*Research Article*

# In their Own Words: Exploring Students' Perspective on Accessing Assistive Technologies in a Blind School

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**Abstract**

*Assistive technologies are pivotal in enhancing the daily lives of students with visual impairments (SVIs), facilitating activities such as orientation, mobility, reading, writing, and exploring their surroundings. This study adopts a qualitative case study approach to investigate the availability of assistive technologies at a blind school in Delhi and understand the perspective of SVIs towards accessing these technologies. Participants in the study include middle school students aged 12-18 years. Primary data is gathered through observations, unstructured interviews, and conversations, complemented by secondary data from relevant literature. The data is analyzed thematically by categorizing it using an iterative reflective process. The results indicate a prevalence of traditional assistive technologies in schools, including Braille Slate, Stylus, Braille Books, and Taylor Frame for Arithmetic. Students exhibit a preference for these traditional tools, finding them more comfortable. Nevertheless, smartphones are concurrently utilized to stimulate academic and leisure interests. The study highlights the limited reach of various assistive technologies at the grassroots level. Students' engagement with traditional assistive technologies and smartphones for learning introduces an intersubjective dimension, rendering them more preferable to alternative options*

**Keywords:** Assistive technologies, accessibility, students with visual impairment, smartphones, blind school

## Introduction

Nearly one in three students with disabilities in India has a visual impairment (29 per cent), as reported by the Eighth All India School Education Survey (NCERT, 2016). To support the daily living and education of SVIs, the Rights of Persons with Disabilities Act, 2016 (RPWD Act, 2016) and National Education Policy 2020 (NEP, 2020) ensure assistive devices, appropriate technological tools, and language-appropriate teaching-learning material such as Braille and large print for SVIs. Moreover, various governmental entities, including the National Council for Educational Research and Training (NCERT), the National Institute for the Empowerment of Persons with Visual Disabilities (NIEPVD), and the Artificial Limbs Manufacturing Corporation of India (ALIMCO), are dedicated to enhancing accessibility to education and improving the quality of life for individuals with visual impairments. This commitment is manifested through the development and manufacture of assistive technologies and devices tailored to the specific needs of SVIs. In this direction, one such initiative has been taken in the form of Assistance to Disabled Persons for Purchase/Fitting of Aids and Appliances (ADIP Scheme). For approximately three decades, this scheme has been a cornerstone in operationalizing policy initiatives concerning assistive technologies

for persons with disabilities (PwDs). Focused on facilitating physical, social, and psychological rehabilitation, the scheme empowers PwDs by providing essential aids and appliances. In 2020 alone, twenty-one dedicated ADIP camps were held nationwide, effectively distributing crucial assistive resources.

## Available Assistive Technologies for SVIs

The World Health Organization (WHO) frames assistive technology as a comprehensive system encompassing devices and services that empower individuals with disabilities to function independently within their environment. This definition expands beyond tools to encompass the infrastructure and support necessary for effective utilization. As Ravneberg and Söderström (2017) emphasize, assistive technologies not only simplify daily tasks for persons with disabilities but also facilitate their active participation in social life, aligning with the principles of universal design. Advancements in technology have driven the evolution of these tools, leading to a diverse array of solutions applicable across various aspects of daily living, from mobility and education to sports and leisure. Furthermore, Laconsay et al. (2021) argued that the incorporation of technology in (chemistry) education benefits not only the SVIs but also the sighted students. In the Indian context, various assistive technologies are available, developed, and distributed through the above-mentioned government entities and schemes. Some of the assistive technologies available in India (Department of Empowerment of Persons with Disabilities (Divyangjan), Ministry of Social Justice and Empowerment, Government of India, 2014; SakTek, n.d.) are described below:

### Orientation and Mobility

For orientation and mobility, various canes are available for SVIs. There are white canes, including rigid long canes and foldable canes, that help detect the obstacles in the way. There are smart canes which are foldable and come with detachable sensors. These ultrasonic sensor units inform the user about the potential obstacles with the help of vibrations. Also, various spectacles are available for persons with low vision, which help with orientation and mobility.

### Educational kits and devices

1. **Reading and Writing-** For assistance in reading, a wide range of devices and software are available according to the needs of SVIs. There are devices and software like handheld magnifiers and magnifying software for low-vision students. The other available assistive technologies for reading are Audiobooks, Daisy Player, and Victor Reader (used for listening to audio files and text files through read-aloud options and recording lectures). Similarly, the Refreshable Braille Displays are used as an alternative to standard computer monitors to help SVIs read output text. Also, there is a variety of built-in software with screen reading features in computers, tablets, laptops, and smartphones, which help navigate these devices and read different document file formats. Such software includes Job Access with Speech (JAWS), Non-Visual Desktop Access (NVDA), TalkBack, and Google Text to Speech.

   For assistance in writing, the Braille Slate and Stylus are traditional equipment that comes in two varieties: interline and interpoint. Various voice typing software is built

into computers and smartphones, and devices like Braillers and Orbit Writer (Braille Keyboard for Computers and Smartphones) are also available.

2. **Mathematics-** The available assistive technologies for mathematics learning are the Taylor Frame and cubarithm, which are used for mathematical calculations of arithmetic and algebra. Also, an Abacus with Braille markings is available for mathematical calculations. There is a geometric board with accessories such as a serrated scale, spring divider, Braille Protector with serrated arms fitted, Aluminum Spoon, Braille Quarter Protector, serrated Circle, and Foot Ruler. Additionally, for the measurement, the measuring tape with inch and centimetre markings stapled with pins was used for tactile cues.
3. **Science and Social Science-** To assist SVIs in science, tactile diagrams are embossed on the plastic cards. Also, for social science, there is a tactile globe and tactile drawing books for various monuments.

**Games and Sports-** For playing purposes, many sports equipment are modified to make them accessible to SVIs. These include an Audible Cricket Ball, Braille Playing Cards, a Chess Board, a Draught Board with plastic coins, a Tactile Snake and Ladders with Dice, Ludo with Dice and Dice Plate, a Scrabble board with plastic coins, a Puzzle, and an Audible Football.

**Daily Living-** To assist the SVIs in their daily living, some of the assistive technologies are Smart Phone with accessibility features, Talking and Tactile Watch, Large Print Watches, Talking Pulse Oximeter, Talking Blood Pressure Monitors, Talking Thermometer, Talking Calculator, Tactile Medicine Pill Box/ Dispenser, Plastic Measuring Jugs and Beaker, Measuring Cups and Spoon, Liquid level Indicator with Sound and Vibration Feedback, Signature Guide, Bumpons (labeling devices).

Many studies (Senjam et al., 2022; Ghai et al., 2022; Bhatt & Kumari, 2015; Murphy & Darrah, 2015; Tagore, n.d.) have found the critical role of assistive technologies and devices in supporting the education of SVIs in school. These studies report the various devices and technologies and how the SVIs can utilize them. The assistive technologies are based on other sensory stimulations, such as haptic and aural stimulations, to help SVIs learn by touch and auditory means (Jones et al., 2006). Nevertheless, the investigation needed to see the reach of these assistive technologies at the grassroots level. The following research questions help to take the inquiry further.

## Research Questions

- What assistive technologies are available to students with visual impairment in a blind school in Delhi?
- How is the accessibility of assistive technologies perceived by the students with visual impairment enrolled in a blind school in Delhi?

## Methodology

### Research Design

The study employs a qualitative single case study research design. Baxter & Jack (2010) explain that "qualitative case study is an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources" (p. 544). Here, the case of the present research is a group of 15 SVIs studying in middle school, and two staff from the administrative office are sharing their perspective

about accessing assistive technologies. Keeping in mind the nature of the study, the researcher employed a purposive sampling technique.

**Tools and Data Analysis**

The research tools employed in this research design are observations, unstructured interviews, and conversations. All these tools are used to get deeper insights from the field and the participants. Secondary data is obtained by reviewing the existing literature in this field. As per the nature of the research design, the thematic analysis was done by reflecting on the transcribed data and giving codes to repeated words, phrases, and sentences. The themes were generated using the iterative analysis and coding process. As for the research ethics, the students and the school were informed about the research and permission to record data through field notes, audio recordings, and photos. Also, the participants' anonymity is maintained throughout the research writing process.

**Field and Context of the Study**

The study is situated in a residential special school for boys in a famous market area of Delhi. The school was a charitable blind school and a branch of one of the oldest blind schools in Delhi. This school was managed with the help of donations from people and aid granted by the government of Delhi. This school is an elementary school that provides a hostel and mess facilities as well. Books and uniforms are provided free of cost to all the students. Most children in this school come from neighbouring states such as Uttar Pradesh, Bihar, Haryana, and Rajasthan. A large number of students are from Bihar. The number of students in each class varies, and the number of students in upper primary classes is less than in primary classes. The participants are boys aged 12-18 years studying in upper primary classes. These students come from lower socioeconomic strata. The degree of visual impairment also varies as some students are totally blind, some have low vision and can see some colours and large prints, and some have a perception of light and shapes.

**Result and Discussion**

The analysis is based on observations and transcriptions of conversations with the students and staff of the school and unstructured interviews with students. The identification of the themes is done by providing codes to organize the data into categories with an iterative reflective process.

**Availability of Assistive Technologies for SVIs in the School**

The school is a charitable school run with the help of donations from affluent people and aid from the Government of Delhi. The school gets some assistive technologies in the form of donations and aids, as the secretary of the school said:

"We have some devices given by the government and non-government organizations. We have scanners that read books in an audio format and devices for recording and listening, but they are one or two devices and, therefore, not given for use. And we provide students with NCERT Braille books."

As the above statement highlights, except for traditional assistive technologies like Braille, the school has very few assistive devices available for reading, which are insufficient for all the students. Furthermore, it was observed that the only traditional assistive technology available in the school for assistance in writing is Braille Slate with stylus and Braille Sheet. Each student has their slate and stylus. Braille sheets

and books were always under their desks, and stacks of Braille books were organized in each classroom.

Similarly, observations reveal that each student has a Taylor frame with types used to teach arithmetic for assistance in mathematics.

It was also observed that no assistive technologies are available except Braille books for assistance in science and social science. As one of the students of class 7 said:

"We study science from books, and sir sometimes sends audio; we listen and make notes."

Students' primary learning in science (also in other subjects) happens through Braille books and lectures given by teachers in the classroom. Many studies (Senjam et al., 2022; Dey et al., 2018; Eligi & Mwantimwa, 2017; Bhatt & Kumari, 2015; Haider & Zaman, 2015)) also found a limited availability of assistive technologies specifically related to curricular areas like science and mathematics in schools.

Further, students inquired about the availability of assistive devices for playing; they were asked about the games they play. Student responses show that they play different games using assistive technologies such as audible cricket balls, chess, snakes, and ladders during and after school hours. As one of the students of class 6 said:

"Yes, we play cricket, snakes and ladders, and carrom...no, there is no carrom, but it will come soon, and we also sometimes race in sports, period. We enjoy it a lot while playing."

The other student in class 8 said:

"We play cricket, the cricket ball is different, it has a sound... Do you know there are small metal balls (chharre) used in the tire of a bicycle. These are inserted in a ball through a hole after that ball makes a sound. Also, we play chess and rassakashi (tug of war)."

The above excerpts highlight that students are aware about the features of the equipment used by them for playing and the other equipment which are going to be available soon.

Similarly, for orientation mobility and daily living, no assistive technologies were mentioned by students and have yet to be observed by the researcher as also reported by Senjam et al. (2022) that there is inadequate availability of walking canes in blind schools in Delhi. However, one of the students of class 8 mentioned:

"I had a walking stick earlier... yes, the smart cane, but I gave it to someone else, and he lost it somewhere."

One of the students from class 7 said:

"We usually do not go outside the school; therefore, we do not need canes to move...but when sometimes we go to another school, the school bus takes us there."

The other student said:

"We do not need any device for walking as we do not go anywhere, and when we have to go home, our parents take us with them".

However, students' responses reflect their limited perspective on the utilization of walking canes within the school periphery only, where they do not usually require it. Additionally, due to their familiarity with the school environment, students are less dependent on external assistance within the school premises. Ravneberg and Söderström (2017) argue that users abandon assistive technologies when there is no need for them. Notably, as observed, collaborative movements in pairs or groups are prevalent, particularly as a means of support for those with low vision assisting their peers who are entirely blind.

## Assistive Technologies: As a part of rehabilitation

Students are aware of assistive technologies, and one of the community ophthalmic rehabilitation training teams from a renowned medical institution comes to train them to use these devices. This team comes for the weekly or monthly training and demonstration of assistive technologies for students. As one of the students of class 8 recalled:

"The team comes every week or two; they bring many devices, and let us know how to use them and ask for our feedback on these devices."

The researcher observed one such demonstration session; the team gathered a few students from classes 7 and 8 and helped them recall their previous sessions in which they demonstrated using devices like Daisy player and Victor Reader. They handed these devices to students and asked them questions about their functioning. Moreover, students agree that the team made them aware of devices like Daisy Player, Victor Reader, hand lenses, smart spectacles, and data-storing devices like Flash Drive. However, in post-rehabilitation training sessions, students do not have the requisite devices for the practice, leading to a lapse in their proficiency with these tools, as the absence of regular practice in their daily routines results in a diminished familiarity with their functionalities.

**Figure-1: Some of the assistive technologies used by students in classroom and rehabilitation training.**

Furthermore, students show reluctance towards the rehabilitation training, as observed in class 6, where two students refused to attend the rehabilitation session when a teacher asked them to go to the computer lab. One of the students told the researcher:

"This is a waste of time; they take periods of our other classes, and there is no benefit; the devices are expensive."

The other student said:

"These are such expensive devices, and we can only read the recorded books...phones are better; we can search for anything we want anytime on the internet."

The students' reaction indicates that they are disappointed by the rehabilitation training as they are aware that the devices are not affordable financially and that getting training for them is pointless. Silondwa and Muzata (2019) discuss that assistive technologies are usually developed outside the country, which makes them expensive and financially inaccessible for SVIs. On the other hand, class lectures and smartphones are easily accessible and affordable. Also, Senjam et al. (2021) found in their study that the two major barriers to accessing assistive technologies are unavailability and economic constraints among students who are acquainted with the assistive technologies.

**Habituation to Braille**

All the students in this school are taught reading and writing Braille script from class 1. They practice Braille daily through language, science, and social science classes. Teachers also encourage them to read the books and take notes from them. One of the class 6 students said:

"Sir helped us a lot in reading Braille...he says that we must have Braille letters in our memory so we do not have difficulty reading Braille script."

Students are accustomed to reading and writing Braille whether they have low vision or are totally blind; therefore, they feel more confident learning through Braille. As one of the students of class 8 said:

"Ma'am...How will a blind read if not from Braille?... and we understand well reading through Braille and reading practice is also needed"

The statement asserts that students perceive Braille as the most convenient and effective medium for understanding text. Braille engages a different cognitive pathway than visual reading, potentially leading to deeper comprehension and information retention. Also, it empowers SVIs to access information directly without relying on sighted assistance.

The other student in class 7 said:

"We read through Braille, and sometimes sir send the audio of question answers, and we note them on sheets of paper."

Students are so accustomed to Braille that even audios are utilized after converting them into Braille notes. Studies (Bhatt & Kumari, 2015; Senjam et al., 2022) show that SVIs are reluctant to adopt new assistive technologies because learning to use new devices requires practice and time.

One of the students of class 6 said:

"...Until eighth, we read through books and afterwards students use audios... now we only require books for reading and PDFs of NCERT have diagrams when we listen to them. The diagrams were read as some weird codes."

The other class 8 student said:

"Ma'am Braille is the most convenient way to read; suppose sometimes we do not have internet; how we will read through audio or InstaReader."

Another student of Class 8 said:

"...Yes, there are many reading devices, but we need to purchase them, and they are expensive and can get damaged over time."

In the above excerpts, the limitations of assistive technologies are highlighted, emphasizing that their effectiveness hinges on appropriate user input. While technologies like Daisy Players offer specific functionalities like data reading, recording, and storage, their narrow scope and potential expense raise concerns about their suitability for broader assistive applications. Studies (Bhatt & Kumari, 2015; Borg et al., 2015) also conclude that one of the challenges of adopting assistive technologies is its high cost and non-availability. Furthermore, Borg et al. (2015) explain that less awareness about assistive technologies and the lower purchasing capacity of people can hamper production and result in high costs. These concerns highlight the nuanced relationship between technology and individual needs, where advantages and drawbacks must be carefully considered.

**Limitations of Braille**

Braille has significantly supported the education of SVIs. It helped in independent learning by tactile and kinesthetic input. However, braille books have limitations as they do not have diagrams, figures, or graphics to illustrate a particular science or social science concept. As one of the students of class 7 said:

"No diagrams are there in the book... there is only a mention of diagram that the print version had the diagram on this particular page; it becomes difficult for those who are totally blind have not experienced that diagram visually."

The other student said:

"We are blind; we do not need diagrams... even when there is some mention of a diagram while reading, sir, always skip it."

The above responses highlight that the teachers and students believe that diagrams can be experienced visually. This belief limits the scope of utilization of alternatives such as tactile diagrams and 3D models for learning the concepts. However, it is argued that the tactile and kinesthetic value of tactile diagrams, maps, 3D models and charts, and graphs have educational implications for SVIs (Penny and Mary, 2001, as cited by Haider & Zaman, 2015).

**Smartphones as Assistive Technology**

After Braille, smartphones are the second-best preference as an assistive technology that students use for education and leisure. In contemporary times, smartphones come with accessibility features that help SVIs navigate through the phone and search for anything that piques their curiosity. However, before 2019, the students relied on Braille books only. As one of the class 8 students said:

"Earlier, we did not have phones; it's all because of COVID that our parents had to buy them for us."

Another student said:

"I got the phone during COVID because teachers were taking online classes on Google Meet."

COVID has allowed the SVIs to explore other technologies like TalkBack, Read Aloud, and voice assistance software. Similarly, Senjam et al. (2021) argue that recent technological advancements have equipped mobile technology with sound and haptic gestures to interact with smartphones. SVIs sometimes clear their conceptual doubts by visiting different sites and downloading various mobile applications. As one student said:

"I am interested in astronomy, so I search about space and planets on YouTube."

Moreover, for SVIs, smartphones have transcended the limitations of traditional textbooks, opening doors to diverse educational and leisure opportunities. Audio-based applications offering narrated stories, podcasts, and even NCERT textbook PDFs through document reading software like InstaReader and AdobeReader's read-aloud features have broadened their content engagement. This technology extends their learning beyond prescribed curricula, allowing them to delve deeper into topics that pique their curiosity through independent online research. Smartphones further enrich their lives by serving as portals for leisure activities like music listening, cricket commentary, and entertainment news, fostering connection and enjoyment beyond academic pursuits. In essence, smartphones have become indispensable companions for SVIs, enriching their educational journeys and leisure pursuits.

## Conclusion

In summary, the school has limited availability of assistive technologies. Economic constraints are the reason for the unavailability of assistive technologies, as the school exhibits a limited capacity to adequately provide fundamental amenities, including traditional assistive technologies. Due to such financial constraints, it is difficult to afford expensive assistive technologies with functional specificities. Therefore, students and teachers both rely on traditional assistive technologies as these are affordable and accessible for them. Moreover, the rehabilitation program has given the SVIs exposure to modern assistive technologies and helped them learn about the functionalities. However, limited interaction with these modern assistive technologies does not engage the SVIs in the same way as the traditional assistive technologies do. Similarly, COVID has allowed SVIs to engage with smartphones and explore different accessibility features. Engagement with assistive technologies involves the intersubjective dimensions, such as social and learning dimensions of assistive technologies, as well as existential dimensions of impairment and disability (Berndtsson, 2018). Therefore, accessing assistive technologies not only requires the availability of it but continuous interaction and practice to make it a part of one's existence.

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