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Mobile as Assistive Technology

Brazil Summary Report

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Mobile as Assistive Technology

Brazil Project Report Summary

An accessible summary of evidence for policymakers, funders, mobile network operators, and mobile manufacturers

This document presents the summary of findings from research investigating the impact of Mobile as Assistive Technology conducted in Brazil between 2024 and 2025. The project explored whether smartphones can serve as assistive technology for people who are Blind or Partially Sighted (BPS) and people who are Deaf or Hard of Hearing (DHH).

The research was funded by the UK Department for International Development, Google, and ATScale – Global Partnership for Assistive Technology.

The research was led by Global Disability Innovation Hub (GDI Hub) and University College London in collaboration with University of Sao Paulo, Rio Branco Vocational Center and Educational Center for the Deaf (CES and CEPRO), Laramara — the Brazilian Association to Assist People with Visual Impairment, Support Centre for the Visually Impaired (CADEVI), Light for the Blind Institute, ENIAC — Guarulhos University Centre of Excellence (via a local BPS instructor). The mobile data plan was provided free of charge through an agreement between a local telecommunications provider (Claro S.A.) and the University of São Paulo Medical School General Hospital (HCFMUSP).

Background and Rationale

More than 84% of people in Brazil use the internet — yet this figure masks a persistent and significant gap for people with disabilities. Data collected between 2012 and 2016 indicate that internet use, computer use, and mobile phone ownership are consistently lower among people with disabilities across all social classes in Brazil. Only 36.8% of people with disabilities use the internet, and 64.9% own a mobile phone, compared to higher rates in the non-disabled population.

Globally, people with disabilities in low- and middle-income countries (LMICs) face a mobile ownership gap ranging from 11% to 55% compared to the general population. Brazil reflects these patterns: while approximately 84.4% of Brazilians owned a mobile phone for personal use before this study, access was far from universal, with economic constraints and limited digital literacy cited as the primary barriers.

Smartphones have significant potential as assistive tools. Built-in accessibility features and specialised applications can replicate or complement many traditional assistive products. When accessible and properly used, they can increase independence, facilitate participation in the digital economy, and expand access to information and services. Despite this, there is limited evidence on the impact of providing smartphones or data plans to assistive technology (AT) users in LMICs, or on how such programmes can be implemented effectively.

This study, therefore, aimed to examine the feasibility and impact of providing smartphones to AT users in Brazil, with a specific focus on two groups: Blind and Partially Sighted (BPS) individuals and Deaf and Hard of Hearing (DHH) individuals. The core objective was to generate evidence to inform the design of future, larger-scale programmes that leverage mobile technology for empowerment.

Research Questions

The study was structured around four primary research questions:

- How do people with disabilities use mobile phones in their daily lives?
- How does mobile phone use affect the quality of life of people with disabilities?
- To what extent can mobile phones complement or replace conventional assistive products?

- What types of support enable people with disabilities to develop the digital skills needed to benefit fully from mobile technology?

Methodology

Study Design

This was a mixed-methods pre-post intervention study conducted in São Paulo, Brazil, between August 2024 and February 2025. Each participant received a smartphone and a mobile data plan, followed by structured digital skills training. Data were collected through pre- and post-training surveys, passive smartphone usage monitoring, and monthly qualitative follow-up interviews.

Participant Recruitment

Participants were recruited through established partnerships with reputable institutions serving people with visual or hearing impairments in São Paulo. These organisations maintained databases of potential participants and conducted initial eligibility screening. Introducing the study through trusted institutions helped reassure participants about the legitimacy of the research and reduced the risk of individuals enrolling solely to receive the device.

Where required, snowball sampling was used to supplement recruitment, particularly for DHH participants, given the limited number of partner institutions available in that community. Initial contact with potential participants began in February 2024 via partner networks; direct outreach by phone call — rather than text message — significantly improved response rates.

Sample

The study enrolled 242 participants, divided equally between DHH (n=121) and BPS (n=121) groups. Table 1 summarises key baseline demographic characteristics.

Characteristic	All Participants (n=242)	DHH (n=121)	BPS (n=121)
Average age (years)	40.7	34.0	47.2
Age range (years)	19–82	19–72	21–82
Female (%)	48.8%	41.9%	54.6%

Characteristic	All Participants (n=242)	DHH (n=121)	BPS (n=121)
Secondary education or above (%)	79.8%	82.9%	76.7%
Owned a mobile phone at baseline (%)	95.5%	95.7%	95.9%
Owned or had used a smartphone at baseline (%)	≈66%	≈83%	≈51%
Currently using at least one assistive product (%)	64.4%	70.2%	59.5%
Reporting unmet assistive technology needs (%)	47.3%	59.7%	33.0%

Table 1: Baseline participant characteristics (source: Block 1 and Block 2 pre-training survey data).

DHH participants were, on average, younger than BPS participants (34.0 vs 47.2 years) and had greater prior smartphone experience. Around two-thirds of participants already owned a mobile phone before joining the study, though many were using basic or feature phones with limited or no accessibility functionality. Notably, approximately half of all participants reported unmet needs for assistive products — meaning they required equipment such as hearing aids but lacked access to them.

With respect to disability severity, 52% of BPS participants reported being unable to see at all, and 32% reported a lot of difficulty seeing. Among DHH participants, 38% reported being unable to hear at all, 17% reported a lot of difficulty hearing, and 25% reported no hearing difficulty, reflecting the diversity of hearing profiles within the DHH group.

Intervention

Device

The study protocol originally specified the Samsung Galaxy A14. However, this model was unavailable in Brazil at the time of procurement, and the newer Samsung Galaxy A15 was used instead. This substitution caused delays: devices did not arrive until the end of July 2024, compressing the study timeline and requiring several protocol adjustments (see Section 2.7). The research team pre-configured all devices — installing system updates and SIM cards — before distribution.

Mobile Data Plan

Each participant received a free SIM card with unlimited calls and messages to any number in Brazil, plus 10 GB of mobile data per month. The plan was provided at no cost through an agreement between the telecommunications provider Claro S.A. and the University of São Paulo Medical School General Hospital.

Digital Skills Training

Training sessions were translated and adapted into Portuguese from the original project materials. The curriculum was updated to reflect the specific smartphone model and Android version used, and a new module on digital security and online safety was added. Sessions were delivered in groups, totalling approximately 8 to 9 hours per cohort, and focused exclusively on the accessibility features already built into the device.

Several accessibility-focused adaptations were made to the delivery:

- Training for DHH participants was delivered in Brazilian Sign Language (Libras)
- All consent forms and survey questions were read aloud for BPS participants
- Sessions were split across two or more days to accommodate travel constraints in São Paulo
- BPS sessions were held at familiar, independently accessible venues
- Two trainers worked simultaneously in most sessions — enabling one to support individuals while the other continued group instruction
- WhatsApp group chats were created for each training cohort to facilitate ongoing communication and peer support after sessions concluded.

Data Collection

Surveys

Two surveys were administered using the Qualtrics platform and translated into Portuguese. A pre-training survey was conducted at enrolment, and a post-training survey was administered after completion of training. Survey content was organised into thematic blocks:

Block	Content	Pre-training	Post-training
1	Demographic information	All participants	All participants
2	Self-reported need and use of assistive technology	All participants	—
3	Mobile phone expectations	Non-smartphone users only	—
4	Mobile phone usage	Smartphone users only	All participants
5	Digital skills self-assessment (MDPQ)	Smartphone users only	All participants
6	Quality of life	All participants	All participants
7	Mobile data plan impact	—	All participants

Table 2: Survey structure — blocks administered at each time point.

Smartphone Usage Monitoring (Murmuras)

The Murmuras application was installed on participants' smartphones to passively record which applications were used and the duration of each session. Application session data were aggregated into daily usage records per participant per application. The Murmuras database was monitored throughout the study to ensure data integrity, with troubleshooting procedures applied when collection gaps were identified.

Monthly Follow-Up Interviews

Between November 2024 and February 2025, a subset of participants was invited to participate in monthly follow-up interviews. Each month, 16 interviews were conducted — eight with DHH participants and eight with BPS participants. Half involved the same participants across all months (longitudinal tracking); the other half were selected randomly from the remaining sample. Interviews were conducted by video or audio call using a semi-structured script translated and adapted into Portuguese.

Data Analysis

Quantitative Survey Analysis

Demographic and baseline variables were summarised using descriptive statistics. Pre- and post-training survey comparisons were conducted for three outcome measures: mobile phone usage (Block 4), digital skills (Block 5, scored using the Mobile Device Proficiency Questionnaire — MDPQ), and quality of life (Block 6). Only participants who completed both surveys were included in pre-post comparisons.

Paired pre-post comparisons were conducted using the two-tailed Wilcoxon Signed Rank Test, selected over the paired t-test due to skewness in score residuals. Effect sizes were estimated using Cohen's d. Linear Mixed Models (LMMs) were fitted to examine associations between participant characteristics (age, gender, group) and outcome scores, with a random intercept per participant to account for individual-level variation. P-values were adjusted using the Holm-Bonferroni correction; adjusted p-values below 0.05 were considered statistically significant.

Murmuras Usage Data Analysis

Application usage was analysed across three metrics: number of unique users per application, total cumulative use time, and average daily use time. Analyses were conducted for all participants combined and separately for DHH and BPS groups. Accessibility applications and social media applications were identified and analysed as distinct sub-categories. Trend analysis was used to identify applications with the largest increases or decreases in usage over the study period.

Qualitative Analysis

Monthly interview transcripts were analysed thematically to identify recurring themes and sub-themes related to participants' experiences with smartphones, data plans, and training.

Protocol Adaptations

Due to the delayed arrival of smartphones, the study timeline was compressed, and several protocol adjustments were made:

- Target participant number reduced from 550 to 300 (242 ultimately completed the programme)
- Initial and final in-depth interviews were removed from the protocol

- Recording of training sessions discontinued
- Minimum follow-up period shortened from six months to four months

Two timeline extensions were also granted — first to December 2024, then to February 2025 — to ensure participants received the full follow-up period.

Findings

Findings are presented across four domains: participant baseline characteristics and assistive technology use (Section 3.1); quantitative pre-post outcomes across mobile phone usage, digital skills, and quality of life (Section 3.2); objective smartphone usage patterns from Murmuras monitoring data (Section 3.3); and qualitative evidence from monthly follow-up interviews (Section 3.4).

Baseline: Assistive Technology Use and Mobile Ownership

At baseline, approximately 64% of all participants reported currently using at least one assistive product. Commonly cited products included hearing aids, the ICOM Brazilian Sign Language interpreting app, and Live Captions among DHH participants; and white canes, magnifying glasses, braille typewriters, braille displays, TalkBack, and Google Voice Search among BPS participants.

Despite this, nearly half of all participants (47%) reported needing assistive products they did not currently have access to or that required replacement. Among DHH participants, this figure rose to 60%. Commonly cited unmet needs among BPS participants included braille typewriters, braille displays, artificial vision systems, and screen magnification tools.

Key baseline finding: significant unmet AT need

- 64% of participants were using at least one assistive product at baseline
- 47% reported unmet needs for assistive technology they could not access
- This rose to 60% among DHH participants
- Smartphones were therefore entering an ecosystem of incomplete AT provision — not filling a vacuum

Regarding prior mobile phone ownership: 95.5% of participants already owned a mobile phone at baseline. However, ownership patterns differed significantly between groups. Among DHH

participants, 83% already owned or had used a smartphone. Among BPS participants, this was 51% — with a higher proportion using basic or feature phones with limited accessibility functionality. Over 70% of smartphone owners in both groups had owned one for more than five years, suggesting familiarity with devices but not necessarily with their accessibility features.

Survey Outcomes: Pre- and Post-Training Comparisons

Three outcome measures were assessed by comparing pre-training and post-training survey responses: mobile phone usage, digital skills (MDPQ score), and quality of life. Results are presented separately for all participants, DHH participants, and BPS participants.

Mobile Phone Usage (Block 4)

Block 4 assessed self-reported mobile phone usage and was completed by participants who already owned or used a smartphone before training (n=139 for the paired comparison). Table 3 presents the pre- and post-training average scores, score changes, and statistical results.

Group (n)	Pre-training avg.	Post-training avg.	Change	p-value (Wilcoxon)	Effect size (Cohen's d)	Key finding
All participants (n=139)	2.80	2.77	−0.03	0.798	0.04 (low)	Score decreases with age (−0.012 pts/year)
DHH participants (n=79)	3.11	2.91	−0.20	0.003	0.39 (medium-low)	Score decreased significantly post-training (−0.183 pts)
BPS participants (n=57)	2.36	2.55	+0.19	<0.001	0.35 (low)	Score increased significantly post-training (+0.188 pts); decreases with age

Table 3: Mobile phone usage — pre- and post-training comparison (Block 4, participants who already owned a smartphone).

BPS participants showed a statistically significant increase in self-reported mobile phone usage following training — a meaningful result given their lower baseline score. DHH participants showed a statistically significant decrease. This counterintuitive finding is likely explained by the higher baseline proficiency of DHH participants: having used smartphones extensively for years, their post-training scores may reflect more realistic self-assessment

rather than a genuine reduction in use. Age was consistently associated with lower usage scores across all groups.

For participants who did not own or use a smartphone before training, Block 3 (Mobile Phone Expectations) was used as the pre-training comparator. Overall, this group reported slightly lower actual usage post-training than they had initially expected — a pattern driven primarily by BPS participants. DHH new users reported slightly higher usage than expected, though neither difference was statistically significant.

Digital Skills Self-Assessment — MDPQ (Block 5)

Digital skills were assessed using an adapted version of the Mobile Device Proficiency Questionnaire (MDPQ), which covers eight domains: Basics of Mobile Devices, Communication, Data and File Storage, Internet, Calendar, Entertainment, Privacy, and Troubleshooting and Software Management. A composite proficiency score was calculated by averaging domain scores. Block 5 was completed by smartphone-owning participants at pre-training and by all participants at post-training (paired-comparison, n=138). Table 4 presents the results.

Group (n)	Pre-training avg.	Post-training avg.	Change	p-value (Wilcoxon)	Effect size (Cohen's d)	Key finding
All participants (n=138)	30.81	31.28	+0.47	0.07	0.09 (low)	Score decreases with age; female participants scored lower than males (−2.3 pts on avg.)
DHH participants (n=78)	35.29	34.99	−0.30	0.77	0.08 (low)	No statistically significant change; score decreases with age
BPS participants (n=57)	24.64	26.21	+1.57	0.001	0.17 (low)	Significant improvement post-training (+1.642 pts); score decreases with age

Table 4: Digital skills (MDPQ) — pre- and post-training comparison (Block 5).

BPS participants, who began with lower baseline MDPQ scores than DHH participants, showed a statistically significant improvement in self-assessed digital proficiency following training.

DHH participants, who started from a higher baseline, showed a slight and non-significant decrease — again consistent with a recalibration effect as participants became more accurate in evaluating their own skills.

Across all participants, individual variation accounted for a large share of score differences, with high inter-participant variance observed in both groups. Age was the most consistent predictor of lower scores. A gender effect was also observed in the full sample: female participants reported average MDPQ scores approximately 2.3 points lower than male participants.

An increase in 'Never Tried' responses between pre- and post-training surveys was observed across both groups (from 648 to 756 instances overall). This pattern was most pronounced among BPS participants. One plausible explanation is that, having built trust with the research team during the intervention, participants felt more comfortable responding honestly in the post-training survey — rather than over-reporting prior proficiency as they may have done at baseline.

Quality of Life (Block 6)

Quality of life was assessed using a validated scale included in both surveys. Table 5 presents pre- and post-training comparisons for all participant groups.

Group (n)	Pre-training avg.	Post-training avg.	Change	p-value (Wilcoxon)	Effect size (Cohen's d)	Key finding
All participants (n=211)	3.82	3.87	+0.05	0.07	0.09 (low)	No statistically significant change; no significant variables in the model
DHH participants (n=94)	3.76	3.72	−0.04	0.75	0.04 (low)	No statistically significant change
BPS participants (n=112)	3.88	3.99	+0.11	0.02	0.21 (low)	Statistically significant improvement (+0.104 pts); score decreases with age

Table 5: Quality of life — pre- and post-training comparison (Block 6).

The intervention had a positive and statistically significant impact on the self-reported quality of life of BPS participants (p=0.02). No statistically significant change was observed for DHH participants or across the full sample. These results suggest that, within the study period, the

combination of smartphone provision and structured training produced a measurable quality-of-life benefit specifically among visually impaired participants. Age was again negatively associated with scores among BPS participants.

Summary of quantitative outcomes

- BPS participants showed statistically significant improvements across all three measures: mobile phone usage, digital skills, and quality of life
- DHH participants showed no statistically significant improvement on any quantitative measure, likely reflecting their higher baseline proficiency and specific barriers encountered
- Age was the most consistent predictor of lower scores across all outcome measures and both groups
- Female participants scored lower than male participants on digital skills (MDPQ), on average
- Individual variation between participants was the largest single source of score differences overall

Mobile Data Plan Impact (Block 7)

Block 7, included only in the post-training survey, captured participants' experiences with the 10 GB monthly mobile data plan. The findings reveal a stark contrast between the two groups.

Data plan experience	DHH participants (%)	BPS participants (%)
Never ran out of data	3.8%	62.4%
Ran out of data frequently or always	49.5%	12.0%
Used more than 2 GB per day	35.9%	12.1%
Monitored data frequently or always	46.2%	8.6%
Data depletion affected app use considerably or significantly	50.9%	25.0%

Table 6: Self-reported mobile data consumption and impact (Block 7, post-training survey).

The contrast is pronounced: 62% of BPS participants never ran out of data, while nearly half of DHH participants ran out frequently or always. DHH participants were also far more likely to actively monitor their data usage. This pattern is consistent with the communication behaviours of DHH users, who rely heavily on data-intensive modalities — particularly WhatsApp video calls and streaming — as their primary means of interaction. The 10 GB monthly allocation was insufficient for this group's needs.

Smartphone Usage Patterns (Murmuras Monitoring Data)

Passive usage data from the Murmuras application provides objective evidence of how participants used their smartphones throughout the study. Results are reported separately by unique users, total cumulative use time, and average daily use, and further disaggregated by DHH and BPS groups.

Most Widely Used Applications

WhatsApp was the application with the largest number of unique users across all groupings, reaching 228 of 242 participants. This reflects the app's dominant position in Brazilian digital communication culture and its utility across text, audio, and video. Table 7 summarises the top applications by user reach and total use time.

Metric	All participants	DHH participants	BPS participants
Most users (any app)	WhatsApp (228 users)	WhatsApp (114 users)	WhatsApp (114 users)
Most users (accessibility)	Text-to-Speech (152)	Live Transcribe (106)	Text-to-Speech (101)
Highest total use time (social)	Instagram (335,734 min)	Instagram (287,791 min)	WhatsApp (127,448 min)
Highest total use time (accessibility)	Live Transcribe (11,615 min)	Live Transcribe (11,514 min)	No accessibility tool in top 15

Metric	All participants	DHH participants	BPS participants
Highest avg. daily use (social)	Instagram (33.2 min/day)	Instagram (36.9 min/day)	TikTok (39.5 min/day)
Top 2 accessibility tools by daily use	Magnifier, TalkBack	Central de LIBRAS	Magnifier, TalkBack

Table 7: Top applications by user reach, total time, and average daily use (Murmuras data).

Changes in Application Use Over Time

Trend analysis identified which applications showed the largest increases and decreases in average daily use over the course of the study.

Increases: TikTok showed the largest overall increase in average daily use across all participants. Among accessibility tools, the Magnifier showed the largest increase for all participants, including BPS participants. The Central de LIBRAS sign language interpreting app showed the greatest increase among DHH participants.

Decreases: No accessibility tool appeared in the top 10 applications with the largest decrease for all participants or for DHH participants. Among BPS participants, TalkBack showed the largest decrease of any accessibility tool — possibly reflecting participants transitioning to other accessibility approaches, or reduced novelty over time.

Qualitative Findings: Themes from Monthly Follow-Up Interviews

Thematic analysis of monthly follow-up interview transcripts identified six recurring themes. These are reported below using direct participant quotations to illustrate key points.

Theme 1: The foundational role of digital skills training

A central and consistent finding across interviews was that training — not device access — was the mechanism that enabled participants to use their smartphones as assistive tools. Many participants had owned smartphones for years but had never discovered the built-in accessibility features.

> *"If you hadn't shown them, how would I have known? It was a great opportunity. I was able to explore the functions. Before, I would just say that it was not accessible, because no one had helped me."* ***— DHH participant***

> *"It did change my life, because no one had taught me about all these functions. I was able to make the most of this moment, which was in sign language and they explained everything clearly so I could use the cell phone. I didn't know about all this assistive technology on the cell phone."* ***— DHH participant***

Several participants reported that they had previously paid for third-party applications to perform functions that the phone could already do through its native accessibility tools. The training revealed these capabilities.

> *"Before, I had to download and use other apps, sometimes even paid ones, to be able to translate. I didn't know that there was accessibility on my cell phone itself."* ***— DHH participant***

Participants frequently expressed a desire for additional training beyond what the sessions covered, indicating that the programme served as an entry point rather than a complete learning experience. Some described their progress as incremental, reflecting continued learning after formal training ended.

Theme 2: Impact on independence and quality of life

A strong and consistent outcome across both groups was an increased sense of independence and self-confidence in navigating everyday tasks — many of which had previously required the assistance of others.

> *"Now I can do things without depending so much on other people like my husband. Everything is on my phone. I can pay bills, access my bank account, send messages and make video calls."* ***— BPS participant***

> *"I feel freer. I don't need to call my mother or a friend to interpret. With the cell phone I can do things alone, I go wherever I want and I have communication."* — ***DHH participant***

For DHH participants, tools such as Live Transcribe enabled participation in workplace meetings and social situations from which they had previously been excluded.

> *"I noticed that things started to change mainly because of Live Transcribe. Before I felt very excluded, now I am able to work together with other people. I had a meeting at work and I was able to use my cell phone and feel more included."* ***— DHH participant***

For BPS participants, accessibility shortcuts, the Magnifier, and screen reading tools reduced barriers to interaction and improved efficiency in professional as well as personal contexts.

> *"I use my cell phone a lot for work and these tools allowed me to deliver better results using these accessibility resources. Because I need to read many documents and the font is very small, the magnifier allows me to read in a better and more accessible way."* ***— BPS participant***

Theme 3: Device hardware and software quality

Participants frequently compared the Galaxy A15 with their previous devices and reported meaningful improvements in usability and accessibility. Hardware features highlighted included stronger vibration alerts, larger screens, and more stable video call performance.

> *"The quality of the vibration is very good, because it's very strong, so I wake up easier in the morning. My old cell phone was very weak so I ended up being late."* ***— DHH participant***

> *"It is better because I can make video calls. My old cell phone disconnected a lot, in this one the connection and the image are better."* ***— DHH participant***

Software accessibility settings were also noted as clearer and easier to configure compared to participants' previous phones. The consistency and reliability of the Android accessibility interface was valued.

Theme 4: Limitations of automated captioning

While tools such as Live Transcribe provided meaningful gains for DHH participants, interviews also surfaced important limitations in automated captioning quality — particularly in Portuguese.

> *"I noticed that the captions on some Instagram videos have some flaws. I ended up choosing not to use this feature often and I look for other ways to access information."* ***— DHH participant***

> *"If there's one person talking, I can use accessibility. If there's more than one person, it gets in the way. I can't keep up."* ***— DHH participant***

Participants also reported that transcription accuracy was sensitive to the physical distance between the device and the speaker, requiring the phone to be held close to the source of sound. These limitations point to ongoing gaps in the quality of Portuguese-language automated speech recognition for accessibility use cases.

Theme 5: Smartphones as a hub within a broader AT ecosystem

Rather than replacing existing assistive tools, the smartphone consistently functioned as a central platform that connected and enhanced multiple assistive technologies and services.

> *"I use a hearing aid because of communication and ambient sounds, but what I really depend on is my cell phone because of accessibility in communication when using written Portuguese."* ***— DHH participant***

On-demand sign language interpreting services remained important for DHH participants, particularly in high-stakes situations such as medical appointments where automated transcription was less reliable.

> *"Interpreting services help me more, because many times the transcription tool is not accurate. When there is no interpreter, I sometimes use Google to transcribe speech, but I prefer interpreting services, especially in situations like medical appointments."* ***— DHH participant***

Several participants also reported independently adopting AI-powered tools for transcription and language support — uses that went beyond what the training curriculum covered. One participant described forwarding WhatsApp audio messages to an AI contact to generate written transcripts. Another used AI to assist with drafting professional emails in Portuguese. These findings suggest a growing role for AI-based tools within the broader AT ecosystem.

Theme 6: Challenges common to all smartphone users

As participants became more integrated into digital life, they began to encounter challenges experienced by the broader population: spam calls, security concerns when using phones in public, and managing screen time.

> *"Having a smartphone is quite important, but I recognise that it can be an obstacle, such as when you spend too much time on the device and end up not paying attention to your family. On Sundays, I usually step away from my cell phone a little to value the people around me."* ***— DHH participant***

These reflections indicate that digital inclusion also means navigating the full range of challenges associated with connected life — and that future programmes should consider how to support participants in developing strategies for digital wellbeing and online safety.

Implementation and Device Findings

Training Delivery

Several observations emerged during training delivery that have direct implications for programme design.

- Groups with mixed prior skill levels progressed more efficiently and encouraged peer interaction, with participants frequently exchanging tips and helping one another navigate accessibility features.
- Peer support emerged organically in at least one instance: a BPS participant became an effective peer trainer, supporting other participants with guidance from the research team.
- WhatsApp group chats created for each cohort continued to be actively used after formal sessions ended — for sharing tips, troubleshooting issues, and recommending additional applications.
- Most missed sessions among BPS participants were due to medical appointments in the public healthcare system — a structural constraint outside participants' control.

Device Issues

Several device-related issues were identified during the study with implications for manufacturers and programme planners.

Hearing aid connectivity

The Samsung Galaxy A15 does not include a dedicated accessibility menu option for pairing hearing aids — a feature present in older Samsung models. Users must instead pair hearing aids through the standard Bluetooth process, which requires hearing aids to be placed in pairing mode. Many DHH participants were unfamiliar with this procedure and reported that it had not been necessary with their previous phones. Samsung technical support was unable to identify a simpler workaround. As a result, several DHH participants were unable to connect their hearing aids to their new device — a significant accessibility regression compared to prior models.

Simultaneous use of Magnifier and TalkBack

Running both the Magnifier and TalkBack accessibility features simultaneously caused the device to slow down, freeze, or become unresponsive in several cases. In some instances, the

only resolution was to wait for the battery to drain before restarting. No permanent fix was identified by Samsung technical support.

General performance instability

Some participants experienced general performance issues after several days of use — including application crashes and unexpected closures — even after installing the latest system updates. A partial mitigation was identified: creating a Samsung account and enabling all associated data collection settings appeared to reduce the frequency of these issues for some users.

Device replacements

Seven participants had their smartphones replaced due to hardware or software issues. One required a SIM card replacement. Four participants reported that both their device and SIM card had been stolen; replacement devices and SIM cards were issued following submission of police reports.

Recommendations

The following recommendations are drawn directly from the study's findings and are directed at specific audiences: policymakers and governments, mobile network operators, mobile device manufacturers, and programme implementers and researchers.

For Policymakers and Governments

Improve the affordability of smartphones for people with disabilities

Despite most participants already owning a mobile phone, many were using basic or feature phones with limited accessibility functionality. Governments should consider targeted subsidies or discounts on smartphones for DHH and BPS individuals, aligned with existing assistive technology provision frameworks. Smartphones should be explicitly recognised within these frameworks.

Introduce differentiated mobile data plans for DHH users

DHH participants consumed significantly more mobile data than BPS participants, with nearly half reporting frequent or constant data depletion. Video-based communication and real-time transcription are primary — not optional — modes of interaction for this group. Digital inclusion

programmes must reflect this through larger or subsidised data allocations, rather than applying a uniform plan across disability types.

Fund sustained digital skills training as a core component of AT provision

The training mechanism made smartphone provision effective. Participants consistently reported that, without structured instruction, they would never have discovered or used built-in accessibility features. Governments, disability organisations, and service providers should treat ongoing digital skills training as a necessary and recurring element of device provision — not a one-time addition.

Formally recognise smartphones as assistive technology

Smartphones increasingly function as multifunctional assistive platforms supporting communication, navigation, information access, and daily living. AT policies and procurement frameworks should explicitly include smartphones and mobile data plans within AT provision programmes.

For Mobile Network Operators

Zero-rate accessibility-critical applications

Applications such as WhatsApp, Google Maps, Be My Eyes, Live Transcribe, and sign language interpreting services are not general-purpose entertainment tools for people with disabilities — they are essential accessibility infrastructure. Mobile network operators should consider zero-rating these applications, meaning their use would not count against users' monthly data allowances.

Develop accessible data management tools

The Minha Claro data management app was valued by DHH participants but lacked integration with ICOM, a Brazilian live sign language interpreting service available through some competitors. Operators should ensure that data management and customer service applications are fully compatible with the assistive services used by their customers. Accessibility and interpreting service partnerships should be considered a baseline requirement, not an optional feature.

For Mobile Device Manufacturers

Restore and maintain dedicated hearing aid pairing menus

The removal of the dedicated hearing aid pairing option from the Galaxy A15 accessibility menu — requiring users to navigate the general Bluetooth settings instead — created a significant barrier for DHH participants and prevented several from using their hearing aids with the new device. Manufacturers should ensure that accessibility features that exist in older models are not removed in newer ones without an equivalent or improved replacement.

Resolve compatibility issues between simultaneous accessibility features

The inability to run Magnifier and TalkBack simultaneously without causing device instability is an accessibility failure. Manufacturers should prioritise testing and resolving conflicts between accessibility tools, treating these as critical software defects rather than edge cases.

Improve Portuguese-language automated captioning quality

DHH participants consistently reported that automated captions on platforms including Instagram and YouTube were inaccurate or unreliable in Portuguese, particularly in multi-speaker settings or when the device was not held close to the sound source. Manufacturers and platform developers should invest in improving captioning accuracy for Portuguese and other underserved languages, including in challenging acoustic environments.

For Programme Implementers

Reduce training group sizes or increase trainer-to-participant ratios

Sessions with two trainers consistently allowed for better individual support without disrupting overall group progress. Smaller groups with higher trainer ratios give participants more time for hands-on practice and questions.

Prioritise real-life use cases over comprehensive feature coverage

The features participants continued to use were those directly relevant to their daily lives. Training should focus on communication, accessing services, and navigation, rather than attempting to cover all available accessibility features in a single programme.

Adopt a two-phase training model

An initial session should introduce core features. A structured follow-up session approximately one month later — once participants have used the device in their own context — should address the practical questions and issues that have emerged from real-world use.

Design explicitly for peer learning

Mixed-proficiency groups progressed more efficiently, and peer support emerged organically. WhatsApp cohort groups continued to provide value long after sessions ended. Future programmes should be designed for peer learning intentionally rather than relying on it arising by chance.

For Researchers

Conduct longer follow-up studies

The four-month follow-up period was sufficient to detect early changes but too short to understand how use evolves over time, or how smartphones interact with other assistive products as users become more experienced. Extended follow-up, including passive usage monitoring, would provide stronger evidence.

Study DHH and BPS participants as distinct cohorts

The two groups showed meaningfully different outcomes and faced different barriers. Future studies should treat them separately rather than combining them under a single disability category, with particular attention to DHH-specific issues around data consumption, captioning quality, and hearing aid integration.

Investigate AI-based accessibility tools

Participants independently adopted AI-powered transcription and language support applications in ways that went beyond the scope of the intervention. How these tools interact with established accessibility features, and how people with disabilities can be effectively supported in using them, is a productive and timely area for future research.

Conclusion

This study confirms that smartphones can function as meaningful and effective assistive tools for people with visual and hearing impairments — but that device access alone is insufficient to

achieve this outcome. The training was the mechanism that made the smartphone genuinely useful. Many participants had owned smartphones for years without knowing that built-in accessibility features existed. Structured, accessible instruction changed that.

Measured improvements were clearest among BPS participants, who showed statistically significant gains in mobile phone usage, digital skills, and quality of life. Outcomes for DHH participants were more mixed in quantitative terms, partly reflecting their higher baseline proficiency, and partly reflecting specific technical barriers they encountered — including hearing aid connectivity problems, inadequate data allowances, and the limitations of automated Portuguese-language captioning.

Smartphones did not replace existing assistive tools in participants' lives. Instead, they functioned as a flexible hub through which participants combined multiple assistive technologies and services — hearing aids, sign language interpreting, AI transcription, and others — into a personalised accessibility ecosystem.

The barriers to digital inclusion for people with disabilities are not primarily about hardware. They are about skills, support, affordability, and accessible design — and the evidence from this study shows clearly that these factors need to be addressed together. When they are, the results for independence, communication, and quality of life can be substantial.

> *"I feel more independent because now I can do things without depending so much on other people."* ***— BPS participant***