

THE NEED OF TECHNOLOGY USAGE TO SUPPORT DEAF CHILDREN IN EDUCATION AND SOCIAL INCLUSION

DOI: <https://doi.org/10.26758/16.1.26>

Phuong Thi Minh TRAN (1), Lan Thi Thai NGUYEN (2)

- (1) Faculty of Sociology and Social Work, Dalat University (DLU), Vietnam, e-mail: phuongttm@dlu.edu.vn, <https://orcid.org/0009-0008-9762-6494>
- (2) Faculty of Sociology and Social Work, VNU University of Social Sciences and Humanities, Vietnam/Faculty of Social Work, University of Regina; e-mail: lanctxh@ussh.edu.vn, <https://orcid.org/0000-0002-0780-5595>

Address correspondence to: Lan Thi Thai NGUYEN, e-mail: lanctxh@ussh.edu.vn

Abstract

Objectives. Children with hearing impairments frequently encounter substantial barriers to knowledge acquisition and social integration. Assistive technology plays a crucial role in mitigating these challenges and supporting their learning and participation in everyday life. This article provides an overview of key assistive technology applications for children with hearing loss, including hearing aids, cochlear implants, educational software, communication applications, and virtual and augmented reality tools. It further examines the positive impacts of these technologies on deaf children while also addressing the challenges and future prospects in their application. Overall, the study aims to enhance awareness of the vital role technology contributes to improving the quality of life and promoting social integration for children with hearing impairments.

Material and methods. Data were collected from 90 lower-secondary students with hearing impairment in specialized schools in two provinces in Vietnam's Central Highland and southern regions (Lam Dong and Dong Nai) prior to data collection. The questionnaire was designed to identify children's challenges related to learning and inclusion, as well as their needs for assistive technology in these domains. Additionally, five in-depth interviews were conducted with deaf students to gain deeper insights into their experiences, particularly regarding difficulties and specific technological support needs in learning, integration, and daily life.

Results. The findings demonstrate the multifaceted challenges faced by children with hearing impairments in their daily lives. These challenges pose substantial barriers to basic communication, limiting both expression and receiving capacities, and negatively affect academic learning and information acquisition. Critically, seamless social integration becomes challenging, potentially leading to isolation. The children reported a strong need for advanced assistive technologies, including smartphones, hearing aids, education software, and communication applications. These findings underscore the positive role of technology in enhancing communication, learning experiences, and social integration for deaf children. Nevertheless, the adoption and effective use of assistive technology remains constrained by several factors, including financial limitations, shortages of specialized educators, and limited access in certain geographic regions. Looking ahead, continued technological development, increased societal awareness of these needs, and strengthened interdisciplinary research collaboration offer promising opportunities to mitigate these challenges and improve support systems for children with hearing impairments.

Conclusions. Children with hearing impairments demonstrate a strong demand for assistive technology, expressing a clear need for access to new technological devices to support their learning and facilitate integration into everyday life. Accordingly, continued research and improvement in the application of technologies for deaf children are essential to promote equity, social inclusion, and overall well-being for these vulnerable children.

Keywords: assistive technology; challenges; deaf children; education; inclusion

Suggested citation (APA):

Tran, P. T. M., & Nguyen, L. T. T. (2026). The need of technology usage to support deaf children in education and social inclusion. *Anthropological Researches and Studies*, 16, 393-411. <https://doi.org/10.26758/16.1.26>

Introduction

Overview of Hearing Impairment and Its Impact on Children

The term “*hard of hearing*” refers to individuals with mild to severe hearing loss where sounds, such as speech may be heard but not clearly understood. These individuals typically communicate using spoken language and can benefit from hearing amplification devices like hearing aids and cochlear implants. In contrast, *deaf* children have severe or profound hearing loss, resulting in very little or no hearing. While cochlear implants may assist with hearing and speech learning, many deaf children rely on visual support, such as signs, cued speech, and lipreading to communicate (World Health Organization [WHO], 2016). Globally, hearing loss among children and adolescents is a growing concern. In 2021, approximately 97.83 million children and adolescents under the age of 20 were affected by hearing loss, leading to an estimated 3.91 million years of living with a disability. From 1990 to 2021, the global prevalence rate increased from 3,537 per 100,000 to 3711 per 100,000, with an annual increase of 0.15% (95% CI: 0.12–0.17) (Guo et al., 2024). Currently, more than 5% of the world's population – equivalent to 430 million people, including 34 million children, require rehabilitation to address disabling hearing loss. This number is projected to rise to over 700 million people by 2050, equating to one in every ten individuals (WHO, 2025).

In Vietnam, hearing loss also presents a significant public health challenge. For every 1,000 newborns, about 3 are born with hearing impairments in one or both ears. Based on 1,744,400 births recorded in 2023, an estimated 5,232 babies were born with hearing loss. Despite this, only about 30% of newborns in Vietnam undergo hearing screening (Ministry of Health of Vietnam, 2023). Additionally, according to annual statistics from the Ministry of Health, on average, 1.4 million children are born in Vietnam each year, of which 1.5-2% have birth defects.

Ninety percent of deaf children are born into hearing-enabled families (National Deaf Children’s Society, 2002), which often limits early language exposure and communication at home. Studies consistently show that children with hearing loss have many different difficulties. These include communication barriers and delays in receiving critical information due to impaired hearing (Schild & Dalenberg, 2016; Yoshinaga-Itano et al., 1998). Language deprivation from birth contributes to cognitive, emotional, social, and academic development delays (Freitas et al., 2021). Deaf children especially need early access to language spoken or signed—starting in infancy. The critical period for language development is between birth and five years of age. If accessible language is not provided during this time, the consequences can be long-lasting. Even with hearing aids, without a rich language environment, children may still experience significant language delays (Burke et al., 2011).

Challenges Faced by Deaf Children in Communication, Education, and Mental Health

Firstly, deaf children encounter significant communication difficulties not only with hearing individuals but also with other deaf peers and family members (Mwambe et al., 2018; Yoshinaga-Itano et al., 1998). Due to their inability to hear or speak, deaf children are most obviously affected by language development (WHO, 2016). Alys Young's (2002) study found that factors influencing the selection of communication methods for deaf children in the first year of life are information, expectations, and family identity. Many parents, however, receive insufficient or biased information from experts, which limits their understanding of various communication options, such as sign language, oral language, or bilingual approaches (Young, 2002).

Meanwhile, in Vietnam, a number of studies also identified communication challenges faced by deaf children. These children often attended classes where sign language is used (General Statistics Office of Vietnam [GSO], 2018). Children also face many difficulties accessing information and barriers to information (WHO, UNESCO, International Labour Organization, & International Disability and Development Consortium, 2010).

Secondly, deaf children face considerable difficulties in accessing and participating in education. Although they have the right to education at all levels, they often require specialized educational environments to succeed. In practice, a lack of appropriate schools, resources, and specialized facilities—including accessible infrastructure, braille boards, and trained teachers—limits their access to quality education, as seen in both Vietnam and countries like Italy (Perrotta, 2024). Stigma and discrimination from peers, teachers, and the wider community further hinder their inclusion and learning (Khairuddin et al., 2018; Scherer et al., 2023). Moreover, deaf children face specific learning difficulties, including challenges in reading, speaking, and mathematics due to limited language exposure (Govindan & S, 2014; WHO, 2016). Verbal or written language are often the primary modes of instruction, creating significant barriers for deaf students in mainstream educational settings (Mwambe et al., 2018). Data show that 26% of children with hearing difficulties are placed in specialized classrooms where sign language is typically used (GSO, 2018). However, the shortage of individualized support services, such as speech therapy or special education assistants, continues to impede their educational development.

Thirdly, deaf children are vulnerable to psychological difficulties. Communication barriers often lead to feelings of isolation and exclusion from peer interactions. These children may experience stress, behavioral issues, and emotional challenges such as anxiety, low self-esteem, and rebellious or hyperactive behavior (Freitas et al., 2021). Discriminatory attitudes and the use of derogatory terms like "deaf", "dumb", or "mute" contribute to negative self-perception and psychological distress (Hoa, 2014). Additionally, deaf children may struggle with tension between deaf cultural identity and broader societal norms, especially in formal school settings where spoken language is the norm and sign language support is lacking (Jones et al., 2001).

Fourthly, children with hearing impairments face significant barriers in accessing essential resources. Medically, the welfare system of deaf children is seriously neglected, such as inadequate monitoring, lack of appropriate services, and the absence of a comprehensive data system on deafness, hearing loss, and hearing impairment, leading to poor assessment of scale and needs (Bowman, 2018). Financially, although the cost-effectiveness of hearing aids, cochlear implants and other hearing devices has been demonstrated, their acquisition and maintenance remain out of reach for many in low- and middle-income countries (Olusanya et al., 2014). Without timely intervention, children with hearing loss risk falling behind academically, which can limit future employment opportunities (Olusanya et al., 2014; WHO, 2016). Moreover, limited access to information and social support, lack of sign language interpretation services, and a shortage of information in appropriate languages further restricts communication.

Fifthly, deaf children often struggle to integrate into society due to communication and interaction barriers. These difficulties can lead to social isolation, low self-confidence, loneliness,

and even depression (Fitriyani et al., 2024; WHO, 2016). Limited access to jobs, public services, and financial independence further hinders their full participation in society (Kim et al., 2018). Language-related learning challenges, particularly in reading and verbal communication, negatively impact self-esteem and social skill development (WHO, 2016). In inclusive education settings, children with hearing impairment may face stigma or exclusion from peers and teachers. This creates emotional distress and further alienates them from learning environments (Dixon et al., 2004). It is estimated less than 2% of the 34 million deaf children worldwide receive early childhood exposure to a signed language (Murray et al., 2019) and reality shows that access to hearing aids is slow (Hulme et al., 2022). Thus, deaf children require inclusive educational environments where they can learn alongside their peers with appropriate support (Khairuddin et al., 2018). However, there is a shortage of specialized teachers trained to meet the specific needs of deaf students (Umah et al., 2024).

Technology is vital for helping hearing-impaired children overcome learning and social barriers. This article reviews assistive tools—such as hearing aids, cochlear implants, educational software, and VR/AR—while examining their impact, challenges, and future potential. Ultimately, this study highlights how technology improves the quality of life and fosters social integration for these children.

Role of Technology in Communication and Inclusion

Children with hearing impairments require comprehensive educational strategies that incorporate technology to enhance communication and foster social inclusion. Effective teaching approaches should integrate visual aids, videos, and sign language, supported by diverse, engaging, and regularly updated learning materials. Additionally, routine hearing health screenings are crucial for early detection and timely intervention. Devices such as hearing aids and cochlear implants can significantly improve auditory perception; however, their high cost presents a financial burden for many families, especially in low- and middle-income countries (Nagels et al., 2024).

In the Vietnamese context, early diagnosis and timely treatment, along with environmental adaptations—such as using visible signals to alert children—are essential. For instance, positioning cribs in areas where children can easily see their caregivers helps compensate for hearing deficits and provides a sense of security (Hoa, 2014). Other assistive devices include TV headsets, amplified phones, and light-based alert systems for doorbells (WHO et al., 2010). Beyond these tools advanced devices have been developed to convert spoken language into sign language and vice versa, facilitating two-way communication. One example is the FFCDH (Face-to-Face Conversation Deaf and Hearing people) model developed in English and Japanese (Mwambe et al., 2018). Modern technological devices, such as phones, computers, and the Internet-based platforms serve as vital tools for deaf children's learning, communication, and daily living. Technologies function as essential extensions of sensory access—essentially becoming the "ears" of deaf individuals in navigating contemporary life (GSO, 2018). Software like Cooledit and praat supports Vietnamese tone pronunciation and enhances oral communication skills (Anh, 2018).

Despite the evident importance of these technologies, access remains limited. In Ho Chi Minh City, some specialized schools still lack essential equipment for early intervention, particularly hearing aids (Phuong, 2010). Research in Vietnam has explored the use of HamNoSys (Hamburg Notation System) and Avatar 3D JASigning to bridge gaps in sign language communication. This research has led to the development of PC-based tools designed to support communication with deaf and hard-of-hearing individuals, addressing the shortage of human interpreters (Ngôn & Đa, 2017). Additional technological interventions include the use of multimedia learning materials. For example, "Happy to Learn Rhymes" CDs were developed using MS PowerPoint and Windows Movie Maker to support deaf children's language acquisition (Mỹ

& Hiên, 2007). The BABYBEATS software is another tool used to help develop auditory skills in young children with hearing impairments. Hearing aids amplify sound, enabling better speech detection and improving communication, social interaction, and learning outcomes (Châu, 2024).

Data from a study in Victoria, Australia, involving 882 children under 66 months old (2012–2022), revealed that 33.3% used hearing aids, 10.3% used cochlear implants, and 56.4% did not use any assistive devices. Although children with cochlear implants exhibited delayed communication skills, they demonstrated superior gross motor abilities compared to those without devices (Zehnwirth et al., 2025). These findings underscore the importance of tailoring technological solutions to the specific developmental needs of deaf children. Notably, the design of assistive technologies should involve the participation of deaf children themselves. Research by Leigh Ellen Potter, Jessica Korte, and Sue Nielsen found that children with hearing impairments differ from their hearing peers in many areas. A combination of these differences requires an approach tailored to their needs. For example, the "Seek and Sign" project, in which deaf children are involved as design partners and Cooperative Inquiry (Potter et al., 2014). In another innovative example, the micro:bit device has been employed to enable communication between non-verbal individuals and others through visual signals. This low-cost, wearable technology can translate basic needs—such as hunger or thirst—into illuminated symbols, and also notify users of external auditory events, such as alarms or calls (Asa'ad, 2025).

To assess the effectiveness of assistive technologies, research has shown that although short-term outcomes may not differ significantly, long-term and consistent use of hearing aids is associated with improvements in language development, auditory attention in noisy environments, and academic performance (Stewart et al., 2022). Similarly, in a pilot project in the UK involving 300 deaf children using virtual reality (VR) games combined with paired headphones, VR has helped children better identify sounds in chaotic situations, increasing their ability to understand speech (Parmar et al., 2024).

Despite technological advancements, there remains a lack of localized research in Vietnamese provinces regarding the technological needs of deaf children in specialized education settings. This gap highlights the need for studies exploring the realities faced by these children in learning and integration processes. Preliminary findings indicate that children with hearing impairments continue to experience significant barriers and express a strong desire for technological support. Assistive technologies not only help them overcome learning difficulties but also boost their confidence, autonomy, and inclusion in modern society.

Material and methods

The study employed a mixed-method design, integrating both quantitative and qualitative approaches. Quantitative data were collected through a survey administered to 90 deaf students in Grades 6 to 9 who were enrolled in two specialized schools located in the Central Highland and South of Vietnam. Of the participants, 34 students (37.8%) were from the Lam Dong province Center for Supporting the Development of Inclusive Education 1 (Cam Ly), and 56 students (62.2%) were from the Dong Nai province Center for Supporting the Development of Inclusive Education. The questionnaires were developed based on a review of relevant literature and structured instrument-design process. It focused on identifying children's difficulties related to learning and social inclusion, as well as their needs for assistive technology devices in these domains. Responses were measured using the five-point Likert scale to assess the level of difficulties and perceived needs.

Qualitative data were collected through five in-depth interviews, including interviews with three deaf children and two institutional leaders from the participating centers. Two separate semi-structured interview guides were developed. The first guide was used with deaf students to explore their lived experiences, learning and integration challenges, technological needs, and perceptions

of the role of assistive devices in their daily life. These interviews were conducted with the assistance of a teacher proficient in sign language. The second interview guide targeted institutional leaders to assess their existing facilities, challenges in service provision, and the availability, use, and perceived need for assistive technological devices for children with hearing impairments.

Quantitative data were analyzed using SPSS version 25.0, employing descriptive statistical techniques, including the calculation of means, medians, standard deviations, as well as minimum and maximum values to summarize the distribution of variables. Cross-tabulations and checklists were used to further examine relationships between variables. Inferential statistical analyses, including independent samples *t*-tests, analysis of variance (ANOVA), chi-square tests, and regression analysis, were conducted to examine associations among variables and to identify predictors of assistive technology (AT) demand. The internal consistency of measurement scales was assessed using Cronbach's alpha.

Qualitative data were audio-recorded and transcribed using NotebookLM software to convert recordings into textual data. The resulting transcripts were analyzed using thematic analysis, with themes and subthemes identified to support systematic comparison and in-depth interpretation of participants' perspectives.

Results

Demographic information about the research participants

Of the 90 children surveyed, 48 were female (53.3%) and 42 were male (46.7%). Most participants were enrolled in Grade 6, comprising 34.4% of the sample ($n = 31$), followed by Grade 8 (26.7%), Grade 7 (22.2%), and Grade 9 (16.7%). The ages of participating deaf children ranged from 13 to 23 years, with a mean age of 17.20 years ($SD = 1.89$).

With respect to the severity of hearing loss, 44.4% of the children ($n = 40$) were identified as having mild hearing loss, representing the largest proportion of the sample. This was followed by severe hearing loss (36.7%, $n = 33$), moderate hearing loss (15.6%, $n = 14$), and profound hearing loss (3.3%, $n = 3$). Children diagnosed with hearing impairment are often assessed and referred to specialized educational institutions at an early age. Consequently, many participants had spent extended periods in specialized centers, with some entering these facilities as early as two to three years of age (Table 1).

Difficulties of deaf children

Table 2 illustrates the levels of difficulty experienced by deaf children across six key areas, rated on a 5-point scale (1 = no difficulty, 5 = most difficult). The greatest challenge reported was in accessing examination and treatment for hearing rehabilitation, with the highest mean score of 3.28 and 30.0% of respondents rating this aspect at the highest difficulty level. This was followed by difficulties in career and employment orientation (mean = 3.18), with 20.0% of children selecting the highest difficulty level, and difficulties due to stigma and discrimination (mean = 3.07), with 42.2% indicating a moderate level of difficulty (score 3). Difficulties in integration also showed a relatively high mean score (2.87), with 15.6% rating this as level 4 and 12.2% as level 5. Learning difficulties received a mean score of 2.79, and communication difficulties were rated lowest in comparison (mean = 2.70), though still significant, with over one-third of respondents (38.9%) indicating a moderate level of difficulty. Overall, the results highlight that while communication and learning are key challenges, access to hearing-related medical support and long-term life opportunities pose even greater difficulties for children with hearing impairments.

Table 1
Research participants' characteristics

		N	%
Gender	Male	48	53.3
	Female	42	46.7
Grade	6	31	34.4
	7	20	22.2
	8	24	26.7
	9	15	16.7
Level of hearing impairment	Mild	40	44.4
	Moderate	14	15.6
	Severe	33	36.7
	Profound	3	3.3
Having Disability Certificate	No	75	83.3
	Yes	15	16.7
Duration in the centers	Less than 3 years	33	36.7
	From 3 to less than 6 years	7	7.8
	From 6 to less than 10 years	29	32.2
	Over 10 years	21	23.3

Table 2
Difficulties faced by deaf children

No.	Difficulties	Level of agreement (1 is no difficult to 5 is the most difficult)					Mean	Std. Deviation
		1	2	3	4	5		
1	Difficulties in examination and treatment for hearing rehabilitation	14.4	18.9	21.1	15.6	30.0	3.28	1.44
2	Difficulties in career and employment orientation	12.2	16.7	32.2	18.9	20.0	3.18	1.28
3	Difficulties due to stigma and discrimination	7.8	22.2	42.2	11.1	16.7	3.07	1.15
4	Difficulties in integration	16.7	20.0	35.6	15.6	12.2	2.87	1.23
5	Difficulties in learning	18.9	22.2	34.4	10.0	18.9	2.79	1.28
6	Difficulties in communicating	24.4	16.7	38.9	4.4	15.6	2.70	1.32

The six-item scale demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.770. Corrected item-total correlations ranged from 0.337 to 0.670, indicating that all items were adequately correlated with the overall scale. Most items contributed positively to scale reliability, as removing them would reduce the alpha value. Although deleting the item related to

difficulties in examination and treatment for hearing rehabilitation would slightly increase Cronbach's alpha to 0.786, the item was retained due to its acceptable correlation and conceptual relevance.

Upon discovering their children's communication difficulties, many parents sought medical consultations at various hospitals. However, the distance to these healthcare facilities and the high associated costs posed significant challenges. Deaf children, being unable to hear or speak, rely entirely on sign language for communication. While they can communicate effectively with their deaf peers, communication with their parents remains limited, largely due to the parents' insufficient use and understanding of sign language (In-depth interview with deaf children in Lam Dong Province).

These children often express fear or discomfort with reading, especially with long texts, which they find difficult to understand. For instance, when asked simple questions such as "At what age did your parents take you to the Learning Center?" or "What grade are you in?", some children responded with confusion or unrelated answers, indicating comprehension difficulties (In-depth interview with a deaf child in Dong Nai). Additionally, there are regional variations in Vietnamese sign language across the North, Central, and South, which may further complicate communication and learning processes (Thiệp, 2016). Regarding social integration, children often face communication barriers in their communities. Their reliance on sign language limits interactions with hearing peers, grandparents, and other family members who are unfamiliar with the language (In-depth interview with teachers).

Needs of deaf children

Children with hearing impairment need support from various perspectives, as shown in Table 3.

Table 3
Deaf children's needs for support

No.	Needs	Level of agree (1 is the disagree to 5 is the most agree)					Mean	Std. Deviation
		1	2	3	4	5		
1	Need for communication support	14.4	24.4	34.4	11.1	15.6	2.89	1.249
2	Need for learning support	20.0	16.7	36.7	14.4	12.2	2.82	1.259
3	Need for psychological support and counseling	10.0	31.1	41.1	14.4	3.3	2.70	0.953
4	Need for information support	8.9	23.3	42.2	16.7	8.9	2.93	1.058
5	The need to support vocational training and job creation	13.3	24.4	30.0	17.8	14.4	2.96	1.244
6	Need for support for inclusion	7.8	28.9	36.7	21.1	5.6	2.88	1.015

Overall, the most agreed-upon need was support for vocational training and job creation, with a mean score of 2.96 (SD = 1.244), followed closely by the need for information support (Mean = 2.93, SD = 1.058). These results suggest that children with hearing impairments are concerned about their future careers and the accessibility of information for their development and daily functioning. The need for communication support had a mean score of 2.89 (SD = 1.249), indicating moderate agreement, as did the need for support for inclusion (Mean = 2.88, SD = 1.015) and learning support (Mean = 2.82, SD = 1.259). These responses reflect the challenges deaf

children face in interacting with others and succeeding academically. Interestingly, the lowest level of agreement was found in the need for psychological support and counseling, with a mean of 2.70 (SD = 0.953), suggesting that while this area is still relevant, it may be less of an immediate concern for some children or perhaps under-recognized.

The six-item scale assessing support needs demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.772. Corrected item-total correlations ranged from 0.410 to 0.684, indicating that all items contributed adequately to the overall scale. The removal of any item would not substantially improve the reliability coefficient, as Cronbach's alpha if item deleted remained comparable to or lower than the overall alpha. Therefore, all items were retained for subsequent analyses.

These findings highlight that deaf children express the greatest needs in areas directly related to their future independence and information access, while also indicating ongoing support needs in communication, education, and social inclusion.

The current situation of technology devices used to support children

The data indicate varying levels of access to technological devices among children with hearing impairments. Hearing aids are the most commonly used assistive device, with 73.3% of respondents reporting access, reflecting their central role in supporting auditory function. Smartphones are widely accessible, with 95.6% of participants utilizing them, suggesting their multifunctional value in communication, learning, and daily activities. Approximately 54.4% of children reported access to computers, tablets, and learning support software, demonstrating a moderate level of technological integration in educational settings. In contrast, more specialized tools such as text-to-speech devices and communication applications are less frequently used, with only 16.7% and 34.4% of respondents respectively reporting access. Access to cochlear implants remains limited, with just 7.8% of children having received them, potentially due to financial, medical, or procedural barriers. Finally, virtual reality (VR) technology appears to be the least utilized, with only 13.3% of children accessing it, while 85.6% have no exposure—highlighting significant gaps in access to advanced assistive technology. These findings underscore the disparity in technological support and point to the need for greater investment and policy attention to enhance equitable access for deaf children.

To explore in greater detail the types of technological devices used by deaf children, the findings reveal a diverse range of assistive tools currently in use. Hearing aids are relatively widely used, with 71.1% of children reporting access, emphasizing their fundamental role in auditory support. In contrast, access to cochlear implants remains notably limited, with only 5.6% of respondents having received one, possibly due to high costs or surgical requirements. Smartphones are the most accessible technological device, with 88.9% of participants reporting usage, highlighting their critical role in communication and digital engagement.

Just over half of the children indicated access to computers and tablets (53.3%) and learning support software (52.2%), suggesting moderate integration of technology in educational environments. However, more specialized tools remain less accessible. Only 18.9% of children have access to text-to-speech devices, and 33.3% reported using communication applications, which may be essential for improving interaction and literacy. The least accessed technology is virtual reality (VR), with only 8.9% of respondents reporting usage, and 87.8% indicating no access. These findings underscore substantial disparities in the availability of advanced assistive technologies, pointing to a critical need for targeted interventions and investment to enhance digital inclusion and learning support for deaf and hard-of-hearing children (Table 4).

However, when interviewing, they are hardly allowed to use it because of school regulations; they can use it at the end of the day, or when they need to be contacted, they will ask the homeroom teacher or teachers in the school. 71.1% of children think that they have been using

hearing aids. When talking to them, they said they did not like it very much because there was a difference, and sometimes the effect was not high, and they did not like to use it either.

Table 4

The technology equipment that deaf children have been using (%)

No.	Technology equipment	No	Yes	Total
1	Hearing aids	28.9	71.1	100.0
2	Cochlear implant	94.4	5.6	100.0
3	Smartphones	11.1	88.9	100.0
4	Computers, Tablets	46.7	53.3	100.0
5	Learning Support Software	47.8	52.2	100.0
6	Text-to-speech Devices	80.0	18.9	98.9
7	Communication Apps	65.6	33.3	98.9
8	Virtual Reality Technology	87.8	8.9	96.7

The technological devices used by deaf children originate from various sources. For hearing aids, 35.6% of respondents reported receiving them through sponsorship, while only 16.7% indicated that their families purchased them independently. In terms of smartphones, 52.2% of children stated that they were purchased jointly with family support, while 24.4% reported acquiring the devices through a combination of personal purchase and sponsorship. Regarding learning support software, 33.3% of students noted that the tools were provided through sponsorship (Table 5). In practice, most deaf children attend specialized educational institutions where schools provide the necessary technological equipment, including pre-installed learning and communication applications on school computers and mobile devices. As a result, students often do not need to purchase these tools themselves.

Table 5

Sources of technological equipment supply

No.	Technology Equipment	Self-purchase	Sponsored	Both	Do not know
1	Hearing aids	16.7	35.6	13.3	23.3
2	Cochlear implant	5.6	7.8	1.1	42.2
3	Smartphones	52.2	14.4	24.4	6.7
4	Computers, Tablets	13.3	23.3	14.4	20.0
5	Learning Support Software	3.3	33.3	16.7	20.0
6	Text-to-speech Devices	1.1	10.0	13.3	45.6
7	Communication Apps	2.2	35.6	11.1	16.7
8	Virtual Reality Technology	5.6	18.9	5.6	30.0

Among the devices, smartphones were reported as the most frequently used, with a mean score of 3.56 (SD = 1.15), followed by computers and tablets (M = 3.00, SD = 0.94). Hearing aids also showed a moderate level of use (M = 2.89, SD = 1.49), while learning support software was used with slightly less frequency (M = 2.77, SD = 0.99). Other tools such as text-to-speech devices (M = 2.45, SD = 1.39), communication apps (M = 2.52, SD = 0.99), and cochlear implants (M = 2.21, SD = 1.26) had relatively lower mean usage scores. Virtual reality technology was the least

frequently used, with a mean of 2.15 (SD = 0.97). These findings suggest that while smartphones and basic digital tools are integrated into the daily activities of many deaf children, more specialized or advanced technologies such as virtual reality and cochlear implants are used far less frequently (Table 6).

Table 6
Children's frequency of using technological devices

No.	Technology equipment	Level of frequency (1 is the infrequent to 5 is the most frequent)					Mean	Std. Deviation
		1	2	3	4	5		
1	Hearing aids	24.4	14.4	24.4	8.9	22.2	2.89	1.49
2	Cochlear implant	22.2	16.7	5.6	11.1	2.2	2.21	1.26
3	Smartphones	6.7	5.6	38.9	21.1	26.7	3.56	1.15
4	Computers, Tablets	5.6	13.3	47.8	11.1	6.7	3.00	0.94
5	Learning Support Software	7.8	17.8	32.2	10.0	3.3	2.77	0.99
6	Text-to-speech Devices	21.1	21.1	12.2	3.3	11.1	2.45	1.39
7	Communication Apps	11.1	22.2	26.7	6.7	2.2	2.52	0.99
8	Virtual Reality Technology	22.2	15.6	26.7	1.1	1.1	2.15	0.97

The most prominent barrier identified was the perception that technology is expensive, with 52.2% of respondents indicating this issue. Similarly, 44.4% of children reported that the technology was difficult for them. A lack of knowledge about where to purchase equipment was also a significant barrier, reported by 44.1% of participants. In addition, 24.4% of respondents found technological tools unaffected, while 18.9% cited not being common as a limiting factor. These findings suggest that beyond affordability, awareness, accessibility, usability, and perceived relevance remain critical challenges in adopting assistive technologies among deaf children in the studied context (Table 7).

Table 7
Difficulties of deaf children when accessing technological devices (%)

No.	Technology equipment	No	Yes	Total
1	I don't know where to buy	58.9	41.1	100.0
2	Expensive	47.8	52.2	100.0
3	Difficult to use	55.6	44.4	100.0
4	Not affected	75.6	24.4	100.0
5	Not common	81.1	18.9	100.0

Table 8 below presents data on the perceived usefulness of various technological devices, measured on a 5-point Likert scale (1 = not useful, 5 = most useful). Among the tools, smartphones were considered the most useful, with a mean score of 3.31 (SD = 1.124), followed closely by learning support software (Mean = 3.10, SD = 1.010) and hearing aids (Mean = 3.00, SD = 1.100).

Computers and tablets also received a moderately positive assessment (Mean = 2.98, SD = 1.222). In contrast, cochlear implants and virtual reality technology were perceived as less useful, with mean scores of 2.28 (SD = 1.161) and 2.39 (SD = 1.056), respectively. Similarly, text-to-speech devices (Mean = 2.40, SD = 1.015) and communication apps (Mean = 2.73, SD = 0.936) were rated lower in terms of usefulness. These findings suggest that while some digital tools are valued by deaf children, others are perceived as less effective, possibly due to limitations in accessibility, usability, or relevance to their communication needs.

Table 8
Usefulness of technological devices for deaf children

No.	Technology equipment	Level of usefulness (1 is no useful to 5 is the most useful)					Mean	Std. Deviation
		1	2	3	4	5		
1	Hearing aids	10.0	12.2	48.9	7.8	12.2	3.00	1.100
2	Cochlear implant	17.8	14.4	16.7	3.3	3.3	2.28	1.161
3	Smartphones	7.8	8.9	41.1	20.0	16.7	3.31	1.124
4	Computers, Tablets	11.1	21.1	27.8	16.7	12.2	2.98	1.222
5	Learning Support Software	5.6	10.0	38.9	13.3	7.8	3.10	1.010
6	Text-to-speech Devices	13.3	21.1	20.0	7.8	1.1	2.40	1.015
7	Communication Apps	7.8	14.4	34.4	7.8	2.2	2.73	0.936
8	Virtual Reality Technology	13.3	22.2	17.8	6.7	2.2	2.39	1.056

Feedback from 25 deaf children, smartphones are particularly valued for their role in enhancing communication, accessing information, and completing academic tasks. One student explained, “I need a smartphone because it offers many interesting learning materials and strange new things to explore.” Others emphasized the educational benefits, stating, “I want to use my phone to absorb knowledge and improve in subjects like literature and mathematics.” Computers and tablets were also highly regarded, especially due to the advantage of larger screens that improve visual accessibility. One child noted, “I need a laptop because the large screen makes it easier to study and see the content.” Devices were also deemed essential for online learning and collaborative study, as reflected in comments such as, “I need a computer because I study online,” and “I need a phone to study in a group, chat with friends, and share knowledge.” Another student remarked, “I want to study math, physics, and programming online to absorb knowledge confidently without fear of making mistakes.” Several children also highlighted the importance of accessible, affordable, and user-friendly devices. Many saw smartphones as particularly convenient, describing them as “easy to use,” “practical,” and “helpful for communication.” Some expressed the desire to access social media and stay informed, saying, “I need a phone because it provides new information that helps me expand my knowledge.” In addition to smartphones and computers, hearing aids were frequently mentioned as necessary devices. Students shared their desire to hear their parents, teachers, and friends more clearly: “I need hearing aids because I want to hear my parents calling me,” and “I use hearing aids to communicate with my family and friends.” Others acknowledged the difficulties in verbal communication without these tools: “It is hard to hear and speak; I don’t understand much, so I need hearing aids to connect with others.”

Table 9 presents the perceptions of deaf children regarding the support they receive for using technological devices in educational and assistive contexts. Overall, the findings indicate a moderate to high level of agreement on most support-related activities, with several areas demonstrating particularly strong support from schools and teachers. The highest-rated item was

"Teachers guide the use of devices for children" (M = 3.79, SD = 0.86), suggesting that direct instructional support from educators plays a key role in facilitating technology use. Similarly, "Teachers introduce assistive devices for children" also received a relatively high mean score (M = 3.64, SD = 0.89), indicating the proactive involvement of educators in introducing available technological solutions. Additionally, children acknowledged that centers regularly connect them with assistive devices (M = 3.57, SD = 0.81), and that there is an expressed need for even more connectivity in terms of technology support (M = 3.43, SD = 0.86). This implies a perceived gap between the current level of provision and children's needs. Interestingly, while technical support activities generally received favorable ratings, satisfaction with the supported technology devices remained comparatively lower (M = 3.38, SD = 0.77). This suggests that while the infrastructure and support systems are partially in place, there may be limitations in the quality, appropriateness, or effectiveness of the devices provided. The lowest standard deviation (SD = 0.77) was found in the item "Children receive assistance connecting technology devices" and "Children are satisfied with supported technology devices", indicating relative consensus among respondents. These results highlight both the positive contributions of educators and institutions, and the ongoing need for enhanced access and support mechanisms to maximize the impact of assistive technology for deaf children.

Table 9
Assessment of deaf children on technology device support activities

No.	Technology devices	Level of agreement (1 is disagree to 5 is the most agree)					Mean	Std. Deviation
		1	2	3	4	5		
1	The center regularly connects so that children have assistive devices	1.1	6.7	35.6	45.6	10.0	3.57	0.81
2	The center makes connections that support good equipment	3.3	8.9	31.1	47.8	8.9	3.50	0.90
3	The center needs more connectivity in terms of technology devices	2.2	10.0	38.9	40.0	8.9	3.43	0.86
4	Teachers in the school connect devices for children	5.6	6.7	32.2	43.3	12.2	3.50	0.97
5	Teachers introduce assistive devices for children	3.3	4.4	30.0	48.9	13.3	3.64	0.89
6	Teachers guide the use of devices for children	1.1	3.3	32.2	42.2	21.1	3.79	0.86
7	Children receive assistance connecting technology devices	2.2	3.3	43.3	43.3	6.7	3.49	0.77
8	Children are satisfied with supported technology devices	0.0	11.1	46.7	35.6	6.7	3.38	0.77
9	Children need more support with technology devices	2.2	6.7	36.7	40.0	14.4	3.58	0.89

The suitability of the data for factor analysis was confirmed by a Kaiser–Meyer–Olkin (KMO) measure of 0.783, indicating adequate sampling adequacy, and Bartlett’s Test of

Sphericity, which was statistically significant ($\chi^2 = 312.141$, $df = 36$, $p < .001$). These results support the appropriateness of conducting principal component analysis (PCA).

PCA extracted two components with eigenvalues greater than 1, explaining a cumulative 58.81% of the total variance. After Varimax rotation, the first component accounted for 29.99% of the variance and was primarily associated with institutional and technical connectivity support (e.g., center-level connections and device accessibility). The second component explained 28.82% of the variance and reflected instructional and user-oriented support, including teacher guidance and children's needs for additional assistance with assistive technology.

The rotated component matrix showed satisfactory factor loadings, with all items loading meaningfully ($\geq .30$) on one of the two components, indicating a clear and interpretable factor structure.

Discussions

The study has showcased that deaf children are facing many challenges, particularly in communication and learning when they need a lot of time to learn sign language before entering the high school program. Therefore, the findings underscore the critical role that assistive technologies play in supporting deaf children's communication, education, and social integration. The children's responses reflect a consistent pattern of reliance on various technological devices—primarily hearing aids, smartphones, computers, and tablets—to overcome barriers related to auditory and verbal communication. Smartphones emerged as the most versatile and accessible device. Children reported using them for multiple purposes, including accessing educational materials, searching for information, communicating with peers and teachers, and engaging in group study. This aligns with existing research that identifies mobile technology as a vital tool for promoting digital inclusion and interactive learning among children with disabilities (Nagels et al., 2024; Potter et al., 2014). Furthermore, the portability and multifunctionality of smartphones make them a preferred choice for children who seek flexibility in learning and social interaction. Similarly, computers and tablets were cited for their value in enhancing online learning and visual engagement. Children noted that larger screens improved the visibility of content, making it easier to follow lessons, particularly for subjects such as mathematics, physics, and computer sciences. These findings resonate with previous studies demonstrating that visual-based instruction, when combined with accessible digital platforms, supports better academic outcomes for deaf students (Zehnwirth et al., 2025; Stewart et al., 2021). Hearing aids were also widely referenced, particularly for their utility in facilitating communication with parents, teachers, and peers. However, concerns about their limited effectiveness, damage over time, or battery failure were also raised. This highlights a broader issue of sustainability and maintenance, which often hinders consistent usage—especially in low-resource settings like Vietnam. In line with prior literature, this study confirms that although hearing aids and cochlear implants are effective in improving auditory perception, access and long-term functionality remain problematic (BO et al., 2014; WHO, 2016).

Interestingly, while children acknowledged the benefits of more advanced technologies—such as cochlear implants, virtual reality tools, or text-to-speech applications—these were largely out of reach due to high costs, limited availability, and lack of familiarity. This suggests a pressing need to bridge the gap between technological innovation and practical accessibility, especially for low-income families in developing countries. Moreover, the findings point to a need for localized and culturally relevant technological solutions tailored to the specific linguistic and educational contexts of deaf children in Vietnam. The study also revealed several challenges affecting deaf children's broader learning and development. These include delays in sign language acquisition, differences in regional sign language structure, and difficulties in expressing thoughts through written language. Such challenges reinforce the importance of simple, clear communication during

both instructional and research interactions with deaf children. The responses further emphasize that assistive devices must be not only effective but also convenient, affordable, and user-friendly. Many children rely heavily on their devices, particularly outside of school hours or during holidays, underscoring the need for sustained, daily access. The deterioration of older hearing aids and the lack of financial resources to replace them suggest a broader issue of systemic underinvestment in specialized support services for deaf children.

Deaf children express a clear desire for compact, user-friendly, and cost-effective technologies that support their learning and communication. They value the guidance and connection facilitated by educational institutions and teachers in accessing these resources. However, to truly bridge the digital divide, there remains an urgent need for stronger institutional commitment, sustained investment, and cross-sector collaboration to ensure that no child is left behind in the digital era.

Conclusion

Children with hearing impairments in Vietnam—and similar low- and middle-income contexts—face numerous challenges related to hearing rehabilitation, education, vocational training, and social inclusion. These children express a strong desire to be supported, particularly in communication and skill development. They recognize the importance of various technological devices in their daily lives, including smartphones, hearing aids, computers, tablets, and, to a lesser extent, cochlear implants, virtual reality tools, and speech-to-text devices. The findings confirm that communication barriers with hearing peers and a scarcity of specialized pedagogical resources constitute the primary challenges for deaf lower-secondary students in the Lam Dong and Dong Nai provinces. Furthermore, qualitative analysis identifies prohibitive hardware costs and insufficient professional development in technological integration for educators as the two critical impediments to the adoption of assistive technologies in these settings.

The study underscores the crucial role of schools, teachers, and support centers in connecting children with assistive technologies and guiding them in their use. Deaf children highly appreciate these efforts but express a need for continued and expanded support. Addressing the persistent gaps in access, affordability, and sustainability of assistive technologies requires a coordinated, multisectoral approach. Educators, policymakers, healthcare providers, and technology developers must work together to create inclusive environments where deaf children can thrive academically and socially. Ensuring equitable access to appropriate technology is a vital step toward promoting the well-being and full participation of deaf children in society.

This study contributes to both the theoretical and practical foundations supporting the use of technology to promote social inclusion for children with hearing impairments in specialized support centers. In Vietnam, the State has established specific regulations and policies aimed at supporting this population, with legal frameworks facilitating the integration of deaf children, particularly through the application of digital technologies. The upgrading and provision of technological equipment in schools serve as tangible examples of these policy commitments in practice. Nevertheless, the limited duration and scope of the study, which was conducted at only two centers, restrict the generalizability of the findings and do not fully capture the broader landscape of technological needs for inclusive education and learning among deaf students nationwide. Future research should therefore expand to include a larger number of specialized educational institutions across Vietnam to provide a more comprehensive understanding of technology use in supporting inclusion and learning for children with hearing impairments.

Competing interests

The authors declare no competing interests.

Ethics Committee Approval

This study was conducted in accordance with the ethical guidelines of the VNU University of Social Sciences and Humanities, Hanoi, which are clearly stipulated in Decision No. 4589/QĐ-XHNV (2023), to ensure the integrity and validity of the analysis. According to the institutional and national regulations applicable to this type of anonymized educational research, a separate ethics committee approval was not required.

Consent to participate

Participation in the study was voluntary. All students and their legal guardians were informed about the objectives and procedures of the research, their right to withdraw at any stage, and the confidentiality and anonymization of the reported data. Written informed consent was obtained from the participants' legal guardians prior to inclusion in the study.

Acknowledgements

We would like to thank deaf students and leaders from the two special education institutions for their voluntary participation and insights.

References

1. Anh, V. T. (2018). Thực nghiệm bước đầu sử dụng các phần mềm phân tích tiếng nói Cooledit và Praat giúp học viên nước ngoài và trẻ nghe kém phát âm đúng thanh điệu Tiếng Việt [Initial experiment on using cooledit and praat in teaching Vietnamese tones to foreigners and hard-of-hearing children]. *Tạp chí Khoa học Ngôn ngữ và Văn hóa [Journal of Inquiry into Languages and Cultures]*, 2(1), 1–8.
2. Asa'ad, I. A. U.-S. (2025). Smart Assistant for Deaf and Mute Using Micro:bit. *Protek: Jurnal Ilmiah Teknik Elektro*, 12(2), 106–111. <https://doi.org/10.33387/protk.v12i2.8091>
3. Bowman, M. E. (2018). The grand challenges of social work: Deaf children in the child welfare system. *Elsevier*, 88, 348–353. <https://doi.org/10.1016/j.childyouth.2018.03.034>
4. Burke, T. B., Kushalnagar, P., Mathur, G., Napoli, D. J., Rathmann, C., & Vangilder, K. (2011). Language Needs of Deaf and Hard-of-Hearing Infants and Children: Information for Spiritual Leaders and Communities. *Journal of Religion, Disability & Health*, 15(3), 272–295. <https://doi.org/10.1080/15228967.2011.590644>
5. Châu, V. M. (2024). Phát triển kỹ năng nghe cho trẻ khiếm thính 2 - 4 tuổi có sử dụng thiết bị trợ thính qua phần mềm Babybeats [Measures to develop listening skills for children with hearing difficulty at the age of 2 - 4 years old using hearing aids through Babybeats software]. *Tạp chí Khoa học Trường Đại học Thủ đô Hà Nội [Scientific Journal Of Hanoi Metropolitan University]*, 86, 5–15.
6. Dixon, R., Smith, P., & Jenks, C. (2004). Bullying and Difference: A Case Study of Peer Group Dynamics in One School. *Journal of School Violence*, 3(4), 41–58. https://doi.org/10.1300/J202v03n04_04
7. Fitriyani, F., Amalia, M., Pratama, M. V., & Pratiwi, N. A. (2024). Analysis of Social Interaction of Deaf Children in Special Schools. *Journal of Science and Research*, 5(1), 90–94. <https://doi.org/10.51178/jsr.v5i1.1760>
8. Freitas, E., Simões, C., Santos, A. C., & Mineiro, A. (2021). Resilience in deaf children: A comprehensive literature review and applications for school staff. *Community Psychology*, 50, 1198–1223. <https://doi.org/10.1002/jcop.22730>

9. General Statistics Office of Vietnam. (2018). *National survey on people with disabilities 2016*. Statistical Publishing House.
10. Govindan, N. P., & Ramma, S. (2014). Mathematical difficulties faced by deaf/hard-of-hearing children. *Conflux Journal of Education*, 2(7), 28–39. <https://doi.org/10.13140/RG.2.2.18528.99842>
11. Guo, Z., Ji, W., Song, P., Zhao, J., Yan, M., Zou, X., Bai, F., Wu, Y., Guo, Z., & Song, L. (2024). Global, regional, and national burden of hearing loss in children and adolescents, 1990–2021: a systematic analysis from the Global Burden of Disease Study 2021. *BMC Public Health*, 1–11. <https://doi.org/10.1186/s12889-024-20010-0>
12. Hoa, N. T. K. (2014). *Công tác xã hội với người khuyết tật [Social work with people with disabilities]*. Nhà xuất bản Đại học Quốc Gia Hà Nội [Hanoi National University House].
13. Hulme, C., Young, A., Rogers, K., & Munro, K. J. (2022). Deaf signers and hearing aids: motivations, access, competency and service effectiveness. *International Journal of Audiology*, 63(2), 136–145. <https://doi.org/10.1080/14992027.2022.2143431>
14. Jones, L., Atkin, K., & Ahmad, W. I. U. (2001). Supporting Asian Deaf Young People and their Families: The role of professionals and services. *Disability & Society*, 16(1), 51–70. <https://doi.org/10.1080/713662035>
15. Khairuddin, K. F., Miles, S., & McCracken, W. (2018). Deaf Learners' Experiences in Malaysian Schools: Access, Equality and Communication. *Social Inclusion*, 6(2), p. 46–55. <https://doi.org/10.17645/si.v6i2.1345>
16. Kim, E. J., Byrne, B., & Parish, S. L. (2018). Deaf people and economic well-being: findings from the Life Opportunities Survey. *Disability & Society*, 33(3), 374–391. <https://doi.org/10.1080/09687599.2017.1420631>
17. Ministry of Health of Vietnam. (2023). *Quyết định số 359/QĐ-BYT về việc ban hành văn bản “Hướng dẫn phát hiện sớm – Can thiệp sớm cho trẻ khuyết tật” [Decision No. 359/QĐ-BYT on the issuance of the document “Guidelines for early detection – Early intervention for children with disabilities”]*. <https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyết-dinh-359-QĐ-BYT-2023-tại-liệu-Hướng-dẫn-Phát-hiện-sớm-Cần-thiệp-sớm-khuyết-tật-trẻ-em-552196.aspx>
18. Murray, J. J., Hall, W. C., & Snoddon, K. (2019). Education and health of children with hearing loss: the necessity of signed languages. *Bulletin of the World Health Organization*, 97(10), 711–716. <https://doi.org/10.2471/BLT.19.229427>
19. Mwambe, O. O., Nathan, S. S., Nguyen-Duc, T., & Kamioka, E. (2018). FFCDH: Solution to Enable Face-to-Face Conversation between Deaf and Hearing People. *Journal of Computer and Communications*, 6(5), 1–14. <https://doi.org/10.4236/jcc.2018.65001>
20. Mỹ, C. T. X., & Hiền, Đ. T. (2007). Xây dựng CD “bé vui học vần” hỗ trợ việc học vần cho học sinh khiếm thính [Building a CD "Happy children to learn rhymes" to support rhyming learning for deaf students]. *Tạp chí Khoa học Đại học Sư phạm thành phố Hồ Chí Minh [Ho Chi Minh City University of Education]*, 12.
21. Nagels, L., Gaudrain, E., Vickers, D., Hendriks, P., & Başkent, D. (2024). Prelingually Deaf Children With Cochlear Implants Show Better Perception of Voice Cues and Speech in Competing Speech Than Postlingually Deaf Adults With Cochlear Implants. *Ear & Hearing*, 1–17. <https://doi.org/10.1097/AUD.0000000000001489>
22. National Deaf Children's Society. (2002). *Deaf children: Positive practice standards in social services*.
23. Ngôn, N. C., & Đa, Q. L. (2017). Ứng dụng Hamnosys và Avatar 3D Jasingning để dựng ảnh động ngôn ngữ ký hiệu Việt Nam [Application of Hamnosys and Avatar 3d jasingning to construction of Vietnamese sign language animations]. *Tạp chí Khoa học và Công nghệ Đại học Đà Nẵng [The University of Danang Journal of Science and Technology]*, 11(120), 61–65.

24. Olusanya, B. O., Neumann, K. J., & Saunders, J. E. (2014). The global burden of disabling hearing impairment: a call to action. *Bulletin of the World Health Organization*, 92(5), 367–373. <https://doi.org/10.2471/BLT.13.128728>
25. Parmar, B. J., Corbetto, M. S., Picinali, L., Mahon, M., Nightingale, R., Somerset, S., Cullington, H., Driver, S., Rocca, C., Jiang, D., & Vickers, D. (2024). Virtual reality games for spatial hearing training in children and young people with bilateral cochlear implants: the “Both Ears (BEARS)” approach. *Frontiers in Neuroscience*, 18. <https://doi.org/10.3389/fnins.2024.1491954>
26. Perrotta, F. (2024). Promotion Of School Inclusion For Students With Disabilities. *International Journal of Education & Social Sciences (IJESS)*, 5(7), 1060–1065. <http://www.ijess.org/wp-content/uploads/2024/08/IJESSP24510274.pdf>
27. Phương, Đ. T. M. (2010). Một số biện pháp tổ chức nhằm nâng cao hiệu quả công tác can thiệp sớm cho trẻ khiếm thính tại một số trường chuyên biệt Thành phố Hồ Chí Minh [Some organizational solutions for enhancing efficiency of the early intervention for the deaf children at some special schools in Ho Chi Minh City]. *Tạp chí Khoa học Đại học Sư phạm thành phố Hồ Chí Minh [Ho Chi Minh City University of Education]*, 22, 90–96.
28. Potter, L. E., Korte, J., & Nielsen, S. (2014). Design With the Deaf: Do Deaf Children Need Their Own Approach When Designing Technology? *Interaction Design and Children (IDC)*, 249–252. <https://doi.org/10.1145/2593968.2610464>
29. Scherer, N., Smythe, T., Hussein, R., Wapling, L., Hameed, S., Eaton, J., Kabaja, N., Kakuma, R., & Polack, S. (2023). Communication, inclusion and psychological wellbeing among deaf and hard of hearing children: A qualitative study in the Gaza Strip. *PLOS Glob Public Health*, 3(6). <https://doi.org/10.1371/journal.pgph.0001635>
30. Schild, S., & Dalenberg, C. J. (2016). Information Deprivation Trauma: Definition, Assessment, and Interventions. *Journal of Aggression, Maltreatment & Trauma*, 25(8), 873–889. <https://doi.org/10.1080/10926771.2016.1145162>
31. Stewart, H. J., Cash, E. K., Pinkl, J., Nakeva von Mentzer, C., Lin, L., Hunter, L. L., Moore, D. R., & CCHMC Division of Audiology. (2022). Adaptive hearing aid benefit in children with mild/moderate hearing loss: A registered, double-blind, randomized clinical trial. *Ear and Hearing*, 43, 1402–1415. <https://doi.org/10.1097/AUD.0000000000001230>
32. Thiệp, T. T. (2016). *Giáo trình ngôn ngữ kí hiệu thực hành [Practical Sign Language Curriculum]*. Nhà xuất bản Đại học Sư phạm [University of Education Publishing House].
33. Umah, R. N., Angraeni, M., Usman, & Fitriyani. (2024). Communication Skills of Deaf Children. *Journal of Science and Research*, 5 (1), 77–83. <https://doi.org/10.51178/jsr.v5i1.1758>
34. World Health Organization. (2016). *Childhood hearing loss: strategies for prevention and care*. <https://iris.who.int/handle/10665/204632>
35. World Health Organization. (2025). *Deafness and hearing loss*. Retrieved February, 26, 2026, from <https://www.who.int/en/news-room/fact-sheets/detail/deafness-and-hearing-loss>
36. World Health Organization, UNESCO, International Labour Organization, & International Disability and Development Consortium. (2010). *Community-based rehabilitation: CBR guidelines*. World Health Organization. <https://iris.who.int/handle/10665/44405>
37. Yoshinaga-Itano, C., Sedey, A. L., Coulter, D. K., & Mehl, A. L. (1998). Language of early-and later identified children with hearing loss. *American Academy of Pediatrics*, 102(5), 1161–1171. <https://doi.org/10.1542/peds.102.5.1161>
38. Young, A. (2002). Factors affecting communication choice in the first year of life – assessing and understanding an on-going experience. *Deafness and Education International*, 4(1), 2–11. <https://doi.org/10.1179/146431502790560935>

39. Zehnwirth, N., Smith, L., Shepherd, D. A., & Sung, V. (2025). Developmental Profiles of Young Deaf and Hard of Hearing Children and Their Associated Predictors. *Child: Care, Health and Development*, 1–13. <https://doi.org/10.1111/cch.70129>