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INCLUSIVE DIGITAL EDUCATION FOR PEOPLE WITH
VISUAL AND HEARING IMPAIRMENTS:
PERSPECTIVES IN SHARED LEARNING ENVIRONMENTS

EDUCACIÓN DIGITAL INCLUSIVA PARA PERSONAS
CON DISCAPACIDAD VISUAL Y AUDITIVA:
PERSPECTIVAS EN ENTORNOS COMPARTIDOS
DE APRENDIZAJE



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INCLUSIVE DIGITAL EDUCATION FOR PEOPLE WITH VISUAL AND HEARING IMPAIRMENTS: PERSPECTIVES IN SHARED LEARNING ENVIRONMENTS

EDUCACIÓN DIGITAL INCLUSIVA PARA PERSONAS CON DISCAPACIDAD VISUAL Y AUDITIVA: PERSPECTIVAS EN ENTORNOS COMPARTIDOS DE APRENDIZAJE

ABSTRACT

Education must be guaranteed under the principles of human dignity and substantive equality, ensuring real conditions of access, retention, participation, and learning for all. In this context, educational institutions have moved toward more inclusive models by incorporating pedagogical strategies and using digital environments. However, these efforts are insufficient if equitable access is not guaranteed for students with visual and hearing impairments. Faced with this challenge, the integration of Inclusive Digital Applications takes on a strategic role by facilitating communication, reducing technological barriers, and promoting effective participation in educational processes. People with sensory disabilities have the right to equivalent opportunities for academic training and skills development, tailored to their specific needs. Achieving this equity involves transforming traditional teaching and learning practices, adapting resources and teaching materials, and designing accessible content from a universal design perspective. It also requires the participation of teachers, students, and educational authorities in the development of inclusive activities. This process requires strengthening institutional communication, consolidating accessible digital environments, and recognizing the dignity and learning paces of people with disabilities.

Keywords: digital education, digital inclusion, digital applications

RESUMEN

La educación debe garantizarse bajo los principios de dignidad humana e igualdad sustantiva, asegurando condiciones reales de acceso, permanencia, participación y aprendizaje para todas las personas. En este contexto, las instituciones educativas han avanzado hacia modelos más incluyentes mediante la incorporación de estrategias pedagógicas y el uso de entornos digitales. Sin embargo, estos esfuerzos resultan insuficientes si no se garantiza un acceso equitativo para los estudiantes con discapacidad sensorial visual y auditiva. Frente a este desafío, la integración de Aplicaciones Digitales Inclusivas adquiere un papel estratégico al facilitar la comunicación, reducir barreras tecnológicas y promover una participación efectiva en los procesos educativos. Las personas con discapacidad sensorial tienen derecho a oportunidades equivalentes de formación académica y desarrollo de competencias, ajustadas a sus necesidades específicas. Lograr esta equidad implica transformar las prácticas tradicionales de enseñanza y aprendizaje, adaptar recursos y materiales didácticos, y diseñar contenidos accesibles desde un enfoque de diseño universal. Asimismo, requiere la participación de docentes, estudiantes y autoridades educativas en la construcción de actividades inclusivas. Este proceso demanda fortalecer la comunicación institucional, consolidar entornos digitales accesibles y reconocer la dignidad y los ritmos de aprendizaje de las personas con discapacidad.

Palabras clave: educación digital, inclusión digital, aplicaciones digitales

1. INTRODUCTION

Visual and hearing impairment encompasses sensory disorders that affect how people perceive and process information from their surroundings. Visual impairment can manifest as blindness or low vision, either congenital or acquired, and affects activities such as mobility, reading, and access to visual information. Hearing impairment, on the other hand, involves partial or total loss of hearing, which affects oral communication, language development, and social interaction, creating barriers that require specific support and assistive technologies.

In this context, inclusive digital education (IDE) promotes respect for diversity, human dignity, and equal opportunities through accessible digital environments. Its purpose is to guarantee the right to education not only for people with sensory disabilities, but for the entire educational community, by promoting more flexible and equitable teaching practices. The incorporation of accessible technologies and Inclusive Digital Applications (IDA) reduces historical barriers and strengthens educational participation.

This document analyzed the experiences and perceptions of people with and without disabilities in a university community and a specialized care center, focusing on the use of ADIS and accessibility conditions in digital environments. The objective of EDI is for society to learn about and use tools that facilitate communication, teaching, and learning with people with sensory disabilities, ensuring equal opportunities and socially responsible educational practices.

1.1. General Law on Higher Education in Mexico

The General Law on Higher Education in Mexico establishes specific obligations to guarantee inclusive education. Article 4 states that the State must implement policies that ensure access to higher education based on criteria of equity and inclusion; Article 6 defines reasonable accommodations as the modifications necessary to guarantee access, retention, and graduation for students with disabilities. Likewise, the General Provisions, section XXII, establish the obligation to implement affirmative actions that favor access, retention, continuity, and timely graduation of students with disabilities (Cámara de Diputados del Heroico Congreso de la Unión, 2021).

1.2. General Law for the Inclusion of persons with disabilities

This law establishes the principles for ensuring equitable access to education and full participation in educational settings. Article 12 mandates the Ministry of Public Education (SEP) to ensure the right to education for persons with disabilities, prohibiting any form of discrimination. Article 14 recognizes Braille, Mexican Sign Language, and other accessible formats as valid means of communication. Article 15 determines that special education must avoid situations of backwardness, dropout, and discrimination, while Article 13 requires public libraries to have accessible technologies and materials (Cámara de Diputados del Heroico Congreso de la Unión, 2024).

1.3. Inclusive digital education

IDE is an educational transformation process that integrates digital technologies to ensure equity, accessibility, and full participation. This approach recognizes that digitization without inclusive criteria can deepen inequalities. Therefore, platforms, content, and methodologies must be designed from the outset based on principles of universal accessibility, promoting digital environments that expand learning opportunities (Weber et al., 2022).

1.4. Disability

Disability arises from the interaction between physical, mental, intellectual, or sensory impairments and social, technological, or environmental barriers that limit participation on an equal basis (Organización Panamericana de la Salud [OPS], 2025), recognizing its social and structural nature. In this regard, one in three people with disabilities has experienced discrimination, which affects areas such as education and access to services. These barriers are exacerbated when digital environments lack universal accessibility, particularly impacting people with visual and hearing impairments.

1.4.1. Visual impairment

Visual impairment encompasses conditions that affect total or partial vision. The World Health Organization (WHO) clasificó la función visual en visión normal, discapacidad moderada, grave y ceguera, agrupando las dos primeras como baja visión. Malta (2025) reported mild limitations to total blindness, either congenital or acquired. In the educational field, they require accessible materials, assistive technologies, and platforms that are compatible with accessibility standards.

1.4.2. Hearing impairment

Hearing impairment affects the ability to perceive sounds, ranging from partial hearing loss to profound deafness. People face particular barriers in educational and digital environments when content does not incorporate supports such as subtitles, Mexican Sign Language (MSL) interpretation, simultaneous transcription systems, or visual communication options. The lack of these resources can limit the understanding of information, interaction in synchronous activities, and effective participation in academic spaces. Within the framework of IDE, it is essential that platforms, audiovisual resources, and assessment methods be designed with specific needs in mind, ensuring that communication is accessible and that the educational environment does not reproduce gaps of exclusion. (Hernández-Suárez & Márquez Ramos, 2013).

1.5. Sensory accessibility systems and languages

Sensory accessibility systems and languages are key resources for ensuring communication, learning, and equal participation for people with visual and hearing impairments in inclusive educational environments.

1.5.1. Mexican Sign Language

Sign language is a fully human language, with its own grammatical structures, complex syntactic rules, and an expressive capacity that allows for the communication of abstract ideas, emotions, and specialized knowledge (Serafín de Fleischmann & González Pérez, 2011). Its importance transcends its communicative function, as it represents a central element of the sociocultural identity of deaf communities and the means by which they access learning, social interaction, and full participation in different areas of life. From this perspective, sign language must be recognized as the basis for ensuring inclusive and culturally relevant educational processes, especially in digital environments where linguistic accessibility is indispensable (Cruz-Aldrete, 2024).

1.5.2. Braille system

The Braille system is a tactile reading and writing method that allows people with visual impairments to independently access written information. Based on a matrix of six raised dots, it enables the representation of letters, numbers, mathematical, scientific, and musical symbols, and is essential for literacy and educational participation. In addition to its technical function, Braille strengthens independence and social inclusion. In inclusive digital environments, its effectiveness is enhanced by assistive technologies such as electronic Braille displays and haptic devices, which promote educational access for people with low vision or blindness.

2. METHOD OF RESEARCH

For this research, a mixed exploratory-transversal approach was adopted, aimed at identifying, characterizing, and analyzing the conditions, perceptions, and practices associated with IDE for people with visual and hearing impairments in educational contexts mediated by digital technologies. The study was structured around two distinct perspectives: the first reflects the opinions of people with visual and hearing impairments in their capacity as students, and the second reflects those of the rest of the community that makes up their educational environment and shares the same academic setting.

In order to address the social phenomenon from a comprehensive perspective, two surveys (E1 and E2) were conducted, each organized around four analytical dimensions, which made it possible to measure aspects

related to knowledge, accessibility, experience of use, and application of the regulatory framework. Demographic data were also collected on educational level, educational institution, age, gender, type, and level of disability (Table 1).

Table 1

Dimensions by survey

Dimension	Survey aimed at people with disabilities (E1)	Survey aimed at people without disabilities (E2)
1	Knowledge about inclusive digital applications: Identifies the level of knowledge, familiarity, and willingness to learn about inclusive digital applications among people with visual and hearing impairments.	Knowledge and perception of inclusive digital applications: Identifies the level of knowledge and appreciation of inclusive digital applications, as well as their usefulness for integration and collaboration with people with visual and hearing impairments.
2	Accessibility to digital technologies: Analyzes perceptions of accessibility, usability, and suitability of digital learning equipment, resources, and objects, as well as institutional availability of inclusive technologies..	Inclusive training and communication skills: Analyzes the training experience, interest, and communication skills needed to interact effectively with people with disabilities, and perceptions about the need for inclusive training.
3	Inclusive experience and learning challenges. Examine the conditions that influence the educational experience, including pedagogical and organizational barriers, as well as the existence of support and inclusion strategies..	Collaborative and inclusive interaction experience: Examines coexistence, academic collaboration, and shared responsibility for inclusion within the classroom and in group activities.
4	Awareness of institutional obligations and digital rights: Explore knowledge and perceptions of institutional actions and the regulatory framework that guarantee the right to IDE.	Awareness of institutional obligations and digital rights: Explore perceptions of institutional preparedness, practices, and resources available to ensure IDE.

In addition, the operationalization of the dimensions was established using indicators (Table 2).

Table 2*Indicators by dimension*

Dimension	Survey aimed at people with disabilities (E1)	Survey aimed at people without disabilities (E2)
1	<p>Indicators:</p> <p>Contribution of ADIs to academic autonomy and communication.</p> <p>Knowledge and use of transcription and conversion applications to accessible formats.</p> <p>Identification of ADIs used, according to type of disability.</p> <p>Willingness to learn about and use new ADIs.</p>	<p>Indicators:</p> <p>Perception of the usefulness of inclusive tools for academic collaboration.</p> <p>Knowledge and identification of ADIs aimed at visual and hearing impairments.</p>
2	<p>Indicators:</p> <p>Accessibility of technological equipment and digital learning resources.</p> <p>Accessibility of digital learning objects.</p> <p>Assessment of the effectiveness of ADIs visual and auditory support.</p> <p>Assessment of assistive devices as facilitators of academic participation.</p>	<p>Indicators:</p> <p>Experience and need for inclusive training.</p> <p>Development of communication skills.</p> <p>Assessment of training as a strategy for reducing communication gaps.</p>
3	<p>Indicators:</p> <p>Existence of platforms, activities, and assessments with an inclusive approach.</p> <p>Adjustment of academic timetables.</p> <p>Participation in ADIs training processes.</p> <p>Availability of human support and relevance of training activities.</p>	<p>Indicators:</p> <p>Academic collaboration with students with disabilities.</p> <p>Inclusive treatment, participation, and shared responsibility in the classroom.</p>
4	<p>Indicators:</p> <p>Availability of accessible services, infrastructure, and technological resources.</p> <p>Existence of mentoring and support programs.</p> <p>Knowledge and perception of institutional compliance with the General Law for the Inclusion of Persons with Disabilities (GLIPD).</p>	<p>Indicators:</p> <p>Accessibility of services, infrastructure, and institutional resources.</p> <p>Knowledge of protocols and recognition of inclusive institutional actions.</p>

The data collection technique used in both instruments (E1 and E2) was designed using a mixed approach, in line with the general methodology, based on the analysis of data for each dimension. The questions were mainly closed-ended, with explicit statements that guided predefined answers, some with a single option and others with multiple choices. The option *I don't know* and the option *other* were also included, with space for free writing, in order to gather qualitative information.

A single-response Likert scale was also used to indicate the degree of acceptance among participants by rating alternatives such as *strongly agree*, *somewhat agree*, *disagree*, *fully accessible*, *partially accessible*, and *inaccessible*. Finally, although to a lesser extent, dichotomous responses of *yes* and *no* were considered, with the neutral value *I don't know* as a variant in some topics..

Google Forms was the tool selected for the design of two information collection instruments, due to its technological features of customization, accessibility, and ease of distribution. It also allowed for the implementation of a remote digital repository model, with real-time recording, applied over a period of one to three months. Following the automated distribution and implementation of the surveys (E1 and E2), the analysis phase was carried out with the aim of identifying the behavior of the indicators in each instrument for the evaluation of each dimension, having previously defined the context of the sample, which includes the relationship between the subject and object of study, and the application scenarios. Using a technical and methodological approach, the data was cleaned and organized into tables for interpretation. Subsequently, it was converted into graphs using the *Napkin AI* tool. Finally, *ChatGPT* was used for style correction.

2.1. Context of the sample

The study universe consisted of 250 actors in the teaching-learning process belonging to the Faculty of Business, Campus IV, of the Autonomous University of Chiapas (AUNCH), Mexico, the National Technological Institute of Mexico, Tapachula campus (NTecM), Mexico, and the Municipal Care and Training Center for People with Disabilities (CTCPD) in Tuxtla Gutiérrez, Chiapas, Mexico. Of the total, 20% (50 participants) were students with visual and hearing impairments, and 80% (200 participants) were students and teachers without disabilities who share the same educational environments (Table 3 and Table 4).

Table 3
Gender and age

Surveys	Male	Female	16 to 25 years old	26 to 35 years old	35 years and older
E1	54%	46%	84%	0%	16%
E2	52%	48%	66%	8%	25.5%

Table 4*Academic background*

Surveys	Middle school	Higher education
E1	38%	62%
E2	0%	100%

2.2. Type of disability

This indicator considered visual and hearing impairments and mutism, the latter associated in some cases with hearing impairment. In *E1*, the participant's disability was recorded, while in *E2*, the disability of a classmate with whom they had shared an academic training space at any stage of their educational career was identified. (Table 5).

Table 5*Type of disability*

Surveys	Visual disability	Auditive disability	Mutism	Without disability
E1	46%	54%	4%	0%
E2	15%	5%	0%	80%

2.3. Degree of alteration

This indicator considered the level of disability, classified as *mild*, *moderate*, or *severe*. In *E2*, the same methodological considerations as for the previous indicator were applied, since the assessment was based on the perception of a person with whom the respondent had shared some academic training, at any stage of education. The estimation of the degree of disability focused on the 40 cases identified. (Table 6, Table 7 and Table 8).

Table 6*Nivel de alteración*

Surveys	Slight	Moderate	Severe	Without disability
E1	30%	60%	10%	0%
E2	13%	7%	0%	80%

Table 7*Role of participation (teachers and students)*

Surveys	Teachers	Students
E1	6%	94%
E2	20%	80%

Table 8*Institutional affiliation*

Encuestas	AUNCH	NTecM	CTCPD
E1	14%	16%	70%
E2	60%	40%	0%

3. RESULTS

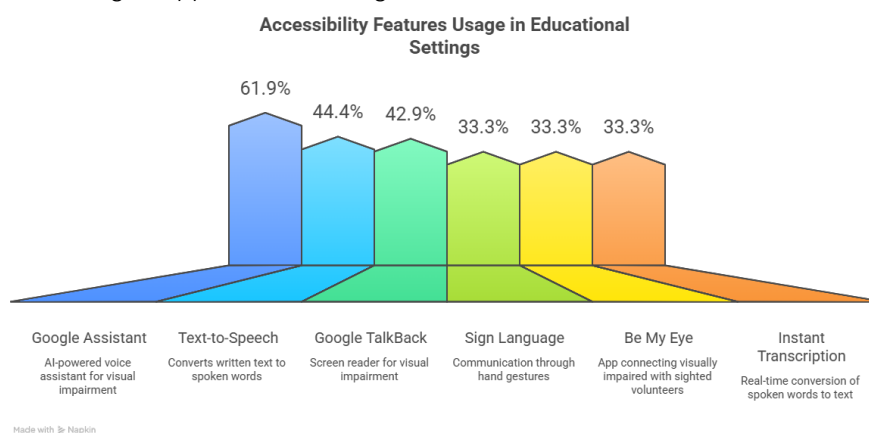
3.1. People with visual and hearing impairments

3.1.1. Primera dimensión: Conocimiento sobre aplicaciones digitales inclusivas

Sixty-five percent of students reported using some form of assistive technology to transcribe text, audio, or images into accessible formats, and to convert sign language or Braille, and viceversa. Its use contributed to improving communication with third parties and strengthened students' autonomy in accessing educational resources. (Table 9 y Figure 1). It is important to note that, even though many students already use some form of assistive technology, 54.2% expressed interest in learning about new applications. This reflected a favorable disposition toward expanding inclusive technological resources.

Table 9*Using an ADI*

ADI_Visual Disability	Percentage	ADI_Auditive Disability	Percentage
Virtual Assistant of Google	61.9%	Text to voice	44.4%
Talkback Google	42.9%	Sign Lsm	33.3%
Be My Eye	33.3%	Instant transcription	33.3%

Figure 1*Preferences for inclusive digital applications among students*

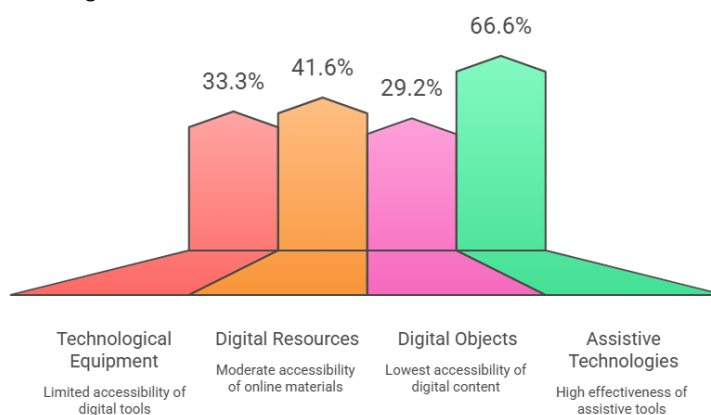
3.1.2. Second dimension: Accessibility to digital technologies

In the digital education ecosystem, computers, tablets, and smartphones serve as the primary devices for accessing programs, applications, platforms, blogs, and websites, through which it is possible to create, modify, consult, and delete digital content or documents. However, beyond innovations in hardware and software, adaptations are needed to enable effective interaction with digital environments, free of barriers.

In this context, participants' perceptions regarding the accessibility of the elements involved in their academic training revealed significant differences between the various components of the digital environment. Thirty-three point three percent considered technological equipment to be accessible, while 41.6 percent identified accessibility in digital resources and only 29.2 percent in digital objects. This highlighted the persistence of barriers in the design and adaptation of educational content, materials, and tools (Figure 2).

Figure 2

Accessibility and effectiveness of digital tools in education



Similarly, when assessing the effectiveness of ADIs and assistive devices, the results showed a similar and considerably more favorable perception. 66.6% of participants considered visual support, auditory support, and assistive device applications to be effective.

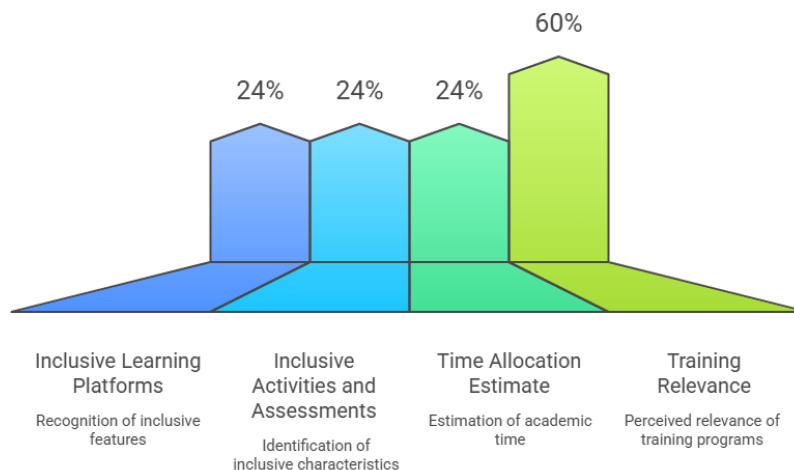
3.1.3. Third dimension: Inclusive experience and learning challenges

From a pedagogical perspective, various indicators associated with the instructional design of educational programs were identified, with the aim of assessing the level of collaboration and joint participation among members of the educational community. The results showed that 24% of participants recognized the existence of learning platforms and resources with inclusive characteristics, while the same percentage identified activities and assessments with inclusive features, as well as an estimate of the time allocated to academic activities. These data

showed limited incorporation of the inclusive approach in pedagogical design. This coincided directly with the learning experience of people with disabilities.

Two types of training programs were also analyzed: the first was aimed at teachers and students for the use of ADIs, and the second was aimed at people with disabilities for the development of new technological skills through the intervention of inclusive agents. In cases where these actions were present, the results showed that 60% of participants considered the training relevant for both teachers and students as well as people with disabilities (Figure 3).

Figure 3
Indicators of instructional design and training relevance



3.1.4. Fourth dimension: Regulatory awareness and digital rights

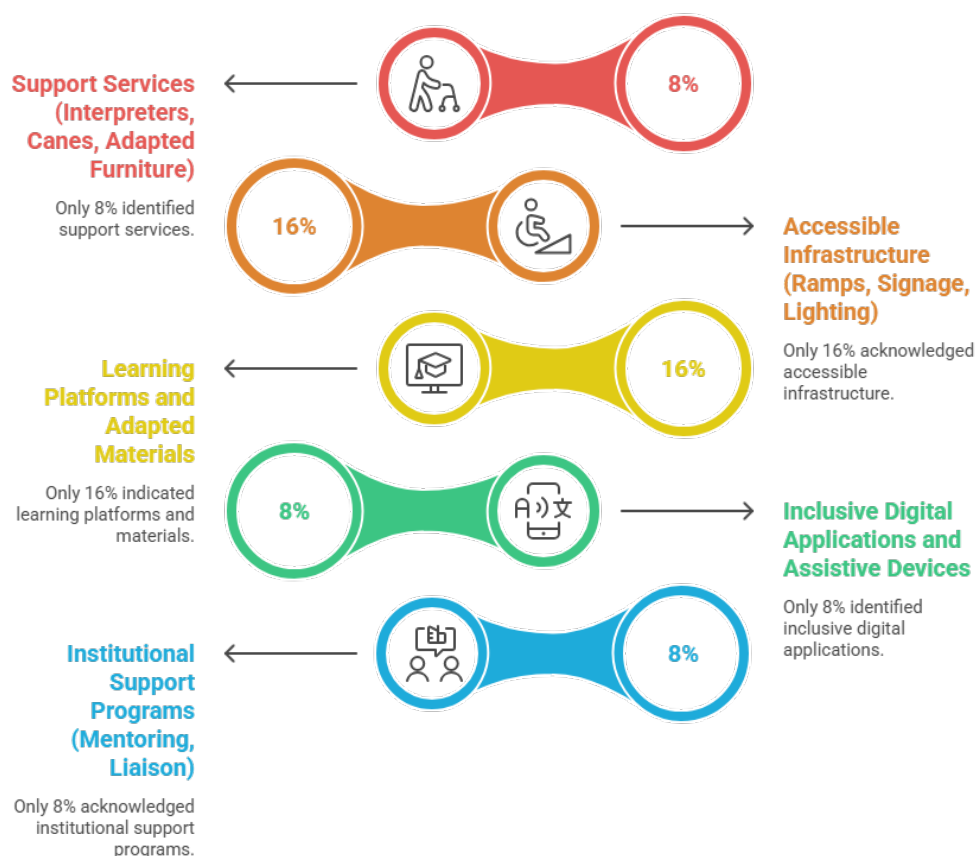
In addition, it was recognized that educational institutions have a responsibility to provide the infrastructure, services, and technological resources necessary to ensure accessibility, support, and monitoring for people with disabilities. Within this framework, the existence of actions aimed at academic support, social integration, and attention to specific educational needs was analyzed. The results showed a limited presence of institutional services and resources. Only 8% of participants identified the existence of support services, such as interpreters, canes, or adapted furniture.

As for accessible infrastructure—ramps, signage, and adequate lighting—only 16% acknowledged its availability. Similarly, 16% noted the existence of learning platforms and adapted educational materials, while 8% identified the presence of inclusive digital applications, such as text-to-speech or image-to-text software, as well as

assistive devices, such as Braille keyboards or hearing aids. With regard to institutional support programs, the results showed that only 8% of participants recognized the existence of a mentoring program for students with disabilities, as well as a family-institution liaison program aimed at addressing specific needs. This revealed a lack of coordination of formal mechanisms for comprehensive support.

Additionally, participants' perceptions regarding their level of knowledge and institutional compliance with the provisions of the GLPD were considered. In this regard, only 25% stated that they were aware of these regulations, while only 20% perceived that the institution complies with the provisions of the law (Figure 4).

Figure 4
Indicators of instructional design and training relevance



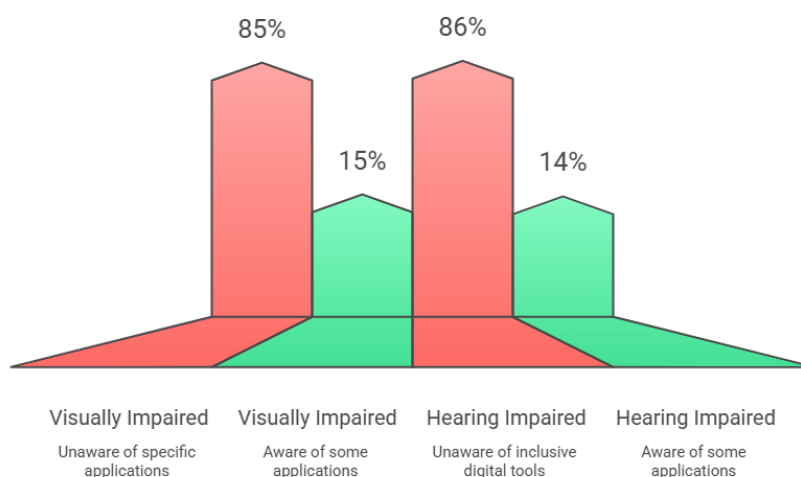
3.2. People without visual or hearing impairments

3.2.1. First dimension

Seventy percent of participants believed that knowledge of inclusive tools, applications, or technological devices could promote their integration and collaboration with classmates with visual or hearing impairments, reflecting a favorable attitude toward inclusion in the educational environment. However, when asked about specific knowledge of inclusive digital applications, the results showed a significant gap between willingness and actual knowledge. In relation to applications aimed at visual impairment, 85% said they were not aware of any applications, while 15% mentioned some, including *Be My Eyes*, *WhatsApp* and *Word* transcribers, *Listen AI*, *Image to Text Converter*, and *TalkBack* from *Google* (Figure 5).

Figure 5

Knowledge of inclusive digital applications



Similarly, with regard to support applications for hearing impairment, 86% said they were not familiar with inclusive digital tools, while 14% mentioned applications such as *InterSign LSM*, *Hand Talk*, *AVA*, *WhatsApp*, and *Pedius* (Table 10).

Table 10

Functions of the ADIs

Visual disability	Function	Auditive disability	Function
<i>Be My Eyes</i>	Real-time visual assistance for object identification and reading.	<i>Intersign LSM</i>	App for learning LSM, with lessons, dictionary, and exercises.

Table 10
Functions of the ADIs

Visual disability	Function	Auditive disability	Function
<i>TalkBack de Google</i>	Screen reader for Android devices with voice and gesture control.	<i>Hand Talk</i>	Text and voice translator to animated sign language.
<i>WhatsApp</i>	Audio transcription and voice dictation.	<i>WhatsApp</i>	Text and voice translator to animated sign language.
<i>Listen AI</i>	Reading texts aloud using artificial intelligence.	<i>Pedius</i>	Accessible calls with voice-to-text and text-to-voice conversion.
<i>Image to Text Converter</i>	Conversion of images with text into accessible digital format.	<i>AVA</i>	Conversion of images with text into accessible digital format.

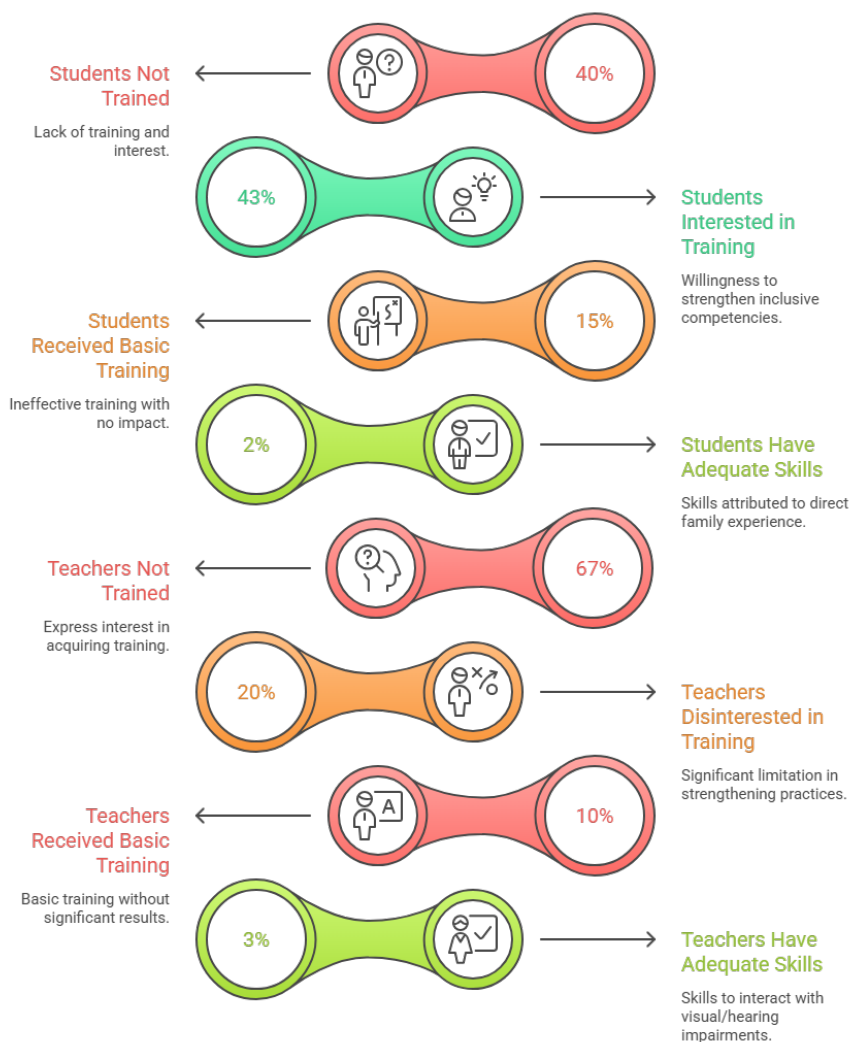
3.2.2. Second dimension

From an educational perspective, the perception of students and teachers without disabilities regarding training in effective communication with people with visual and hearing impairments was analyzed, as well as the level of skills developed and the assessment of their relevance in the educational environment. In the case of students, 40% have not received training in effective communication with people with sensory impairments and, furthermore, express a lack of interest in receiving such training.

In contrast, 43% expressed interest in receiving training, demonstrating a significant willingness to strengthen inclusive skills. On the other hand, 15% reported having received some type of training. However, they described it as *basic* and *ineffective*, with no real impact on the development of communication skills. Finally, 2% considered themselves to have adequate communication skills, attributing this mainly to direct experience in the family environment with people with disabilities..

With regard to teachers, 67% indicated that they had not received training but were interested in acquiring it. However, 20% expressed a lack of interest in training, which represents a significant limitation in strengthening inclusive teaching practices. Likewise, 10% reported having received previous training, although they considered it *basic* and *without significant results*, while 3% stated that they had adequate communication skills to interact with people with visual or hearing impairments. Across the board, 69% of participants recognized that inclusive training is necessary to reduce the communication gap between people with and without disabilities, while 26% considered it moderately necessary and 5% perceived it as unnecessary (Figure 6).

Figure 6
Perception of training in inclusive communication



3.2.3. Third dimension

From a community perspective, educational inclusion is conceived as a shared responsibility that involves both students with disabilities and those who make up the academic environment. Under this approach, indicators related to direct interaction, inclusive treatment, participation in academic activities, and the perception of shared responsibility within the classroom were analyzed. The results showed that 38% of participants had collaborated directly with a student with visual or hearing disabilities in an academic activity or project, which indicated limited

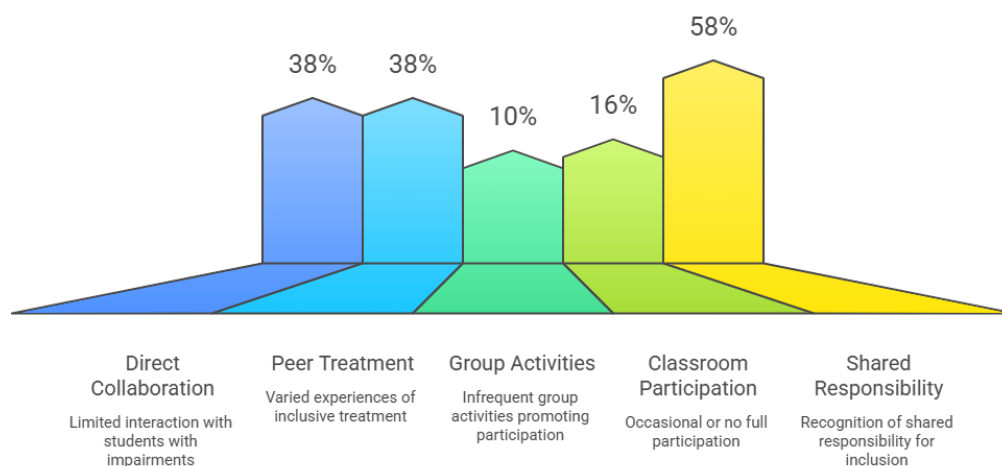
and non-generalized interaction. Consistently, 38% perceive that their peers treat these students inclusively, while the remaining percentage rated it as *moderate* or *nonexistent*, suggesting variability in coexistence experiences.

Regarding teaching practices aimed at integration, 10% identified that group academic activities that encourage the participation of students with visual or hearing impairments are frequent. Likewise, 16% considered that these students participate fully in classroom activities, while the majority indicated that this participation occurs occasionally or not at all. These results showed that effective integration is not yet systematized and depends largely on isolated situations rather than on consolidated educational strategies.

However, 58% of participants acknowledged that integrating students with and without disabilities into group dynamics is a shared responsibility, reflecting an average level of inclusive awareness within the educational community. However, this willingness does not consistently translate into collaborative practices or full participation, highlighting a gap between recognizing the value of inclusion and its everyday implementation in the classroom (Figure 7).

Figure 7

Perceptions of educational inclusion in the classroom



3.2.4. Fourth dimension

From an institutional perspective, the perception of people without disabilities was analyzed with regard to the institution's level of preparedness to incorporate students with visual and hearing impairments, particularly in relation to academic services, infrastructure, technological resources, and accessible digital environments. The results showed a mostly negative perception of the institution's ability to guarantee adequate conditions for inclusion. First, 60% of participants considered that the institution is not prepared in terms of accessible laboratory

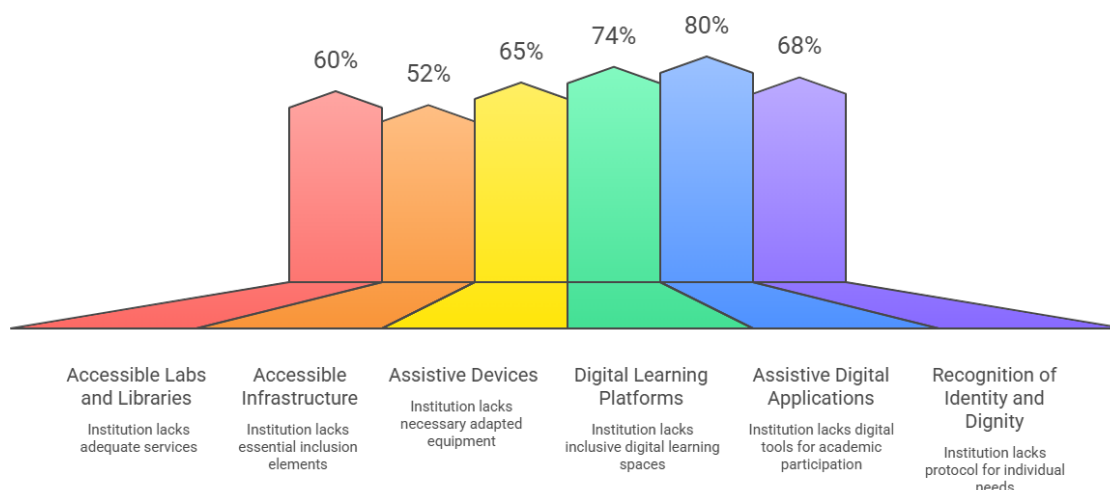
and library services, while the remaining percentage perceives the preparation as *null* or *partial*, limited to compliance with some basic aspects.

With regard to accessible infrastructure, 52% indicated that the institution does not have the necessary conditions, such as ramps, sensors, indicative lighting, tactile and Braille signage, handrails, or other elements essential for the inclusion of students with visual or hearing impairments. The rest of the participants identified partial progress, without these being consolidated as a comprehensive strategy.

Similarly, 65% considered that the institution is not prepared in terms of the availability of assistive devices, such as adapted screens, headphones, speakers, Braille keyboards, or tablets, for students with sensory disabilities. This perception was accentuated when analyzing digital environments, as 74% stated that there are no adapted learning platforms or educational materials, and 80% pointed out the absence of assisted digital applications that facilitate academic participation for those who require them.

Finally, with regard to recognizing the identity and dignity of persons with disabilities, 68% of participants were unaware of or dismissed the existence of an institutional protocol for listening to the individual needs and preferences of students with visual and hearing impairments in order to adapt services. The remaining percentage acknowledged its possible existence, although they perceive its application to be *insufficient* or *ineffective*. This revealed weaknesses in the institutionalization of inclusion practices and differentiated care (Figure 8).

Figure 8
Institutional preparation for inclusion



4. DISCUSSION AND CONCLUSIONS

The results of the study revealed a structural gap between the available technological advances and their effective integration into educational environments from an IDE perspective. Although both people with disabilities and members of the educational community without disabilities were found to be favorably disposed toward inclusion and the use of accessible technologies, this has not been systematically translated into consolidated pedagogical, technological, or institutional practices.

In the case of people with visual and hearing impairments, active use of ADIs aimed at individual autonomy and compensation for immediate barriers was observed. However, this use responds more to personal initiatives than to an institutional strategy, which coincides with previous studies that indicate that digital inclusion often falls on the resilience of students when there are no clear operational policies (Weber et al., 2022). The fragmentation in the accessibility of equipment, resources, and digital objects confirms the absence of Universal Design for Learning (UDL) in curriculum planning.

From the perspective of people without disabilities, the findings reveal a significant contradiction: although there is recognition of inclusive tools and training for accessible communication, there is a predominance of practical ignorance of ADIs and limited participation in effective training processes. This gap between attitude and competence restricts academic collaboration and reinforces dynamics of unintentional exclusion within shared educational environments.

At the institutional level, low levels of recognition of accessible infrastructure, support services, mentoring programs, and regulatory compliance reflected a disconnect between the legal framework and its implementation. These findings suggest that digital inclusion continues to be treated as a complementary action rather than an enforceable educational right.

From a practical perspective, the results underscored the need to incorporate UDL into curriculum planning, ensuring that platforms, resources, and assessments are designed from the outset according to accessibility criteria. It is also essential to strengthen ongoing training programs for teachers and students, focusing not only on the technical use of technologies, but also on the development of communication and collaboration skills that promote inclusive interaction. At the institutional level, it is necessary to move from isolated actions to operational policies for digital inclusion, with resource allocation, clear protocols, and monitoring mechanisms.

The study had some limitations associated with its exploratory design, which aims to analyze a poorly documented phenomenon without attempting to establish causal relationships or generalizable inferences, as well as its cross-sectional nature, which involves collecting information at a single point in time. Likewise, the limitation of the sample to specific educational contexts narrowed the scope of the results. These characteristics do not

detract from the validity of the study, but rather strengthen its relevance by offering an empirical, contextualized approach anchored in real-life scenarios.

In conclusion, IDE faces challenges that transcend technology and extend into the pedagogical, training, and institutional spheres. Although there are functional ADIs and a positive attitude toward inclusion, their impact is limited by a lack of strategies, training, and institutional policies. Technological accessibility continues to be reactive and fragmented, which prevents the guarantee of equitable conditions for participation and learning.

Finally, the low uptake of the regulatory framework highlights the need to strengthen institutional awareness, strategic planning, and monitoring of actions aimed at IDE. Moving toward truly accessible environments requires recognizing inclusion as a cross-cutting theme of educational quality, supported by the UDL, ongoing training, and effective enforcement of the digital rights of persons with disabilities.

Based on the results obtained, future lines of research were identified aimed at analyzing the impact of the systematic use of ADIS on the academic performance and school retention of students with disabilities, as well as longitudinal studies to evaluate the evolution of inclusive competencies in teachers and students, and the effective implementation of UDL in university digital environments.

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