

Assistive Technology for Visually Impaired Students

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ABSTRACT

This study investigates the challenges faced by visually impaired students in Pakistan using assistive technology. The research employs a qualitative approach to explore the barriers and facilitators in the educational journeys of these students. Data was collected through interviews and analyzed using thematic analysis. The findings reveal a range of challenges, including accessibility issues, lack of training, and social stigma. However, assistive technology also provides students with increased independence and academic success when used effectively. These insights contribute to understanding how assistive technology can be better integrated into educational practices for visually impaired students in Pakistan.

Keywords: Assistive technology, visually impaired, qualitative research, educational challenges

1. Introduction

In recent years, there has been a growing emphasis on the role of assistive technology in supporting students with disabilities, particularly those with visual impairments. The World Health Organization (WHO, 2022) estimates that over 2.2 billion people globally experience some form of vision impairment, making assistive technology a crucial tool for visually impaired students, particularly in countries like Pakistan. For these individuals, access to quality education often hinges on the availability and effectiveness of assistive technologies designed to bridge the gap between disability and learning.

Pakistan, like many developing countries, faces significant challenges in providing equitable educational opportunities for students with disabilities. While international conventions, such as the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), emphasize the importance of inclusivity, the implementation of these policies has been slow. Visually impaired students in Pakistan often encounter barriers in accessing education due to a lack of resources, societal stigma, and inadequate infrastructure (Khan & Iqbal, 2020). To address these challenges, assistive technology provides vital tools, such as screen readers, Braille displays, and specialized software applications, that can transform the learning experience for visually impaired students.

Assistive technology, including screen readers, Braille displays, and magnification devices, has the potential to level the playing field. However, these technologies are not universally available, and many students continue to rely on outdated or inadequate resources. This disparity severely limits their academic performance, future employment opportunities, and social inclusion. These technologies have the potential to level the playing field by providing visually impaired students with access to educational materials and resources that are otherwise inaccessible. However, the availability and effectiveness of these tools vary greatly depending on factors such as socioeconomic status, geographical location, and institutional support.

This research explores the lived experiences of visually impaired students in Pakistan as they use assistive technology in their educational journeys. By examining the barriers they face and the strategies they use to navigate these challenges. The study aims to, inform future policy and practice, ensuring more inclusive educational environments for these students.



1.1 Problem Statement

Despite advancements in assistive technology, its utilization among visually impaired students in Pakistan remains limited. Students often rely on traditional learning methods, which fail to meet their specific needs, leading to suboptimal educational outcomes. The dependence on traditional lecture-based approaches, blackboards, and printed handouts raises further challenges. VI pupils cannot benefit from visual aids or written assignments unless they are converted to Braille, audio, or big print forms, which is rarely done in a timely fashion. The difficulty is exacerbated in courses like physics and mathematics, where visual representations such as graphs and diagrams are critical. Many professors avoid involving VI children in lab-based learning because of the perceived difficulties of adaption. Furthermore, most AT tools are created in English or other Western languages, making them less useful for Urdu-speaking learners. The lack of Urdu-compatible screen readers and Braille systems restricts access to national curriculum content. Software localization, including text-to-speech engines in Urdu and regional dialects, is still in its early stages, limiting the usefulness of otherwise sophisticated capabilities. Furthermore, cultural subtleties are frequently not included in imported software. For example, apps that rely on Western analogies or metaphors may fail to resonate with Pakistani learners, lowering interest and comprehension. Culturally appropriate, regionally designed solutions are critical for maximizing AT's full potential. This exclusion perpetuates educational disparity. This study aims to investigate the challenges associated with using assistive technology in educational settings and to identify areas where improvements can be made.

1.2 Purpose of the Study

The primary aim of this research is to explore the qualitative experiences of visually impaired students in Pakistan regarding their use of assistive technology. The slow pace of policy implementation and the gap between policy and practice raise questions about the commitment of the government and educational institutions to truly inclusive education. The need for a more proactive and responsive policy framework is evident, one that not only acknowledges the importance of assistive technology but also actively works towards making it a reality in classrooms across Pakistan. Despite multiple legislative commitments, Pakistan has made little headway in establishing accessible education and encouraging the use of assistive technologies. The Directorate General of Special Education has just 11 centres for VI kids countrywide (JICA, 2002), and they are frequently concentrated in metropolitan locations, leaving rural people neglected.

1.3 Research Question

1. What Are the Challenges Faced by Visually Impaired (VI) Students Associated with the Use of Assistive Technology?

1.4 Significance of the Study

This research is significant for several reasons. First, it contributes to the growing body of literature on assistive technology for students with disabilities, particularly in the context of developing countries like Pakistan. While much of the existing research focuses on developed countries, where assistive technologies are more widely available, this study highlights the unique challenges faced by students in resource-constrained environments. Second, the findings of this research have practical implications for educators, policymakers, and technology developers. By understanding the specific barriers faced by visually impaired students, educational institutions can develop more targeted interventions to support these students. Additionally, policymakers can use this research to advocate for more inclusive policies that promote the widespread availability of assistive technology in schools and universities. For technology developers, the insights gained from this study can inform the design of more user-friendly and culturally appropriate assistive devices and software.

2. Literature Review

The role of assistive technology in education, particularly for visually impaired students, has been widely researched across different global contexts. While assistive technology has opened up new possibilities for students with disabilities, its integration into educational settings remains uneven, especially in developing countries like Pakistan. This literature review provides an overview of existing studies on the use of assistive technology for visually impaired students, highlighting key challenges and opportunities that shape their educational experiences. The debate

over the best ways to integrate and utilize assistive technology in the education of visually impaired students is ongoing. While there is a consensus on the potential benefits of these technologies, the challenges of implementation, cost, and training remain significant hurdles. Moreover, the question of how to ensure equitable access to these technologies is critical. In Pakistan, addressing these issues is not just a matter of improving education for visually impaired students; it is a crucial step towards building a more inclusive and equitable society.

While Pakistan adopted the UNCRPD and enacted the Sindh Right of Children to Free and Compulsory Education Act (2013), implementation has been shallow. Most regulations do not clearly address inclusiveness or give specific instructions for AT integration. Furthermore, there is a lack of cooperation across many ministries (education, IT, and social welfare), resulting in fragmented activities.

2.1 Assistive Technology and Education

Assistive technology (AT) includes tools like screen readers, Braille displays, magnification devices, and voice recognition software. According to Wachiuri (2015), assistive technology enables visually impaired individuals to engage more fully in academic and social environments, providing them with greater independence and access to learning resources. This study offers a comprehensive analysis into the accessibility, use and challenges related to assistive technology (AT) for VI students in Pakistani institutions, with an emphasis on the transformative potential of AT products such as KNFB Reader, TapTapSee, Supersense, Be My Eyes, and NVDA. Most AT tools are created in English or other Western languages, making them less useful for Urdu-speaking learners. The lack of Urdu-compatible screen readers and Braille systems restricts access to national curriculum content. Software localization, including text-to-speech engines in Urdu and regional dialects, is still in its early stages, limiting the usefulness of otherwise sophisticated capabilities. Furthermore, cultural subtleties are frequently not included in imported software. For example, apps that rely on Western analogies or metaphors may fail to resonate with Pakistani learners, lowering interest and comprehension.

In educational settings, AT has been described as a “great equalizer” (Michaels & McDermott, 2003), allowing visually impaired students to participate in classroom activities alongside their sighted peers. Tools like screen readers and Braille note-takers help students access reading materials and complete assignments independently. Additionally, mobile applications like KNFB Reader and Be My Eyes have become essential for visually impaired individuals to navigate both academic and everyday tasks (Martinez, 2020).

However, the successful implementation of AT in education depends heavily on factors such as teacher training, institutional support, and student awareness (Kelly & Smith, 2011). In many cases, visually impaired students are left to navigate assistive technology on their own, often without adequate guidance from educators or technical staff. This lack of support can lead to underutilization of available technologies, further exacerbating the educational disparities faced by these students (Borg & Stergren, 2015).

2.2 Challenges in the Adoption of Assistive Technology

Despite its potential, assistive technology remains underutilized in many parts of the world, particularly in developing countries. Johnson (2011) highlights several barriers to the effective use of AT, including financial constraints, and societal stigma. Pakistan's educational system is predominantly developed for sighted students. The majority of learning resources are printed, teaching methods are visual, and test formats are inaccessible to those with visual impairments. Even colleges labelled as “inclusive” frequently do not provide Braille or audio resources. An inflexible curriculum that does not permit alternate learning styles further reduces accessibility, making it harder for VI students to participate meaningfully in the learning process.

Technological gaps worsen this problem. Most AT tools used worldwide are not only expensive, but also linguistically unsuitable with Pakistan's multilingual environment. Students who are fluent in Urdu or other regional languages struggle to use English-based technologies. Furthermore, inconsistent internet connections and frequent power outages impede the use of web-based AT apps.

In Pakistan, where education systems are often underfunded, the cost of assistive devices can be prohibitively high for many students. Moreover, the availability of such technology is typically limited to urban centers, leaving students in rural areas with few or no options for accessing the tools they need (Khan & Mahmood, 2022).

Another significant challenge is the lack of training for both students and educators. While AT can significantly enhance learning outcomes for visually impaired students, its effectiveness largely depends on the user's ability to operate the tools efficiently. In a study conducted by Kelly (2008), it was found that even in developed countries like the United States, a significant portion of visually impaired students did not use assistive technology to

its full potential due to a lack of proper training. This issue is even more pronounced in countries like Pakistan, where teachers themselves may not be familiar with the latest AT devices or how to integrate them into the classroom.

Cultural attitudes towards disability also play a critical role in shaping the experiences of visually impaired students. In many communities, disabilities are stigmatized, and students who rely on assistive devices may face social isolation or discrimination. This stigma can discourage students from using assistive technology, even when it is available to them. According to Ferri et al. (2020), cultural perceptions of disability in Pakistan often position individuals with impairments as objects of pity, further limiting their opportunities for education and social participation. In Pakistan, the stigma associated with disability remains a substantial obstacle. Disability is sometimes perceived as a divine punishment or a source of pity, rather as a condition that can be managed with the correct help. These beliefs influence VI students' willingness to utilize AT technologies openly.

Students who use assistive technology may be mocked or perceived as abnormal by their peers, discouraging them from utilizing these technologies in public. This social pressure erodes their confidence and fosters isolation. Bullying or passive neglect in the classroom can have a significant impact on the mental health of VI kids.

2.3 Assistive Technology in Developing Countries

While the benefits of assistive technology are well-documented in developed countries, research on its use in developing nations remains limited. In low-resource settings, students with disabilities face additional challenges in accessing education due to infrastructural deficits, limited funding, and the absence of policy frameworks that support inclusive education (Pal et al., 2017). In Pakistan, the situation is particularly dire, with many schools and universities lacking the basic infrastructure needed to support visually impaired students (Khan & Iqbal, 2020). Even when AT tools become available, they are typically obsolete or incompatible with current software and systems. Schools frequently get used or donated technology that no longer supports the most recent versions of instructional apps. Students have reported numerous gadget failures, low battery life, and a lack of technical help, all of which reduce the perceived utility and simplicity of use. Without technical maintenance, even the best devices can become useless. Moreover, lack of user training often leads to equipment misuse or neglect. Thus, ownership does not equate to effective use, further perpetuating the digital divide.

In a study by Ampratwum et al. (2016), it was noted that less than 10% of the population in need of assistive technology in developing countries has access to it. This gap highlights the critical need for more investment in AT infrastructure, as well as the development of localized solutions that can cater to the unique cultural and linguistic needs of students in these regions. In Pakistan, the introduction of low-cost, locally developed assistive tools could help bridge the gap, making AT more accessible to students in rural and underserved areas (Ahmed & Mahmood, 2019).

2.4 Policy and Institutional Support for Assistive Technology

Government initiatives and institutional support are key factors in the successful implementation of assistive technology in educational settings. In countries where inclusive education is prioritized, policies are in place to ensure that students with disabilities have access to the tools and resources they need. For instance, the United States' Individuals with Disabilities Education Act (IDEA) mandates the provision of assistive technology for students with special needs, ensuring that visually impaired students have the necessary tools to succeed in school (Smith, 2008).

In contrast, Pakistan's policy framework for inclusive education is still in its early stages. Although the country ratified the UN Convention on the Rights of Persons with Disabilities in 2011, there has been little progress in terms of implementing policies that support the widespread availability of assistive technology in schools and universities. As of 2023, Pakistan has only a few state-funded programs aimed at providing AT to students with disabilities, and these programs are often limited in scope and reach (Fatima et al., 2023). The lack of coordinated efforts between governmental bodies, educational institutions, and NGOs further hinders the ability of visually impaired students to access assistive tools.

Recent research has emphasized the need for a more robust and responsive policy framework that not only recognizes the importance of assistive technology but also actively works to integrate it into educational systems. A study by Siddiqua et al. (2022) suggests that inclusive education policies in Pakistan must be accompanied by increased funding for assistive technologies, teacher training programs, and advocacy initiatives that promote the rights of students with disabilities.

3. Methodology

This section outlines the qualitative methodology employed in the study, focusing on how data was collected, analyzed, and interpreted to explore the experiences of visually impaired students using assistive technology in Pakistan. The qualitative approach allows for an in-depth understanding of the subjective experiences and challenges faced by these students, providing rich, descriptive data that quantitative methods might not capture. To better understand how people interact with and feel about the technology being studied, researchers might utilize qualitative approaches like interviews and focus groups during the exploratory phase.

3.1 Research Design

The study adopted an exploratory qualitative research design, using semi-structured interviews as the primary data collection method. Given the study's focus on understanding the lived experiences of visually impaired students, qualitative research was deemed the most suitable approach. This design allows for flexibility in questioning, enabling the participants to share their experiences freely while still addressing the core research questions. The exploratory nature of the study was essential, as there is limited existing research on the use of assistive technology by visually impaired students in Pakistan. The study sought to uncover not just the barriers but also the personal strategies and coping mechanisms these students developed in navigating educational challenges with the help of assistive tools.

3.2 Sampling and Participants

The sample for the study consisted of visually impaired university students enrolled in various higher education institutions in Lahore, Pakistan. These students were selected through purposive sampling, a technique widely used in qualitative research to target individuals who are most likely to provide relevant data for the study (Patton, 2002). Participants were chosen based on their self-reported use of assistive technology in their academic settings.

The sample size included 15 students, which aligns with recommendations for qualitative research where the goal is to obtain in-depth, detailed data rather than statistical generalizability. The sample was diverse in terms of gender and academic discipline, with students from different faculties such as humanities, sciences, and social sciences. All participants were informed about the study's purpose, and informed consent was obtained prior to conducting the interviews.

3.3 Data Collection

Data was collected through semi-structured interviews, a method that allows participants to express their thoughts and experiences in their own words while providing some structure to ensure that key topics are covered. The interviews were conducted in person and lasted between 45 minutes and one hour. Each interview was recorded with the participants' consent and later transcribed verbatim for analysis.

The interview questions were designed to explore various aspects of the participants' experiences with assistive technology.

The use of semi-structured interviews provided flexibility, allowing participants to elaborate on topics that were particularly important to them. Follow-up questions were asked when necessary to clarify points or delve deeper into specific experiences.

3.4 Data Analysis

Thematic analysis was employed to analyze the qualitative data. Thematic analysis is a widely used method in qualitative research that involves identifying, analyzing, and reporting patterns (themes) within the data (Braun & Clarke, 2006). It is particularly useful for exploratory studies like this one, where the goal is to uncover themes related to participants' experiences and perceptions.

Throughout the analysis, the researcher used NVivo, a qualitative data analysis software, to organize and manage the data. This software was particularly helpful in handling large amounts of textual data and in identifying connections between different themes.

3.5 Ethical Considerations

Ethical considerations were given priority throughout the research process. Before data collection, all participants were informed of the study's purpose, and they provided consent to participate. They were assured that their responses would remain confidential, and pseudonyms were used to protect their identities. Furthermore, participants were made aware that they could withdraw from the study at any point without consequence.

3.6 Limitations of the Study

While this research offers valuable insights into the experiences of visually impaired students using assistive technology, it is not without limitations. First, the study's findings are based on a relatively small sample size and are geographically limited to students in Lahore. As a result, the experiences of visually impaired students in other regions of Pakistan may differ.

Second, the qualitative nature of the study means that the findings are not generalizable to the broader population of visually impaired students. It posits that perceived usefulness and perceived ease of use are critical determinants influencing users' attitudes and behavioral intentions towards technology. However, the purpose of qualitative research is not to generalize but to provide in-depth, context-specific insights, which this study has achieved. Future research could build on this study by incorporating a larger, more diverse sample and potentially using mixed methods to gather both qualitative and quantitative data.

4. Results

The data collected through interviews with visually impaired students revealed several recurring themes related to their experiences with assistive technology in academic settings. These themes include accessibility challenges, lack of institutional support, social stigma, and the role of assistive technology in fostering independence. In this section, these themes are explored in detail, with a discussion on how they relate to the broader context of assistive technology use in education, particularly in developing countries like Pakistan.

4.1 Accessibility Challenges

A recurring theme among the participants was the difficulty in accessing modern assistive technology. Most students reported that while they were aware of advanced tools such as screen readers and Braille displays, these devices were often unavailable or outdated in their educational institutions. One participant stated:

"The university has a few Braille displays, but they are always in high demand, and often, they don't work properly. I end up relying on my own devices, which are not always up to date."

This finding reflects the broader issue of resource allocation in educational institutions in Pakistan. As Khan & Iqbal (2020) noted, while urban centers may have some resources for students with disabilities, access remains limited, especially in rural areas where many students are left without even basic assistive tools. One of the most obvious issues is financial inaccessibility. Braille embossers, screen readers like JAWS, and Braille notetakers can cost hundreds of dollars or more, placing them out of reach for the ordinary Pakistani household. Even when available through institutional assistance, these devices frequently incur additional fees for maintenance, software upgrades, and compatible hardware.

Students from economically poor backgrounds are disproportionately affected. For many of them, education is a luxury, and the added demand for specialized equipment throws an unreasonable load on families. Unlike affluent countries that distribute AT devices through governmental or insurance subsidies, Pakistan lacks extensive social programs in this area.

In comparison, students in developed countries often have access to cutting-edge assistive technology as part of government-supported inclusive education programs (Wachiuri, 2015).

The lack of adequate infrastructure not only hampers students' ability to fully participate in academic activities but also affects their academic performance. Some participants expressed frustration at falling behind their sighted peers due to the delays in accessing accessible formats of study materials. For instance, textbooks in Braille or audio format were either unavailable or took weeks to arrive, leaving students to rely on the limited resources they had.

4.2 Lack of Institutional Support

Another significant theme that emerged was the lack of institutional support for visually impaired students. Most participants reported that while their universities were aware of their needs, they did not receive sufficient support in terms of training or guidance in using assistive technology. As one student noted:

"We are given the tools, but no one tells us how to use them properly. I had to figure out the screen reader on my own, and even then, it doesn't always work the way I need it to."

This reflects findings from other studies that highlight the importance of training for both students and educators in the effective use of assistive technology (Kelly & Smith, 2011). In Pakistan, where teacher training programs rarely include components on assistive technology, visually impaired students are often left to navigate these tools on their own, limiting their potential for success (Ampratwum et al., 2016). The lack of trained technical staff in many institutions exacerbates this problem, leaving students without adequate support when they encounter issues with their devices. A significant challenge in Pakistan is the lack of adequately trained educators equipped to use and teach with assistive technologies. The effectiveness of these technologies heavily depends on the teachers' ability to integrate them into their teaching methodologies. Professional development programs and training workshops are imperative for equipping educators with the requisite skills and knowledge. However, such programs are often limited in scope and reach, necessitating a more systemic approach to teacher training in assistive technologies (Malik & Zia, 2021).

This gap in training underscores a broader issue in the educational system, where the professional development of teachers is not always aligned with the evolving needs of students, particularly those with disabilities. The lack of trained educators is not just a logistical challenge but also reflects a deeper issue of value and priority within the educational system. The need for comprehensive and ongoing professional development for teachers is critical in ensuring that assistive technology is effectively integrated into the educational experience of visually impaired students.

This situation is further complicated by the fact that many educators themselves are unaware of how to integrate assistive technology into their teaching practices. Participants reported that teachers would often distribute materials in formats that were inaccessible to them, such as standard printed handouts or PowerPoint slides that were not compatible with screen readers. This lack of awareness among educators creates additional barriers for visually impaired students, reinforcing their sense of exclusion.

4.3 Social and Cultural Stigma

Cultural attitudes towards disability emerged as a central theme in the interviews. Many participants described feeling "othered" due to their reliance on assistive technology. For example, one student shared:

"People always stare when I use my screen reader or ask someone for help reading something. It makes me feel like I don't belong in the same space as everyone else."

This sense of isolation and exclusion is not unique to Pakistan. In many countries, disabilities are still stigmatized, and students who use assistive technology may be viewed as different or incapable (Ferri et al., 2020). In the Pakistani context, where disabilities are often framed through a charitable lens, visually impaired students are frequently pitied rather than empowered. This societal view affects how they are treated in academic settings, with many students feeling that their classmates and even educators do not fully understand their capabilities or the potential of assistive technology.

Participants also noted that the stigma surrounding disability often extended to their families, who were hesitant to invest in assistive technology due to a lack of awareness about its benefits. As one participant explained:

"My family didn't understand why I needed a screen reader. They thought I was better off sticking with traditional methods because it was cheaper."

This highlights the need for broader public awareness campaigns to educate families and communities about the benefits of assistive technology for visually impaired individuals. Without this understanding, students may face resistance not only in educational settings but also at home, where financial and emotional support is crucial for their academic success.

4.4 Independence and Empowerment

Despite the challenges, most participants expressed that assistive technology had a positive impact on their independence and academic performance. Tools like screen readers, Braille displays, and mobile applications such as

Be My Eyes were cited as essential for helping students navigate both their studies and everyday tasks. One student noted:

"Before I started using a screen reader, I had to rely on my friends to read things for me. Now, I can study on my own and feel like I have more control over my education."

This sense of empowerment is echoed in the literature, where assistive technology is often described as a tool for enhancing autonomy and participation in academic and social environments (Michaels & McDermott, 2003). For visually impaired students, being able to access educational materials independently is crucial for their self-esteem and motivation to succeed in their studies.

The use of mobile applications also played a significant role in increasing students' independence. Apps like KNFB Reader, which converts printed text into speech, were particularly valued for their convenience and ease of use. As one participant explained:

"I use KNFB Reader all the time. It's like having someone read things to me whenever I need it, which is a huge relief when I'm studying."

However, the effectiveness of these tools was often limited by the lack of institutional support and access to training. While students recognized the potential of assistive technology to improve their academic experience, they also acknowledged that its full benefits could not be realized without proper guidance and support from their institutions.

4.5 Institutional Variability

The participants also highlighted the inconsistent availability of assistive technology across different institutions. Some universities provided basic tools like screen readers and Braille printers, while others offered little to no support for visually impaired students. This variability created unequal learning opportunities, with students at more resource-rich institutions benefiting significantly from access to technology, while others had to rely on outdated devices or personal funds to purchase necessary tools.

This disparity is reflective of broader systemic issues in Pakistan's educational infrastructure. While some institutions are making strides towards inclusivity, the majority still lack the resources and policies needed to fully support students with disabilities. As Fatima et al. (2023) noted, without coordinated efforts at the governmental and institutional levels, students with disabilities will continue to face significant barriers in accessing quality education.

5. Discussion

The findings of this study highlight the complex and multifaceted challenges faced by visually impaired students in Pakistan when using assistive technology. While the technology itself holds immense potential to enhance educational outcomes, its effectiveness is significantly hindered by systemic issues such as lack of institutional support, social stigma, and accessibility barriers. These challenges are not unique to Pakistan; however, they are exacerbated by the country's limited resources and infrastructural deficits.

Addressing these issues requires a holistic approach that involves not only technological improvements but also changes in policy, education, and societal attitudes. Educational institutions must prioritize training for both students and educators in the use of assistive technology, and policies must be put in place to ensure that all students have access to the tools they need to succeed. Additionally, public awareness campaigns are needed to challenge the stigma surrounding disability and promote the potential of assistive technology to transform lives.

6. Conclusion

The use of assistive technology among visually impaired students in Pakistan presents both significant opportunities and considerable challenges. As this study has shown, assistive technology can empower students, enabling them to achieve greater independence and academic success. Tools such as screen readers, Braille displays, and mobile applications have the potential to transform the educational experience for visually impaired students, providing them with access to resources that would otherwise be out of reach.

However, despite its potential, the effective use of assistive technology in Pakistan is hindered by several systemic barriers. Accessibility remains a primary concern, with many students reporting limited availability of modern assistive tools in their educational institutions. This lack of access is compounded by the absence of institutional support, with many universities failing to provide adequate training for both students and educators. As a result, students are often left to navigate assistive technology on their own, leading to underutilization of available tools and reduced academic outcomes.

Social and cultural stigma further complicates the use of assistive technology. In a society where disabilities are often viewed through a lens of pity or charity, visually impaired students are frequently marginalized, and their reliance on assistive tools is seen as a sign of weakness. This societal perception discourages students from fully embracing assistive technology, limiting its positive impact on their education.

The findings of this study have several implications for policymakers, educators, and technology developers. Based on the aforementioned issues, numerous approaches are proposed:

Government-Level Interventions

- Increase budget allocation for special education and assistive technology procurement.
- Develop and implement a nationwide inclusive education policy that requires AT integration.
- Collaborate with international organizations to localize and subsidize AT tools.
- Establish procedures for monitoring and evaluating policy implementation to guarantee accountability.

Institutional Measures

- Establish accessibility audit guidelines for schools and universities.
- Require teacher training on AT and inclusive pedagogy.
- Establish on-campus accessibility resource centers.
- Promote interdepartmental collaboration to foster inclusive settings.

Community Engagement:

- Develop awareness campaigns to promote inclusive behaviors and reduce stigma surrounding disability.
- Develop community-based initiatives to educate families and guardians on the use of assistive technologies.
- Engage local NGOs and disability rights groups in advocacy and implementation.

In addition, public awareness campaigns are needed to challenge the stigma surrounding disability and promote the use of assistive technology. These campaigns should target not only educational institutions but also families and communities, emphasizing the benefits of assistive technology for visually impaired individuals. By changing societal attitudes towards disability, we can create a more inclusive environment where all students are given the opportunity to succeed.

Finally, future research should build on the findings of this study by exploring the experiences of visually impaired students in other regions of Pakistan and in different educational settings. A larger, more diverse sample would provide a broader understanding of the challenges and opportunities associated with assistive technology in education. Additionally, mixed-methods research that combines qualitative and quantitative approaches could offer deeper insights into the effectiveness of assistive technology in improving educational outcomes.

In conclusion, while assistive technology holds great promise for visually impaired students in Pakistan, its potential is currently limited by a lack of resources, institutional support, and societal acceptance. By addressing these challenges through policy reforms, increased investment, and public awareness, we can create a more inclusive education system that empowers all students, regardless of their abilities.

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Author contributions

Conceptualization, M.A.; methodology, M.A.; software, M.A.; validation, M.A.; writing—original draft preparation, M.A.; writing—review and editing, M.A.

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