ENHANCING MOBILE ACCESSIBILITY FOR PERSONS WITH HEARING AND VISUAL IMPAIRMENTS: CASE FOR MOBILE AS AT

Cluster 1 Inquire
Mobile as Assistive Technology

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Background

Assistive technology (AT) plays a pivotal role in augmenting the quality of life for persons with impairments and disabilities, increased independence, and societal participation. Among various technologies, smartphones have emerged as a multifaceted and accessible tool, providing a range of accessibility features and applications designed to support increased autonomy in daily living activities. Multiple Assistive Products, which are essential for persons with visual and hearing impairments, such as screen readers, closed captioning devices, alarms, hearing amplifiers, magnifiers, and electronic orientation aids, can be replaced by a smartphone with an internet connection.

Integrating smartphones as AT in Low-and-Middle-Income Countries (LMICs) is challenging due to issues like digital literacy, affordability, infrastructure, and the need for localized content and applications (apps). However, these challenges also offer opportunities for innovation, policy-making, and collaboration across different sectors to create inclusive tech ecosystems that support persons with disabilities.

This Policy Note presents key findings and recommendations from the ‘Mobile as AT’ research study to examine the digital literacy gap and assess the impact of smartphone utilisation as AT over a period of six months among persons with visual (VI) and hearing impairments (HI) in India, Kenya, and Brazil. This study has been delivered by the AT2030 programme led by the Global Disability Innovation Hub (GDI Hub) and funded by UK Dev, ATscale, the Global Partnership on Assistive Technology, and Google.

Research Overview

This research aimed to assess the feasibility and impact of providing smartphones and digital skills training to persons with hearing and visual impairments in Low-and-Middle-Income Countries (LMICs). Although the study included participants from various countries, contextual factors may affect the generalizability of the results. Additionally, only a small number of participants were over 60 years old, so the findings may be more applicable to a younger population.

Participants

A total of 752 participants were recruited in India (300), Kenya (200), and Brazil (252) to participate in this study. These countries were selected as they offer a snapshot of three different geographies, have existing mobile ecosystems to ensure reasonable levels of infrastructure and mobile signal coverage, and have a strong network of Organisations of Persons with Disabilities (OPDs) and academic partners to support participants' recruitment and training. The participants included 346 persons with hearing impairments and 406 with visual impairments. Among the participants, 365 identified as female and 387 as male, with ages ranging from 16 to 89 years old.

Recruitment was conducted by partner universities in each country (IIIT Bangalore in India, Jomo Kenyatta University in Kenya, and Universidade de São Paulo in Brazil) with the help of local OPDs. This approach ensured that participants were already known in their communities, fostering mutual trust and reducing the likelihood of dropouts.

Mobile on-boarding and Digital skills training

All participants enrolled in the study were provided with a Samsung Galaxy A-14 5G phones with Android 13 and 2GB of data per month for the six-month duration of the study. Accessories like phone covers, screen guards and adapters, and plug-in headphones for users with visually impairments were also provided to enable participants to use the phones effectively and minimize the chance of accidental damage. Mobile phones and accessories were purchased locally in each country. Phone models were selected to meet minimum specifications required by most common applications (Octa core 1.8 GHz CPU, 4GB RAM, Android 12 or above, and screen size greater than 5 inches). The cost of the handset was approximately $150 USD.

All participants received a two-day training, delivered in groups of 15-20 persons to learn how to use the mobile phones and the Android accessibility features, alongside apps such as Live Transcribe, Sound Amplifier, Live Captions, TalkBack, Google Assistant, and Lookout in their daily activities. The structure of the training was decided and refined in collaboration with local trainers and expert users to ensure it would cover all the necessary skills for independent use.

Training sessions were conducted separately for persons with visual and hearing impairments to better address access needs (such as sign language interpretation for hearing-impaired participants and tactile exploration of the phone for persons with visual impairments). Each focused on specific apps and accessibility features which are more relevant to those with different sensory impairments groups (e.g. Live Transcribe and Talk Back for persons with visual impairments). Participants were provided follow-up training materials and ad-hoc assistance as needed via WhatsApp groups managed by researchers and OPD personnel who provided the in-person training.

Data collection

The study was delivered over a period of 6-months. A baseline set of questions was asked during enrolment to understand the participants' personal and social circumstances and quality of life, including their use of AT and mobile phones and their expectations of the smartphone as AT administered to participants. Follow-up questionnaires and interviews were conducted monthly for the duration of the project.

To monitor how participants adapted and integrated the mobile phone into their activities of daily living, a discrete mobile use tracking app called Murmuras, a UK GDPR-compliant app that anonymously tracks the user's consumption of smartphone features and installed applications, was installed on participants' phones. All participants were informed of the purpose of the study and modality of data collection, including a detailed explanation of how the Murmuras application would monitor the overall frequency and length of usage sessions for applications, but not the content of interactions nor any other personal data such as websites visited, the nature of messages, emails, and phone calls, or identity of senders and recipients of various exchanges. All persons provided informed consent prior to participation.

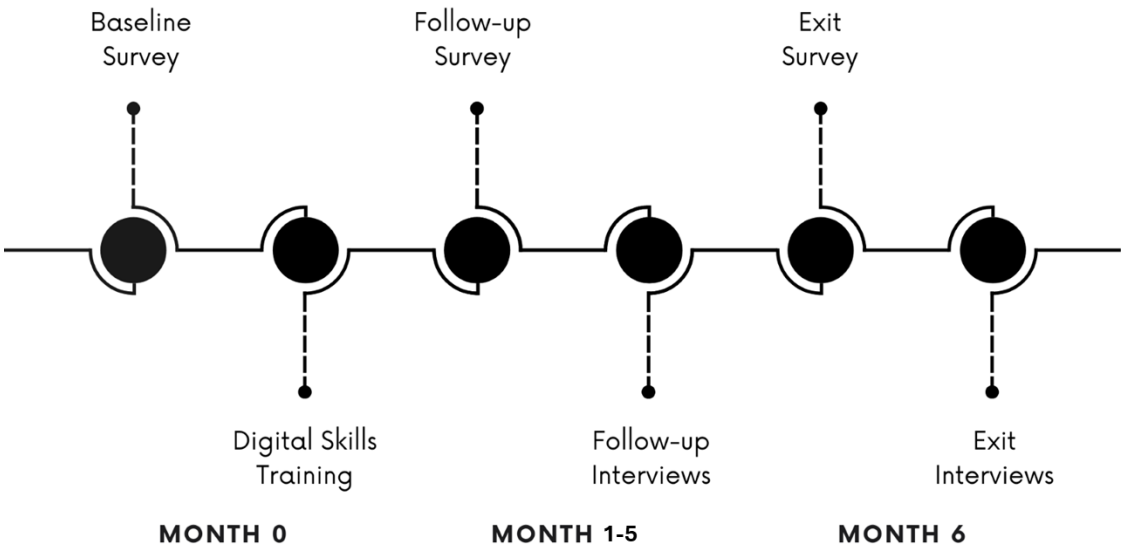

Figure 1 Mobile as AT research process

Key Findings

Our findings are in three sub-sections - Training, Technology, Use - to capture the key research highlights that have direct implications for policy development and implementation at national and international level.

Training

Many of the participants enrolled in the study had never owned a smartphone (32%) and the majority had limited digital skills, with 60% stating they were unfamiliar with accessibility features and applications. Those who had previous exposure to mobile technologies were somewhat familiar with the basic accessibility features. To accommodate for such differences, a modular curriculum was developed to feature incremental levels, including basic smartphone skills, accessibility features, online safety, and social media use. Training modules were adapted according to the digital skills level of the person and the type of impairment. From the initial in-person training sessions, the following key insights emerged:

- **Importance of Modular Training Structures** – Training provided significant insights into accessibility, but individual characteristics and digital skill levels required flexible implementation to meet the bespoke requirements of participants. As the number of features and applications for persons with hearing impairment is lower than those for persons with visual impairment, it was expected that the corresponding training would be shorter and potentially completed within a single day. However, significantly more time was needed to accommodate sign language interpretation, and the training sessions were delivered over two days for all groups.

- **Early Challenges for Persons with Visual Impairment** – Persons with visual impairments faced challenges in physically interacting with smartphones, including unboxing, recognizing phone buttons, and setting up accessibility features like TalkBack. Repetitive practice and hands-on training helped persons gain confidence, **w**ith digital skills improving significantly during the 2-day training period, and throughout the 6-month study period.

- **Sustained Challenges for Persons with Hearing Impairment –** Several persons with hearing impairment initially navigated smartphones more easily but faced language barriers when using accessibility features like Live Transcribe, as many were unfamiliar with written English or regional languages. Many persons with hearing impairment lacked basic digital skills, and national Sign Language sometimes did not cover necessary technical terms. Throughout the training sessions interpreters and participants relied on workarounds such as ad-hoc explanations and demonstrations to convey specific information, but such a strategy solely relies on the resourcefulness of the persons involved and increased the length of the training.

Digital skills training and support continued to be delivered by facilitators throughout the study via the dedicated WhatsApp groups. Additional insights were gathered during subsequent exchanges:

- **Sustained Training Programs** – While some participants felt confident after the in-person training, the majority of users continued to require support over the months of the trial, demonstrating how a one-off training is often insufficient.
- **Different Preferences for Information Exchanges** - Participants with visual impairments were active in WhatsApp groups, engaging in discussions through text and voice messages. In contrast, participants with hearing impairments interacted less frequently primarily using short texts and video messages in sign language.

- **Need for User Manuals** – whilst helpful documentation for users and developers which explains the accessibility features of various products exists on Google platforms, this information remains out of the reach of users due to a combination of factors that included lack of awareness, difficulty grasping terminology, and unavailability of the material in local languages. Throughout the study, participants had to rely on instructions from trainers or more expert peers to identify new features and applications and learn how to use them.

Use

Throughout the duration of the study participants utilized their smartphones for a variety of purposes to enhance their independence, communication, education, and employment opportunities. To achieve their goals, they leveraged a variety of different tools, including accessibility features embedded in the operating system, general purpose applications (such as social media or video streaming applications), and dedicated services for persons with disabilities (such as applications that pair users with visual impairment with sighted guides, or applications that help users with hearing impairment with lip reading). From the data gathered, we summarize the following key insights:

- **Smartphones as Assistive Technology** – Smartphones, combined with digital skills and internet access, can serve as a powerful assistive product for persons with disabilities. Smartphones can partially substitute traditional assistive technology such as braille readers and standalone screen readers for users with visual impairment (through tools such as TalkBack, Google Assistant, and Lookout). For users with hearing impairments, smartphones can partially substitute hearing aids in some cases through Sound Notifications, Live Transcribe, and Live Captions. These applications can complement national sign languages and applications which support sign language support.

- **High Educational Uses of Smartphones** – Smartphones were used for educational purposes in formal and informal settings by both users with visual and hearing impairments, including capturing lectures, accessing online content, and managing coursework.
- **Smartphone use in healthcare –** Participants with hearing impairment highlighted challenges in communicating their needs to healthcare professions due to unavailability of sign language interpreters and lack of appropriate training for hospital staff and healthcare professionals, which could be occasionally bridged using the smartphone (but only when professionals made sure to adapt to the introduction of the smartphone as communication tool, for example giving clients time to read the transcription of a speech to text application before resuming to talk, or type messages using text to speech applications during verbal exchanges.).
- **Access Opportunities for Employment via Smartphone** – Both users with visual and hearing impairments made ample use of their smartphone to find opportunities for work, via web advertising and dedicated applications. Smartphones were also crucial for communication with clients among small business owners, or to engage in other income generating activities such as paid surveys and remote jobs.
- **Support Exchanges between Users with Vision and Hearing Impairments** – The project facilitated effective communication between users with vision and hearing impairment for the first time, enabled by the smartphone accessibility features (speech-to-text and text-to-speech).

Technology

The extent to which both participants with vision and hearing impairment could leverage the smartphone in their daily lives in the modality illustrated above, was influenced by their own digital skills but also by the features of smartphones themselves and the digital ecosystem associated with them. Throughout our study we uncovered the following key insights:

- **Standardizing Accessibility Features** – Low-cost smartphones often strip out accessibility features due to their software. For example, camera applications, which are crucial for users with vision impairments, are not labelled for screen readers, making them unusable. This happens even though the phones have the necessary processing power and specifications.

  Different smartphone models have varying accessibility features, leading to inconsistency. This is due to third-party hardware and manufacturer-restricted versions of the Android operating system, which can interfere with native features. Initially, low-cost smartphones that met the required specifications were selected for the project. However, during testing, it was found that while these smartphones included the native accessibility features of Android, the manufacturer's interface modifications created conflicts, rendering these features unusable.

- **Impact of Removing Native Support for Hearing Aids** – Recently, smartphone manufacturers are moving away from offering native support for hearing aids in favour of more general Bluetooth pairing. This was deeply problematic for users with hearing impairments, causing confusion due to ineffective Bluetooth functionality and lack of guidance from both smartphones and hearing aids manufacturers.

- **Availability of information –** While smartphones could support access to the digital world, participants reported how inaccessibility of websites and information, including essential health-related information and other essential services could hinder their daily lives.

- **Cross-Linking between Apps –** Individual applications could provide basic levels of access, but integration between various services (such as websites and Internet-of-Things enabled smart devices) could further enhance their impact. For example, participants with hearing impairments suggested linking the 'sound notification' app to a video security camera for enhanced physical security.

Recommendations

From the insights presented in the previous section, we summarize a series of recommendations which are specifically targeted to the three key stakeholders with the potential to deliver large-scale implementation of Mobile as AT programs across LMICs countries: International and National Organizations, OPDs and civil society, Governments, Smartphone and Telecom Companies, and Academia.

Governments

- **Recognize Smartphones as AT:** Include smartphones in national assistive product lists and integrate them into Universal Health Coverage (UHC) programmes. Subsidize accessible smartphones under social protection programmes for persons with disabilities. Establish regulatory guidelines mandating the inclusion of accessibility features in all mobile devices.

- **Promote Smartphones as AT -** Invest in training programs as well as Smartphones and accompanying data packages that provide comprehensive education on the use of assistive technologies, ensuring they are accessible to all persons with disabilities. Insights from Barbareschi and Holloway's research can guide the development of these programs.

- **Boost Existing Mobile Employment Networks** – Expand opportunities for remote work and business management via accessible mobile services to unlock work opportunities in formal and informal contexts.

- **Disability and Skill Specific Training -** Develop and fund specialized digital skills training programs for persons with visual and hearing impairments, focusing on the use of mobile technology as an assistive tool. Refer to the Product Narrative: Digital Assistive Technology for insights on improving access to digital AT.

- **Leverage Existing Communities for Reach -** Partner with educational institutions and OPDs to facilitate the recruitment of diverse participants for research and training programs.

- **Improve the Accessibility of the Broader Mobile Ecosystem** - Promote policies that enhance access to smartphones and the internet for persons with disabilities, ensuring they have the skills to utilize these tools effectively. Refer to the Product Narrative: Digital Assistive Technology for detailed recommendations.

- **Promote Smartphones for Universal Learning** - Integrate mobile technology into educational curricula for students with disabilities, ensuring they have access to and training on these tools. The AT2030 programme provides valuable insights on innovation strategies to improve access to assistive technology.

Smartphone and Telecom Companies

- **Accessible Documentation and Self-Paced Training Resources -** Provide freely available self-paced training materials, including user manuals that provide clear instructions on using accessibility features, and ensure they are tailored to the specific needs of different disability groups. Develop help and support documentation in multiple languages and multimodal formats (including video, written explanations, and interactive tutorials).

- **Advocate for Standardized Accessibility Systems -** Work across mobile manufacturers to standardize essential accessibility features across all smartphone models.

- **Develop more Accessible Low-Cost Smartphones and Formulate Tailored Competitively Priced Data Plans -** Due to the unaffordability of high-end smartphones for most persons with vision and hearing impairments in LMICs, it is crucial to ensure that low-cost smartphones meet basic benchmarks for accessibility and that new affordable options become available on the market for both private and public purchase. Data plans which account for the different usage patterns and needs of users with vision and hearing impairments at competitive price points are needed to improve access for persons. This would additionally expand customer bases for companies.

- **Support the Integration between Smartphones and Other Assistive Products** - Ensure the inclusion of native support for hearing aids in mobile devices and ensure compatibility with assistive hearing technologies.

Academia

- **Promote Innovative Approaches to Expand Access Opportunities** - Facilitate the development and adoption of integrated smartphone features and services as well as assistive technologies to enhance the capabilities of persons according to their specific contexts and needs.

- **Investigate Feasibility of Suitable Financing Plans for Users and Providers -** Propose evidence-based approaches for financing plans that enable users with vision and hearing impairments to acquire smartphones that can be leveraged as AT, including options for partial or complete subsidization which accounts for the economic feasibility and integrating public-private partnership opportunities.

- **Support Smartphone-Mediated Communication in Healthcare Settings -** Develop programmes to promote disability inclusion in healthcare by training staff in digital skills for accessibility to reduce dependency on intermediaries such as sign language interpreters or caregivers.

- **Enhance Cross-Disability Solidarity Using Smartphones** - Support initiatives that foster communication and collaboration between different disability groups, enhancing their ability to share knowledge and resources.

- **Expand Accessibility Vocabulary in Sign Language -** Collaborate with local startups and OPDs to develop an appropriate vocabulary in sign language for technical terms and integrate this into training programs.

International Stakeholders

- Engage international organizations like the World Health Organization (WHO) and the International Telecommunication Union (ITU) to integrate digital AT considerations into broader AT and Information and communication technology (ICT) policies.

- Leverage global disability and ICT forums to promote the adoption of smartphones as AT.