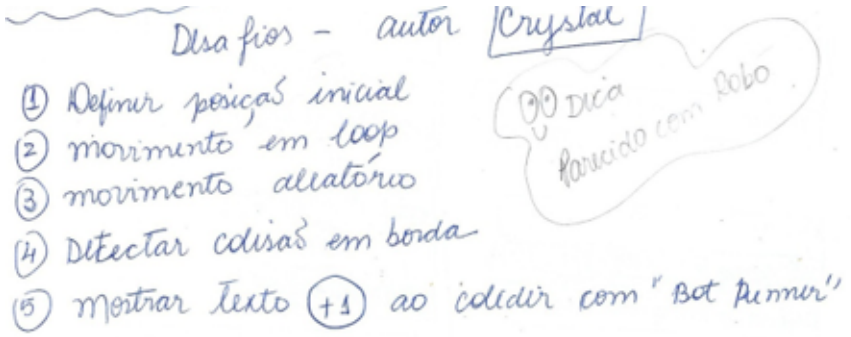
Figure 3
Second code of the Runner x Bot game from the adopted material, and the version developed for use by deaf students



Note. Tech4Me Teaching Material and Instructor's elaboration.

This stage prepared the group for the second product developed, which aimed to ensure the active participation of deaf students and expand their opportunities for interaction with programming. As part of the challenge, the class was invited to define the character's initial position, create random movements, and program the detection of collisions at the edges of the game. The enthusiasm demonstrated by the students during this activity highlighted the motivating potential of the pedagogical approach. Figure 4 shows how the Instructor defined the assessment instruments for the learning of the two deaf students.

Figure 4
Challenges proposed to deaf students as a learning assessment instrument



Note. Instructor's elaboration.

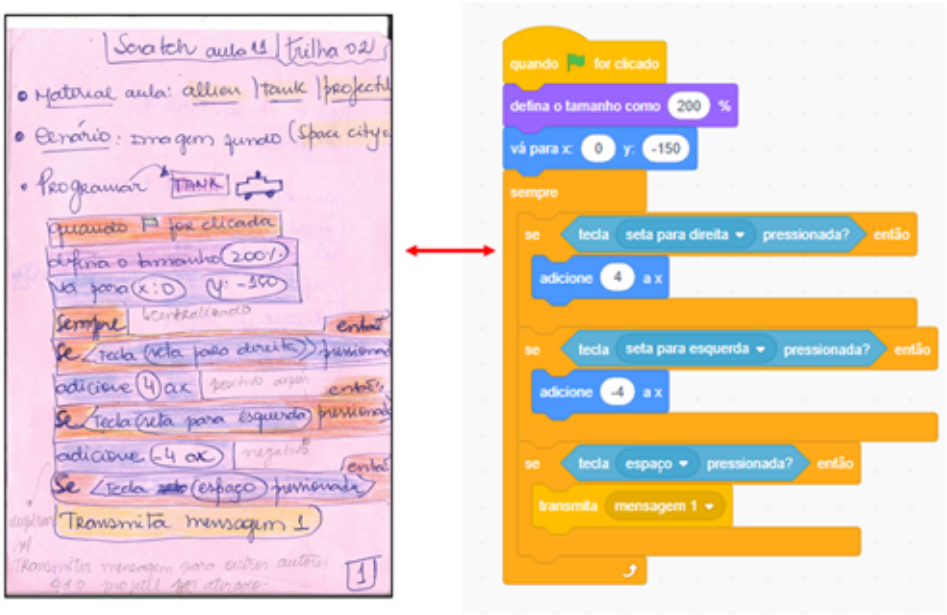
Subsequently, the *Alien Invasion* game was developed using the Scratch programming language. In this game, the spaceship must eliminate the aliens descending in a straight line, and the match ends if any of them reach the bottom of the screen. The activity required attention, strategic planning, and the application of programming logic concepts, contributing to the development of cognitive and socioemotional skills throughout the learning process.

Figure 5
Alien Invasion game developed in Scratch

Note. Tech4Me Teaching Material.

With the development of the new game, the Instructor created a new code specifically designed to promote the active participation and interaction of deaf students in the teaching–learning process. This approach enabled students to engage hands-on with programming, fostering both conceptual understanding and peer collaboration, while ensuring inclusion and student protagonism in the educational environment. Figure 6 presents the code developed by the Instructor for the *Alien Invasion* game in Scratch, designed for use by deaf students.

Figure 6
Code for the Alien Invasion game developed in Scratch for use by deaf students



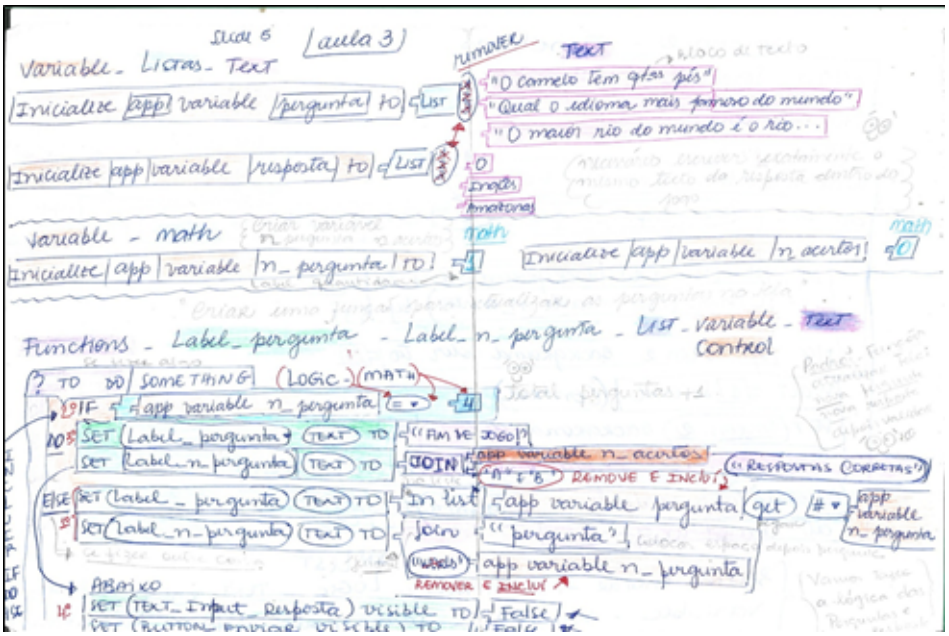
Note. Tech4Me Teaching Material and Instructor's elaboration.

Student understanding and engagement were further enhanced during a lesson using the Thunkable application, which enables the creation of mobile applications (Android and iOS) through block-based visual programming, representing logical commands and functions, thus facilitating programming learning, especially for beginners.

During the lesson, the focus was on teaching students how to assemble and organize the blocks, ensuring the logical structure required for the proper functioning of the applications. Although the visual approach is pedagogically effective, the deaf students faced specific comprehension challenges, highlighting the need for communication adjustments and pedagogical mediation to ensure accessibility and full understanding of the content. Figures 7 and 8 present the block configuration in Thunkable for the development of the Quiz Questions and Answers application, manually represented on bond paper by the Instructor to facilitate understanding and use by the deaf students.

Figure 7

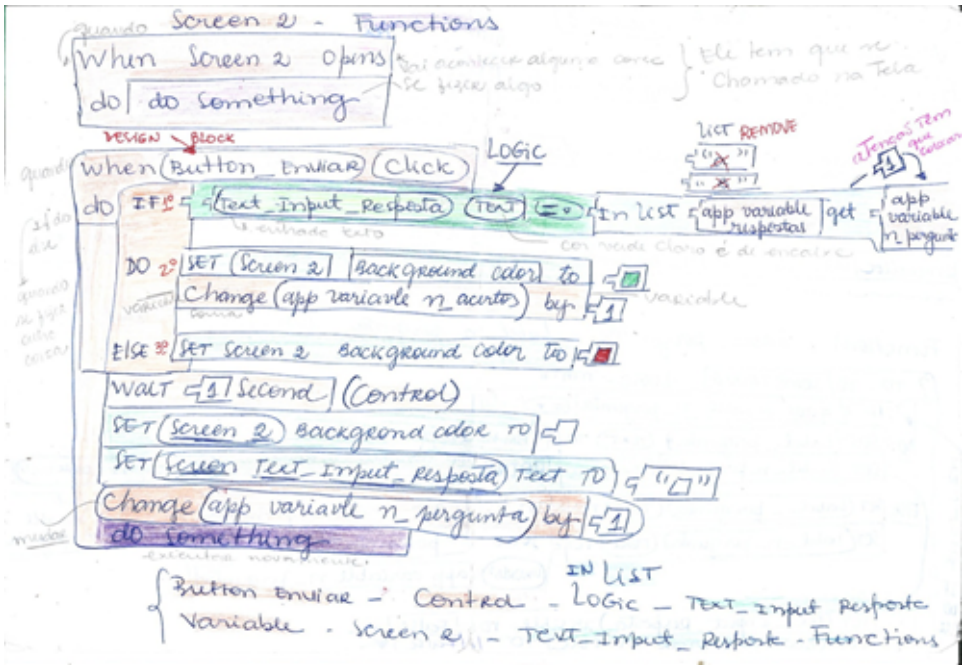
First part of the block configuration of the Quiz Questions and Answers application developed in Thunkable



Note. Instructor's elaboration.

Figure 8

Second part of the block configuration of the Quiz Questions and Answers application developed in Thunkable



Note. Instructor's elaboration.

The methodological decision to convert digital and abstract content into a physically structured and manually organized resource aligns with the concept of adapted pedagogical mediation, as discussed by Lima et al. (2025). This process consists of developing materials based on students' communicative needs, ensuring conditions for their active participation, and strengthening their protagonism in the learning process.

However, this initial adaptation was not without challenges. The Instructor reports: "To be very honest… I froze. I was genuinely afraid. I didn't know Libras, I didn't know how to communicate with them, nor where to start. I felt distant, somewhat lost" (EPES Instructor, 2025). This experience of insecurity in the face of communication barriers is common among teachers who have not yet mastered Libras (Guimarães & Cruz, 2021). Even so, motivated by the need for inclusion, the Instructor sought alternatives, preparing and applying adapted materials to facilitate the participation of deaf students in her classes. She also counted on the support of a teacher in Libras training, which strengthened communication and rapport among everyone involved, constituting a fundamental strategy for promoting inclusion in the school environment.

With the implementation of the visual material, the relationship between the Instructor and the deaf students was transformed, fostering both engagement and comprehension of the content. This proactive stance aligns with the findings of Seno (2009), who, after interviewing 34 teachers from a municipal school system in São Paulo who taught students with hearing loss, observed that although most expressed insecurity and concern—mainly due to the lack of specific training—few were able to convert these challenges into concrete actions for pedagogical adaptation. In this sense, the Instructor's case demonstrates that, despite initial barriers, it is possible to implement strategies that expand learning and participation opportunities for all students.

This experience not only strengthened the strategies adopted but also encouraged the Instructor to reflect on her own challenges and continuing education needs. As she stated: "I intend to begin a Libras course, not only to teach better, but also to learn from them. True inclusion happens when we genuinely commit ourselves" (EPES Instructor, 2025). This posture reflects an ongoing commitment to effective inclusion, recognizing that the process requires openness to mutual learning and constant adjustments.

Thus, the case demonstrates that inclusion in programming education goes beyond content adaptation; it requires an openness to new ways of teaching and learning, capable of respecting the uniqueness of each student (Jesus & Effgen, 2012; Dantas & Guerra, 2024). The Instructor's practice reinforces the importance of strategies that transform materials into accessible resources aligned with the rhythms, languages, and interaction styles of the students. This continuous commitment to professional development and pedagogical adaptation becomes essential for ensuring genuine and effective inclusion.

Critical reflection on the practice

The experience reported here was developed at EPES through innovative educational initiatives focused on building competencies in the areas of technology and entrepreneurship. The institution serves students with diverse profiles, including students with disabilities, and has sought to implement pedagogical practices aligned with the principles of inclusion, accessibility, and youth protagonism. The practice was conducted by one of the Instructors, who worked directly with a class in the Programming track. Attentive to the needs of the students—particularly those with disabilities—the Instructor developed strategies that enabled the active participation of all learners, respecting their learning rhythms, potentialities, and communication modes.

The pedagogical practice analyzed demonstrates strong alignment between theory and action, especially regarding the principles of inclusive education and active methodologies. The adaptation of digital content through the creation of physical visual materials corroborates the concept of adapted pedagogical mediation described by Lima et al. (2025), which emphasizes the importance of considering students' communicational needs to promote effective participation. This approach is consistent with the understanding of deafness as a linguistic and cultural difference (Quadros & Karnopp, 2004), requiring teachers to adopt flexible and sensitive listening practices capable of responding to the singularities of each student (Mantoan, 2003; Sassaki, 2010).

The Instructor's account highlights several positive aspects, such as the personalization of didactic resources, which facilitated understanding and engagement among the deaf students. Transforming abstract digital content into concrete and colorful representations allowed the students to exercise autonomy, revisit materials at their own pace, and engage according to their learning styles and communication modes. This aligns with the inclusive pedagogical practices recommended by Lima et al. (2025). Another positive element was the support of a teacher in Libras training, which enhanced communicational mediation and strengthened the rapport between teachers and students, mitigating the initial insecurities reported by the Instructor—a situation frequently observed according to Dantas and Guerra (2024).

However, the experience also reveals limits and challenges that must be addressed. The linguistic barrier, particularly for students who rely fully on Libras, demands ongoing and in-depth teacher training not only for language mastery but also for the development of culturally relevant pedagogical practices (Guimarães & Cruz, 2021). The Instructor's willingness to learn Libras represents an important step, yet it underscores the institutional need for structured support for professional development and accessible resources. In addition, the separation of the two deaf students and changes in class schedules exposed the fragility

of the connections established and the importance of maintaining continuity in inclusive strategies.

Regarding the relationship between theory and practice, the experience at this institution reinforces that educational inclusion goes beyond mere material adaptation; it requires a reflective stance, ethical commitment, and the recognition of diversity as an enriching element in the educational process (Mantoan, 2003; Sassaki, 2010). The case confirms that programming education, when mediated by accessible and participatory strategies, can help reduce the social and technological inequalities that characterize contemporary society (Brown & Duguid, 2017). Thus, innovative and inclusive pedagogical practices such as those implemented at EPES are fundamental for the holistic development of young people and for building a more just and equitable society.

Finally, this analysis highlights the need to strengthen the dialogue between technological education and inclusive education, encouraging the creation of active methodologies that take into account the cultural, linguistic, and cognitive specificities of students with disabilities, ensuring their protagonism, autonomy, and full inclusion in both school and social contexts.

FINAL CONSIDERATIONS

The experience developed within this social project demonstrated the importance of pedagogical adaptation and communicational mediation for the effective inclusion of deaf students in programming education. Among the main insights, the findings highlight the need to develop visually accessible and concrete didactic resources that respect students' learning rhythms and linguistic particularities, as well as the relevance of sensitive listening and methodological flexibility to foster engagement and autonomy. Moreover, collaborative work between teachers and Libras interpreters proved essential for overcoming communication barriers and strengthening meaningful connections throughout the educational process.

The relevance of this practice extends beyond the EPES context, offering valuable guidance for other educational institutions seeking to promote the inclusion of students with disabilities in technological fields and complex learning processes. The experience aligns with the principles of inclusive and technological education, indicating that combining active methodologies with specific adaptations can expand opportunities for participation and youth protagonism, even in challenging environments.

For the continuity of the project and its replication in other contexts, it is recommended that institutions invest in ongoing teacher training, particularly in Libras proficiency and inclusive pedagogical strategies. It is also advisable to develop and share adapted didactic

materials that can serve as references across different settings. Finally, establishing partnerships between schools, communities, and specialized organizations can strengthen efforts toward educational equity and ensure full curricular access for students with diverse educational needs.

REFERENCES

Almeida, M. A., & Monteiro, F. O. (2023). O papel do professor de apoio na construção de práticas inclusivas. In E. G. Mendes (Org.), *Práticas inclusivas inovadoras no contexto da classe comum: Dos especialismos às abordagens universalistas* (1.ª ed.). Encontrografia. https://doi.org/10.52695/978-65-5456-043-6

Araújo, M. A. N. (2005). A estruturação da linguagem e a formação de conceitos na qualificação de surdos para o trabalho. *Psicologia: Ciência e Profissão*, *25*(2), 240–251. https://doi.org/10.1590/S1414-98932005000200007

Bacich, L., & Moran, J. (2018). *Metodologias ativas para uma educação inovadora*. Penso.

Bardin, L. (2011). *Análise de conteúdo*. Edições 70.

Booth, T., & Ainscow, M. (2012). *Index para a inclusão: Desenvolvendo a aprendizagem e a participação na escola* (M. P. Santos, Trad.). Unesco/CSIE. https://proinclusao.ufc.br/wp-content/uploads/2020/05/index-para-a-inclusao.pdf

Brasil. Ministério da Educação, Secretaria de Educação Especial. (2008). *Política Nacional de Educação Especial*. Diário Oficial da União. https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2025/decreto/d12686.htm#:~:text=Art.%201%C2%BA%20Fica%20institu%C3%ADda%20a,com%20base%20na%20igualdade%20de

Brasil. Conselho Nacional de Saúde. (2016). *Resolução nº 510, de 7 de abril de 2016: Dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais*. Diário Oficial da União. https://www.gov.br/conselho-nacional-de-saude/pt-br/atos-normativos/resolucoes/2016/resolucao-no-510.pdf/view

Brown, J. S., & Duguid, P. (2017). *The social life of information*. Harvard Business Review Press.

Chen, K. (2006). Math in motion: Origami math for students who are deaf and hard of hearing. *The Journal of Deaf Studies and Deaf Education*, *11*(2), 262–266. https://doi.org/10.1093/deafed/enj019

Dantas, M. K. N. S., & Guerra, M. J. (2024). Desafios e perspectivas na formação docente para avaliação do aprendizado de estudantes surdos em leitura. In *Anais do X Congresso Nacional de Educação (Formação de Professores)*. https://doi.org/10.46943/X.CONEDU.2024.GT01.108

Gil, A. C. (2008). *Métodos e técnicas de pesquisa social* (6.ª ed.). Atlas.

Guimarães, U. A., & Cruz, R. C. V. (2021). Os desafios da inclusão de Libras no contexto educacional: Revisão de literatura. R*evista Científica Multidisciplinar Núcleo do Conhecimento*, *12*(2), 75–91. https://www.nucleodoconhecimento.com.br/educacao/inclusao-de-libras

Jesus, D. M., & Effgen, A. P. S. (2012). Formação docente e práticas pedagógicas: Conexões, possibilidades e tensões. In T. G. Miranda & T. A. Galvão Filho (Orgs.), *O professor e a educação inclusiva: Formação, práticas e lugares* (pp. 17–24). EDUFBA. https://repositorio.ufba.br/handle/ri/12005

Kenski, V. M. (2012). *Educação e tecnologias: O novo ritmo da informação* (141 p.). Papirus.

Lacerda, C. B. F. de. (2006). A inclusão escolar de alunos surdos: O que dizem alunos, professores e intérpretes sobre esta experiência. *Cadernos CEDES*, *26*(69), 163–184. https://doi.org/10.1590/S0101-32622006000200004

Lima, A. O., Damasco, C. A. R., Silva, D. M., & Rodrigues, J. (2025). A educação inclusiva e o papel do professor na mediação pedagógica: Formação e desafios. *Ciências da Educação: Pesquisas, Formação de Professores/as e Docência na Educação Básica*, *12*(3). https://revista.unitins.br/index.php/humanidadeseinovacao/article/view/10735

Lüdke, M., & André, M. E. D. A. (2013). *Pesquisa em educação: Abordagens qualitativas* (2.ª ed.). EPU.

Mantoan, M. T. E. (2003). *Inclusão escolar: O que é? Por quê? Como fazer?* Moderna.

Marchesi, A. (2004). Da linguagem da deficiência às escolas inclusivas. In C. Coll, A. Marchesi, & J. Palácios, *Desenvolvimento psicológico e educação: Necessidades educativas especiais e aprendizagem escolar* (2. ed., v. 3). Artmed. https://cinead.org/wp-content/uploads/2021/11/da-linguagem-das-deficiencias-a-educacao-inclusiva.pdf

Nascimento, S. P. de F. do. (2013). A organização dos morfemas livres e presos em LSB: Reflexões preliminares. In R. M. Quadros, M. Stumpf, & T. A. Leite (Orgs.), *Língua de sinais* (pp. 65–82). Artmed.

Minayo, M. C. S. (2014). *O desafio do conhecimento: Pesquisa qualitativa em saúde* (14.ª ed.). Hucitec.

Oliveira, I. A. de. (2004). *Saberes, imaginários e representações na educação especial: A problemática ética da "diferença" e da inclusão social* (2. ed.). Vozes.

Organização das Nações Unidas. (2015). *Transformando nosso mundo: A Agenda 2030 para o desenvolvimento sustentável*. https://sc.movimentoods.org.br/agenda-2030/

Quadros, R. M. de, & Karnopp, L. B. (2004). *Língua de sinais brasileira: Estudos linguísticos*. Artmed.

Sassaki, R. K. (2010). *Inclusão: Construindo uma sociedade para todos* (7.ª ed.). WVA.

Seno, M. P. (2009). A inclusão do aluno com perda auditiva na rede municipal de ensino da cidade de Marília. *Psicopedagogia*, *26*(81), 376–387. https://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S0103-84862009000300005&lng=pt&nrm=iso&tlng=pt

Strobel, K. L. (2008). *Surdos: Vestígios culturais não registrados na história* [Tese de doutorado, Universidade Federal de Santa Catarina, Centro de Ciências da Educação]. Repositório da UFSC. http://repositorio.ufsc.br/xmlui/handle/123456789/91978

UNESCO. (2010). *Educação: um tesouro a descobrir* (Relatório da Comissão Internacional sobre Educação para o Século XXI). UNESCO Digital Library.

Vygotsky, L. S. (1998). *A formação social da mente*. Martins Fontes.

Yin, R. K. (2016). *Pesquisa qualitativa do início ao fim*. Penso.

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