Title: Barriers to using Assistive Technology among students with visual disability in schools for the blind in Delhi, India

Abstract

Background: Students with visual loss may benefit from assistive technology (AT) for their educational activities. **Aim:** To understand the barriers faced in using ATs by students who have heard of ATs and reported needing them but were not using them (acquainted students), at schools for the blind in Delhi.

Methods: Two hundred and fifty students were selected randomly from ten schools for the blind in Delhi and screened for presenting and pinhole binocular distance vision using a modified 'E' chart and multiple pinhole occluder. Students were divided into two groups; 1/60 or better vision (likely to benefit from vision-based AT) and <1/60 vision, (likely to benefit from tactile/sound-based AT). Awareness of, and need for, ATs was investigated for each student with a questionnaire. Then information on barriers to using AT was obtained from students who knew about AT, felt they needed AT, but were not using them. This information was collected for a total of 42 ATs. **Results:** The three most requested tactile / sound-based ATs for the 250 students were talking watch, Braille typewriter and audio format. The three most requested vision-based ATs in 69 (27.6%) students who had presenting or pinhole visual acuity less than 6/18 to 1/60 were near optical magnifiers, electronic magnifiers and large keyboard for computer. Non-availability of ATs in schools was the most common perceived barrier (43% of overall responses), followed by economic constraints (20% of responses).

Conclusion: Non-availability or limited possession of ATs and financial constraints were the major barriers to use of ATs among students.

Key words: Assistive technology, visual impairment, schools for the blind, barriers, Delhi

IMPLICATION FOR REHABILITATION

1. Students with visual disability face many challenges in accessing assistive technology for their education learning, especially in low middle-income countries.
2. Non-availability and limited possession of assistive technology by schools for the blind are main barriers in the study.
3. Schools authorities must recognize their responsibility to ensure assistive technology (academic and non-academic related, visual and non-visual based) are made accessible for their students with adequate quantity.
4. Future studies should focus on all school age children in the community rather than focusing on school going children.

Introduction

Globally, over one billion people with disability need assistive technologies [1], but only 10% can access assistive technology[2]. To address the gap between needs and provision, the WHO launched the Global Co-operation on Assistive Technology (GATE) in 2014, and identified 50 priority assistive products[3].

Disability is a global health concern irrespective of the age of the individuals affected. [4] Disabled persons, as a general, are frequently denied or neglected their right to education, employment, and to participate in social and cultural events. The World Health Report on Disability in 2011, identifies assistive technology as an important intervention to improve the functioning, independent living and quality of life of people with disabilities [5].

Students with visual disability face a great challenge in their education. The article 24 of United Nation Convention on the Rights of People with Disabilities states that persons with disabilities have the right to education[6]. Assistive Technologies can facilitate the education of children with visual disability.

Studies had been demonstrated improving in skill acquisition and enhancement of performance, such as handwriting, motor skills, reading, visual attention and perception, maths and sciences skills with use of assistive technology[7], [8], [9], [10], [11]. Studies have also reported that assistive technology improves independence in daily living activities , enhanced social interaction, motivation and self-esteem[12], [13].

Despite the benefits of assistive technology there is evidence that children in developing nations are not able to access assistive technology. To improve assistive technology services in schools, it is important to understand the challenges and barriers in utilization of assistive technology faced by students.

Methods

A cross sectional study amongst a random sample of 250 students with visual impairment in 10 of the 23 schools for the blind in Delhi was conducted in June-July 2018. Each student was screened for presenting and pinhole distance binocular vision acuity using a modified Snellen 'E' chart with two optotypes (6/18 as small 'E', 6/60 as large 'E') and multiple pinhole occluder. Further details of the study methodology, results about awareness and utilisation of assistive technologies among students are available in the main paper. [14]The actual figures about awareness, utilisation of assistive technologies are given in Table 3 to provide detailed information.

Study tools

A close ended questionnaire was developed consisting of 42 assistive products (13 visual based assistive technologies (VATs), e.g. large print books, optical magnifiers and 29 tactile and sound based assistive technologies (TATs) e.g. DAISY, Braille books). The assistive technologies were categorized into seven domains: Reading-9, Writing-8, Maths-8, Sciences-2, Games & sports-5, Mobility-6 and Activities of Daily Living-4. The first section of the tool included the students' profile and vision screening information. The second section of the tool asked about awareness, use and frequency of utilization. The third section of the tool asked about the perceived need for assistive technologies and the barriers in accessing them. The information about barriers for each of the 42 assistive technologies were obtained from the students who had heard of the assistive technology, said they need it, but were not using it (acquainted students). We included a list of nine potential barriers which was pre-coded (Table 1). Students were asked to identify the most important barrier. If the response reported by the students was not in the list, then it was marked as 'others, specify". If a student replied more than one barrier when the team asked, than the interviewer asked for the most important barrier.

This list was developed in consultation with teachers, rehabilitation workers, students from blind schools and eye care professionals. A pilot test was undertaken in one of the schools before initiation of study.

Table 1: List of potential barriers in accessing assistive technology (AT).

Code	Barriers	Definition
I	Not available	Neither schools nor students have the assistive technology
II	Available but not accessible	Assistive technologies are available in the school, but students do not access them. School has only one or very few of it, so kept for demonstration only.
III	Lack of trainers or instructors in the school	School has enough assistive technologies but no trainers available.
IV	Aware but lack of Knowledge or don't know how to use it.	Students have poor knowledge about AT utility and purpose.
V	Realize it but not needed now	Students aware of AT and know how to use but not using it now, they keep it for future use.
VI	Financial constraints	Students reported they are not able to buy the assistive technologies for their own use
VII	Damaged or lost	Students had AT but it was broken or lost or not functional now.
VIII	Shy/uncomfortable/stigma	Students feel shy or teased by peers or assistive technologies is uncomfortable to use.
IX	Others, then specify	If none of above barriers, then mark as other and student to specify barrier.

Data collection was done by an experienced team involved in the school vision screening program and community-based survey. Two days additional training was provided for the present study. Prior to interview, the investigator briefed each principal of the selected schools about the study and requested a list of eligible candidates. Each student was assigned a unique number for random selection. Further details were given in the main paper. [14]

Ethical approval was obtained from the ethics committee of All India Institute of Medical Sciences New Delhi and London School of Hygiene & Tropical Medicine. Permission from principal of blind school and a written consent from the students aged above 18 years was taken. Assent of the students aged less than 18 years from principal or teachers was taken before interview.

Data management and analysis was done in STATA 14 (StataCorp 2015, Stata Statistical Software: Release 14. College Station, TX: StataCorp LP). Data and perceived barriers obtained were analysed descriptively. The study was conducted in accordance to declaration of Helsinki.

Results

Two hundred and fifty students from ten schools for the blind in Delhi were enrolled in the study of which 17.6% attended integrated schools (table 2). One hundred eighty-one (72.4%) were male. The mean age was 14.8 years (SD±2.5); range 10 - 23 years. The details about awareness and utilization of assistive technologies are presented in the main paper.[14]

Vision status of the students

Out of the total 250 students, 69 (27.6%) had binocular presenting or pin hole corrected visual acuity between less than 6/18 to 1/60. This group of students were the potential beneficiaries for vision based assistive technologies (Table 2). The remaining 181 (72.4%) students had visual acuity less than 1/60 with one third (35.2%) having no light perception (Table 2). Only 14 (5.6%) of the students had spectacles for either near or distance vision.

Table 2: Characteristics of the participants (N=250)

Characteristic		n	Percentage
Gender	Male	181	72.4
	Female	69	27.6
Age	10-14	111	44.4
	15-19	133	53.2
	19+	6	2.4
Attended school	Residential school (blind)	206	82.4
	Integrated school	44	17.6
Class	Primary (I-V)	69	27.6
	Middle (VI-VIII)	91	36.4
	Higher (IX-X)	41	16.4
	Secondary (XI-XII)	49	19.6
Vision status			
Low vision to 1/60 *	<6/18-6/60	27	10.8
	<6/60-3/60	17	6.8
	<3/60-1/60	25	10.0
<1/60 blindness **	Light Perception +ve	93	37.2
	Light Perception -ve	88	35.2

* Potential beneficiaries for VAT (Vision Based ATs) - 69 students

**Potential beneficiaries for TAT (Tactile/Sound Based AT)-250 students

Most requested Assistive Technologies

The three most requested tactile / sound-based assistive technology (TAT) for the 250 students were talking watch (63 students), Braille typewriter (44 students) and audio format (DAISY- 37 students, Table 3). The three most requested vision based assistive technology (VAT) in 69 students who had visual acuity less than 6/18 to 1/60 were near optical magnifiers (10), electronic magnifiers (9) and large keyboard for computer (4, Table 3).

Perceived barriers among the "acquainted" students

Non availability of assistive technologies at school was the most frequent perceived barrier (42.9% of overall responses, Table 3). This was true for vision and tactile / sound based assistive technologies. For example, 17 of the 37 acquainted students could not access audio format materials (DAISY) and 14 of the 23 acquainted students were not able to access handheld audio recorders.

Financial constraint was second most common barrier (20.1% of overall responses, Table 2). For example, 28 of the 44 acquainted students reported that they could not use a Braille typewriter because of unaffordability.

The other reported barriers were limited number of assistive technologies in schools (9.9% of the overall responses), damaged or loss of assistive technologies (8.6%), no felt need for assistive technologies (7.8% of overall responses), and lack of trainers in assistive technologies at the school (4.1%).

Discussion

The World Bank reported that children in India with disability are five times more likely to be excluded from school than children without disability.[15] Blindness and visual impairment significantly affect educational activities in students. The same report highlighted that the illiteracy rate is highest among children with visual loss reaching nearly 80%. Education is important for development of all citizens including children with visual disability. Children with visual disability may benefit from various types of assistive technology to improve their academic learning.

The school for the blind is a separate academic institution outside the mainstream education system that provides special education for students with visual loss. These schools are based on the assumption that children with visual problems have special educational needs including assistive technology. The present study aimed to identify the challenges faced by a group of students who reported awareness and perceived need for assistive technologies but were not using them in schools for the blind in Delhi.

Barriers among "acquainted" students

The study showed that the most common barrier among those who knew about assistive technologies was the lack of availability of assistive technologies in schools (43% of total responses). This was true for vision based as well as tactile / sound based assistive technologies.

The next most common barrier was economic constraints to afford assistive technology (20% of the total responses). In general, assistive technologies are imported, resulting in high cost which leads to unaffordability among the students. There is a need for low cost local production of assistive technology products.

The other barriers were not having adequate number of assistive technologies, and the lack of trainers in the schools for the blind. As the barriers of availability and cost are addressed the importance of good training will become more relevant. Lack of trainers will hamper the effective

implementation of assistive technology teaching program in the classroom. In fact, special schools need a greater number of special trainers compared to general schools, as students with visual problems may need one to one teaching.

The need for assistive technologies will increase in low- and middle-income countries over time. Each school for the blind should be equipped with relevant and sufficient assistive technologies for various educational activities, and appropriately trained teachers of assistive technology.

The major limitation of the study is that the findings cannot be generalised to other populations as the sample is limited to schools in Delhi, also we did not assess the awareness and knowledge on assistive technologies among the teachers. More in depth understanding about challenges and barriers faced by students would require a qualitative study. We could not assess the parents' education and economic status or understanding of assistive technology which might have some impact in accessing assistive technology.

Conclusion:

Non-availability of assistive technologies and financial constraints were the major barriers faced by students who knew about assistive technologies but were not using them.

Conflict of Interest: There are no conflict of interest

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Table 3: Perceived barriers among the needy students for assistive technologies out of total students (N=250)

Type of Assistive Technology	VAT or TAT*	A. Have you heard of it?			B. Do you need it?		C. If heard and reported needing, ask why have you not using it?								
		No	Yes		No	Yes	Barrier Code								
			Using it	Not using it			I	II	III	IV	V	VI	VII	VIII	IX
1. READING															
1.1. Large Print Book	VAT	176	4	70	66	4	1	2	0	1	0	0	0	0	0
1.2. Reading stands	VAT	210	1	39	35	4	1	3	0	0	0	0	0	0	0
1.3. Optical magnifier (Near reading)	VAT	151	0	99	89	10	2	1	1	1	1	3	1	0	0
1.4. Optical magnifier (Distance reading)	VAT	192	0	58	56	2	1	0	0	0	0	0	1	0	0
1.5. Typoscope (one window)	VAT	245	0	5	5	0	0	0	0	0	0	0	0	0	0
1.6 .Low vision lamps (enhance lighting)	TAT	196	1	53	50	3	1	1	0	0	1	0	0	0	0
1.7. Braille Reading Books	VAT	5	227	18	15	3	1	0	1	0	0	1	0	0	0
1.8. Electronic Magnifiers Aids (Video magnifiers, CCTV)	TAT	141	0	109	100	9	3	0	0	0	2	4	0	0	0
1.9. Audio Format Materials (DIASY)		65	41	144	107	37	17	3	0	3	2	12	0	0	0
2. WRITING	TAT														
2.1. Braille Slate and stylus	TAT	2	222	26	21	5	1	0	1	0	1	2	0	0	0
2.2. Braille typewriter	VAT	36	16	198	154	44	9	5	0	0	2	28	0	0	0
2.3. Typoscope (multiple window)	VAT	248	0	2	2	0	0	0	0	0	0	0	0	0	0
2.4. Large computer key Board	TAT	204	5	41	37	4	2	1	0	1	0	0	0	0	0
2.5. Braille Key Board	VAT	183	2	65	49	16	10	3	0	0	1	2	0	0	0
2.6. Handheld pen magnifiers	TAT	246	0	4	3	1	1	0	0	0	0	0	0	0	0
2.7. Handheld audio recorder	TAT	56	72	122	99	23	14	4	1	0	2	2	0	0	0
2.8. Screen readers (JAWS, NVDA)	TAT	57	99	94	72	22	13	1	0	0	1	6	0	0	1
3. MATHEMATICS															
3.1. Abacus	TAT	30	25	195	183	12	5	0	0	1	2	1	1	0	2
3.2. Braille compass	TAT	211	2	37	28	9	4	2	2	0	0	1	0	0	0
3.3. Talking calculator	TAT	103	12	135	104	31	12	4	1	0	5	8	1	0	0

3.4. Braille ruler	TAT	201	4	45	43	2	1	0	1	0	0	0	0	0	0
3.5. Braille protractor	TAT	234	1	15	14	1	0	0	1	0	0	0	0	0	0
3.6. Raised line graph	TAT	230	0	20	18	2	1	0	1	0	0	0	0	0	0
3.7. Tactile geometric kits	TAT	160	7	83	69	14	10	0	2	0	1	1	0	0	0
3.8. Braille cube	TAT	223	3	24	24	0	0	0	0	0	0	0	0	0	0
4. SCIENCES															
4.1. Tactile maps	TAT	148	7	95	86	9	7	1	0	0	0	1	0	0	0
4.2. Tactile diagram set for sciences	TAT	188	7	55	49	6	3	2	0	1	0	0	0	0	0
5. MOBILITY															
5.1. Walking (long) canes	TAT	14	74	162	155	7	3	0	0	1	1	1	1	0	0
5.2. Children's canes (60 to 85 cm)	TAT	195	1	54	53	1	1	0	0	0	0	0	0	0	0
5.3. Guide canes	VAT	238	1	11	10	1	1	0	0	0	0	0	0	0	0
5.4. Smart canes	TAT	26	57	167	134	33	15	2	0	2	1	10	2	0	1
5.5. Symbol canes	VAT	243	1	6	6	0	0	0	0	0	0	0	0	0	0
5.6. Mobile Apps (GPS)	TAT	112	15	123	104	19	8	6	1	0	1	3	0	0	0
6. GAMES and LEISURE															
6.1. Tactile dice	TAT	101	41	108	94	14	7	0	2	0	1	1	2	0	1
6.2. Large print play cards	VAT	195	1	54	51	3	1	0	0	1	0	0	0	0	1
6.3. Large print with Braille cards	TAT	166	11	73	66	7	5	1	1	0	0	0	0	0	0
6.4. Braille chess	TAT	43	74	133	103	30	17	1	3	2	3	0	2	1	1
6.5. Audible games balls	TAT	9	175	66	57	9	4	1	0	1	0	0	1	0	2
7. DAILY LIVING EQUIPMENT															
7.1. Liquid sensor	TAT	218	0	32	21	11	6	1	0	2	0	2	0	0	0
7.2. Color detector	TAT	231	0	19	11	8	4	1	0	0	0	3	0	0	0
7.3. Simplified mobile phone	VAT	77	69	104	96	8	2	0	0	0	2	1	0	0	3
7.4. Talking watch	TAT	5	83	162	99	63	15	2	1	1	8	5	30	0	1
OVERALL RESPONSES (Frequency)						487	209	48	20	18	38	98	42	1	13
PERCENTAGE (%)						100.0	42.9	9.9	4.1	3.7	7.8	20.1	8.6	0.2	2.7

*VAT: Visual Based ATs, TAT: Tactile/Sound Based ATs

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