

TECHNOLOGY USE AND NON-USE BY LOW-INCOME BLIND PEOPLE IN INDIA

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Abstract

Low-income blind people in India face a complex array of socioeconomic barriers, language constraints and infrastructural challenges that impede their use of assistive technologies that are primarily designed for blind communities in the developed world. The environment of constraint and disability has led low-income blind people to appropriate general-purpose technologies as assistive technologies, and use them to orchestrate new coproduction, consumption and sharing practices to address their educational needs. Low-income blind people also use mainstream social media platforms not only to access instrumental information and entertainment, but also to demonstrate their technology acumen to the society, and build meaningful connections with both blind and sighted communities.

Introduction

To date, many of the world's biggest advances in assistive technologies have primarily benefitted visually impaired people living in developed countries, like North America and Europe, that contains only 10% of the world's visually impaired population. However, 90% of the world's 285 million visually impaired people live in low-income settings [31]. India, with more than 63 million visually impaired people, is home to the world's largest number of blind people, many of whom are living in rural areas under severe financial constraints. Prior research has found that the prevalence of blindness is much higher among rural people than urban dwellers [17], and in poor clusters than in affluent clusters [8]. Assistive technologies well-suited for blind people living in developed countries are often inappropriate, expensive and unusable for low-income blind people living in resource-constrained environments in developing regions due to various socioeconomic factors and infrastructural constraints, including cost, language, literacy, and the availability of computing devices and bandwidth. For example, 58% of India's population earns less than USD 3 a day [36], 26% of the adult Indian population are illiterate [37], and around 72% are illiterate with respect to English [4]. Though India alone has more than 1 billion mobile phone subscriptions [35], only 15% of the mobile subscribers use a smartphone [15], and 28% of the population have access to the Internet [33]. The statistics for low-income blind people in India paints an even grimmer picture. To design new information and communication technologies and re-appropriate the existing ones, it is important to gain a deeper understanding of the motivations, technologies, challenges, and coping mechanisms that comes into play when low-income blind people produce, consume, curate, and share digital content.

Prior works in the accessibility domain have examined technology use by blind people in developed countries, and designed new interfaces, devices and mediums for them [1,2,6,7,14,16,18,26,30,32]. Information and Communication Technologies for Development (ICTD) researchers have also studied screen reader usage by blind people in developing regions [13,21], examined challenges faced by them in exploring employment opportunities [20], documented experience of blind people who use mobile devices [19], and explored the role of

mobile devices in providing them access to social, economic, and architectural spaces and interplay between gender and disability [22]. However, the participants in these works were primarily from middle or upper class urban backgrounds and thus, were not representative of blind people in rural and peri-urban India.

Despite the majority of blind people living in low-income settings in developing regions, the research examining their technology use and non-use, constraints and opportunities, and costs and benefits is severely limited. One of the primary reasons for the scarcity of such work is the hardship experienced by researchers in discovering, contacting and gaining the trust of blind communities in remote rural areas and low-income settings. In prior work, we designed, built and deployed *Sangeet Swara* — a voice-based social media platform accessible using basic phones and without Internet connectivity — that received broad and impassioned usage by low-income blind people in remote rural and peri-urban areas in India [28]. The accidental success of our platform offered us opportunities to cultivate a trusting relationship with these blind people and examine their educational ecosystem. The objective of this study (henceforth education study) was to examine mediums and technologies used by them to access educational content, challenges encountered by them, and their coping mechanisms, and to apply that knowledge towards designing new or improved tools/processes/policy for supporting the educational ecosystem [27]. The access to *Sangeet Swara* users and a prior relationship with a non-governmental organization specializing in computer training for low-income blind people enabled us to also examine their social media landscape. The objective of this study (henceforth social media study) was to examine the use and non-use of existing mainstream social media platforms, including Facebook, WhatsApp and Twitter, by low-income blind people in India, analyze content generated by them, identify benefits received and challenges encountered by them, and contrast their usage of existing social media platforms with *Sangeet Swara* [29].

In this article, we offer high-level insights gained from the two studies and request readers to study our prior work [27,29] to access more information. We highlight how low-income blind people in India, despite living under severe financial constraints and with lack of accessible technologies, innovate novel mechanisms to address their educational, information and entertainment needs. Though they are often undervalued by the society, they use technologies to demonstrate their technology acumen to others, uplift their social standing, and build meaningful connections with both blind and sighted people.

Methodology

The findings presented in this article are based on ten semi-structured interviews with blind students of various educational levels, six interviews with blind teachers, analysis of online content available on websites of six nationwide government entities, non-profit organizations and non-governmental organizations (NGOs) generating educational content for blind communities, eighteen interviews with blind social media users and non-users, two interviews with computer instructors for blind people, another two interviews with facilitators of a computer training program for blind people, telephonic survey of fifty-three blind *Sangeet Swara* users, thirteen interviews with blind *Sangeet Swara* users, and analysis of their call logs and interactions. Each interview and telephonic survey was translated and transcribed in English, and was analyzed using open coding.

	Age (years)	Male	Rural or peri-urban areas	Completely blind	Owned smartphone	Median daily family income	Student	Teacher	Unemployed	Others
Education study participants	27.2	94%	100%	94%	19%	USD 2.74 (students) USD 13.70 (teachers)	10	6	0	0
Facebook, WhatsApp and Twitter users and non- users	24.2	89%	67%	62%	11%	USD 5.45	14	0	3	1
<i>Sangeet Swara</i> users	24.6	93%	67%	NA	NA	USD 3.52	24	7	6	16

Table 1: Demographic information of participants in our prior research works.

Demographic Information

The participants were from eleven states in India. 93% of the participants were male and 7% were female. 73% of them were from rural and peri-urban areas while the remaining were from low-income societies in urban areas. The majority of them were from families of farmers, daily wage labourers, small-shop owners, carpenters, and household help. The average family size of the participants was seven. Almost 80% of them were financially dependent on their family members, and lived under severe poverty with less than USD 2 per day. All of them were native Hindi speakers, only one participant spoke fluent English, and many spoke a local dialect of Hindi. Of the eighteen social media users and non-users, nine participants used only Facebook, four used all the three platforms (Facebook, WhatsApp and Twitter), one used only WhatsApp, another used both Facebook and WhatsApp, and three did not use any social media platforms. Table 1 shows high-level demographic information of low-income blind people who participated in our studies that examined their educational and social media landscape. We encourage the readers to study our prior work [27,29] for more detailed information on the methodology, demographics, and analysis.

Findings

We now present a high-level synthesis of our findings from two prior research works to demonstrate how low-income blind people in India design new coproduction, consumption and sharing practices for accessing instrumental and entertaining information, uplift their social status, and transform their relationship with both the blind and sighted communities. We also highlight the challenges encountered by them in using accessible technologies and how they appropriate general-purpose devices and technologies to support their needs.

Challenges in Accessing Content

We found that low-income blind people in India experience acute shortage of accessible educational content, including Braille books, professionally authored audio books, and online content in local languages. Though participants reported several limitations of Braille books, such as rare availability after high school, high cost, heavy, and limited physical storage to store them, all but two participants found Braille to be their preferred content format in comparison to audio

content and textual digital content. They found Braille easier to understand and remember content, and associated its use with independence. Unlike audio books, Braille books were considered easier to go back and review, and of consistent quality. A participant reported:

"Personally, I am a supporter of Braille. Braille is the real thing. There are two things: first, eating food yourself. Second, someone else feeds you. Braille is like eating food from your own hands and audio books are as if someone else is feeding you."

Though screen reader software has been an integral part of the lives of blind communities in the developed world, we found that several low-income blind people used them only sparingly. In fact, 57% of the participants in the education study never used a screen reader software, and roughly 20% did not even know its purpose. Screen reader software were less popular for two reasons. First, the majority of participants lacked access to computing devices, such as computer, tablets, and smartphones. Roughly 81% of the participants in education study and 89% participants in the social media study were using basic phones or feature phones incapable of supporting screen reader software. 57% of the participants of the education study never used a computer and the remaining used it sparingly. The cost of devices and the Internet was prohibitively expensive for them. Though many participants were aware of the importance of computing devices and the Internet in accessing information and entertaining content, they saved money for supporting their daily living requirements. A participant reported:

"I rarely shave and get a haircut because I am unemployed. My financial situation is terrible and I have no family support. If there is no income, there will be no phone, no Internet, and no Facebook..."

Participants also found it challenging to use computer in public spaces like Internet café. The accessibility features were often deactivated on the computers in the interest of sighted customers. Several café owners had also disabled USB port for security purposes, because of which blind customers could not run NVDA from a portable flash drive. A participant stated:

"Going to a café is a laborious task. The computers there do not have screen reader software. I have requested the owner to install them, but he is not interested because few blind people go to his café."

Second, those participants who had intermittent access to a computing device and the Internet found it challenging to find content in Hindi. Most of the content available online was in English, a language many of them feared because of limited language proficiency. The interview with instructors revealed that most participants studied in a Hindi-medium school and had limited exposure to English. According to them, 90% of the students who came to their computer training program in the last two years were unable even to write their name in English. Participants found it difficult to understand the American accent of screen reader software and coped with it by reducing the playback speed. Several of them felt disadvantaged and had lower self-esteem because of lack of English language skills. One of them stated:

"I have to keep the speed of the talking software very slow and this hampers my productivity. Though our intellect is comparable to sighted people, we are unable to compete with them because of the lack of English skills. I feel disadvantaged."

Though some screen reader software supports Indian languages, many participants did not know about them. Others sparingly used them because of the lack of access to textual content in local language, and the poor quality of the output of inexpensive local language speech synthesizers.

Though we assumed the cost of screen reader software like JAWS to be the significant bottleneck for adoption, we found that all screen reader software users in our sample were either using a pirated copy of JAWS or a free screen reader software like NVDA. The low availability of Braille content and constraints with screen reader software forced many participants to rely on audio format, both in offline and online settings, to access educational content.

The findings of our social media study also attributed the cost of devices and the Internet, and challenges with screen reader software to be the prime reason for non-use of social media platforms. The study also revealed that several inaccessible features, such as lack of caption on photos shared on Facebook, Twitter and WhatsApp, lack of commands for Facebook chatting, difficulty in searching for friends and sending friend requests, and inability to send and listen to WhatsApp voice messages due to overlapping of the voice output from screen reader software, among others, affected the adoption of mainstream social media platforms.

Coproduction and Peer Sharing of Educational Content

Though several community champions, and governmental and non-governmental organizations, such as National Institute for the Visually Handicapped, All India Confederation of the Blind, and the National Association for the Blind, among others, produce high quality audio books, a great deal of educational content remains unavailable to low-income blind people in rural and peri-urban areas because of time-consuming services, lack of coordination among several producers, and absence of centralized repository of available books. The environment of constraint and disability has created a thriving ecosystem comprising of user generated content and peer sharing, that is orchestrated by low-income blind people living in rural and peri-urban areas. We discovered that low-income blind people produce their own educational content in audio format either individually or collaboratively. The ecosystem also involves diverse stakeholders, including blind teachers, social connections of the blind (friends and family), social workers, and sighted university students, who are producing and/or sharing educational content to either receive instrumental information, social incentives, and financial incentives.

For producing content, blind participants purchased books for sighted audience and asked their social connections to record it for them. Several of them were also approached by their sighted peers and social workers who offered to record chapters for them. In the event when recording by their social connections was not feasible in a timely fashion, they collaboratively hired a reader for the group by paying anywhere between USD 0.50-2 per hour. Often, the group coordinated among themselves to record the reading sessions using a mobile phone, tape recorder or a laptop. Participants reported that the user generated content, thus obtained, is so abundant that it is not uncommon to see two people in the same class room accessing an audio chapter recorded by two different people. Some blind teachers and students also maintain offline repositories to store, categorize and index the educational content for further distribution.

For accessing content, participants reported that the easiest and fastest way to access any educational content is to ask their friends and teachers for it. They relied heavily on peer sharing to access user-generated as well as professionally produced audio content. They used a wide variety of mechanisms, including sharing CDs, exchanging memory cards, and intermediated sharing [24], to send and receive educational content. Though prior research has documented peer-to-peer media sharing in low-income contexts by sighted people [12,25], to our surprise, several blind participants used Bluetooth to transfer audio book chapters to others. The drive to access and share educational content motivated them to overcome significant barriers in user

interface design. They initiated Bluetooth sharing by memorizing the complex steps of button presses and user interface navigation.

Though it is not uncommon to see disabled stakeholders appropriate general-purpose devices to serve as assistive devices because of their high cost or low usability [3,9,10], the ecosystem we unearthed is unique because of its focus on educational content, involvement of marginalized low-income blind people living in rural and peri-urban areas on less than USD 2 per day, the reliance on low-cost offline technologies such as tape recorders, basic mobile phones, CD players, and the disproportionate amount of user-generated content and peer-sharing than institutionalized and systematic production and indexing of accessible educational content. The ecosystem discovered here is a rare example of a bottom-up, community-driven, organic and self-sustaining intervention in educational domain and reinforces the notion that that outside help may not always be needed for marginalized populations to apply new technologies to gain instrumental benefits. Though looking from a contemporary lens of technology adoption and use, it appears that the blind community is lagging behind since the existing assistive technology (such as screen reader software and Braille printer), devices (smartphones, tablets and computer), and the Internet is unaffordable and inappropriate for many of them. However, a closer look at the educational ecosystem reveals that these blind users are leaders and early adopters in producing multimedia content and designing new sharing practices to quench their thirst for educational material that is not available in other forms.

Bridging the Gap between the Sighted and Blind

Beyond the obvious use of social media platforms, such as widening the social circle, accessing and sharing news, songs and other informational content, sending photos and chatting, among others, our social media study revealed several unique affordances that social media platforms accorded to low-income blind people.

The participants used social media platforms an instrument to receive valuable information about scholarships and health schemes, employment opportunities, and educational material. Though participants had access to mobile phones, they could not communicate with their friends regularly because of harsh financial constraints that made even phone calls unaffordable. A participant stated:

"I only call my friends when I have a question related to a career opportunity or to wish them on festivals. Every time I call, I have to speak for 4-5 minutes and that is expensive."

They used social media platforms as an affordable alternative to bridge the communication gap and thus, strengthen their offline social network of blind friends, colleagues and teachers. Social media platforms not only empowered these users to have longer and frequent conversations through online chatting, they also provided them avenues to discuss topics relating to national and regional interest, and access entertaining content.

Several participants reported that they were treated in a condescending manner by the society, including their friends, colleagues and even family members. A participant expressed:

"People think that even if we study, we will not get a job. When we go to mobile shops for recharging the Internet, they think that we are joking. They have a perception that even if I use Facebook who is going to be friends with me?"

Many of them used social media platforms, especially to have conversations with sighted friends and strangers with the intent to change their perception about the blind. On average, 25% of

their connections were people they never met before, and 69% of their social media friends were sighted people. Participants expressed a deep desire to prove others that they are equally confident and knowledgeable. The desire motivated them to demonstrate their technology acumen to their critiques, using social media platforms. A participant explained:

"When I say to people that I use a computer, then no one believes me. They think I am blind and when they cannot operate a computer properly how I will be able to. But when I send a request on Facebook, they know it is me who has sent that request. People in my locality now know that I use the computer."

Since *Sangeet Swara* could be accessed by anyone who could call a toll-free number, it provided several benefits to those who could not use mainstream social media platforms because of several socioeconomic barriers, infrastructural challenges and language constraints. Though the usage of *Sangeet Swara* was similar to the mainstream social media platforms (such as increasing social connections, strengthen existing connections, access entertaining information, and receiving instrumental benefits, among others), the adoption of *Sangeet Swara* was much higher among low-income blind population across several states in India. Many participants shared that the platform connected them with blind participants in other states and far-off locations for the first time. In fact, *Sangeet Swara* was the first social media platform for 90% of its blind users. Many low-income users believed that the platform was designed exclusively to connect blind people all across India, and provide them opportunities to learn skills, and share information, news, and entertainment.

To summarize, though participants faced very great challenges in accessing mainstream social media platforms, they used them to uplift their social standing among sighted people, make meaningful connections with the blind, access instrumental information, and build self-confidence. *Sangeet Swara* proved to be an accessible platform that capitalized on the strengths of voice and enabled people to create, access and share content in Hindi language.

Recommendations for SIGACCESS Community

Smartphone and Internet penetration is rapidly increasing in developing regions. In India alone, annual smartphone subscription and Internet user growth rate is 55% and 33%, respectively [15]. In fact, 65% of India's Internet traffic comes from mobile devices [15]. The average selling price of smartphones has declined by 16% over past two years [5] resulting in availability of affordable Android phones for less than USD 30. Moreover, the cost of accessing the Internet has steeply declined [11]. Based on the advances in availability and cost, it is inevitable that more low-income, low-literate blind people will have access to smartphones and the Internet in a near future. Recognizing the growing adoption in developing regions, several existing social network service providers have built specialized applications for resource-constrained environments. For instance, Facebook, YouTube and SMS GupShup launched Facebook Lite, YouTube Go, and GupShup messenger, respectively. However, the accessibility challenges are still unaddressed even in the specialized applications. We exhort the research community to capitalize on the rapidly changing infrastructure and ecosystem to design affordable and usable assistive technologies for low-income blind people in India. There are several interesting opportunities such as generating online resources in local languages, building tools to convert educational content in English to other languages, building smartphone-based educational applications that are grounded in local context, designing new accessible interfaces on modern as well as legacy computing devices, building new crowdsourcing systems to provide additional earning

opportunities to low-income blind people, and designing local language digital assistive technologies, among others. Prior studies have also established that in comparison to sighted people, low-income blind people have disproportionate access to educational opportunities, health benefits [23,38], and job prospects [20] that impede their potential of overcoming poverty. There is a need to design and build new technologies that let low-income blind people produce, consume and share information in diverse domains, including health, education, agriculture, civic engagement, finance, and journalism, among others. The technological solutions have the potential to dramatically impact the lives of 256 million visually impaired people living in low-income settings.

Our studies also revealed a disconcerting reality — low technology adoption and use by low-income blind women living in rural and peri-urban India because of several social and cultural factors. Over 90% of all the blind participants in our prior work were male. Even on *Sangeet Swara*, a social media platform that could be accessed simply by placing phone calls on a toll-free line, only 7% of all participants were estimated to be women. The lack of technology use and adoption is much widespread. According to a recent GSMA report [34], almost 1.7 billion women in low- and middle-income countries do not even own mobile phones, and women in South Asia are 38% less likely to own a phone than men. The lack of access to technology limits their access to several health schemes, scholarships, policies, and employment opportunities. During the course of our studies, some women participants expressed that the access to information is the single best thing that has transformed their lives. There is an urgent need to address this pervasive lack of technology adoption by blind women in low-income settings. This could be accomplished by incorporating policies, incentives, and social and behavior change communication tools to support technology adoption, creating awareness about the opportunities available to them through print and media campaigns, and designing usable technologies that are cognizant of their economic, social and infrastructural constraints.

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