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Empowering the Visually Impaired: Advancing Digital Skills in Mobile ICT as Motivator and Enabler

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Abstract. Mobile ICT, such as smartphones and tablets, has become integral for everyday tasks like finance, communication, and entertainment. While these technologies offer significant opportunities for integration and combating loneliness, visually impaired individuals still face challenges. These include practical barriers due to poor universal design, motivational hurdles, and inadequate lifelong education. In this paper, we aim to identify both the motivational and educational facilitators, as well as the technical and societal inhibitors, to digital skill development in mobile ICT among visually impaired individuals. Our approach involved participating as silent observers in an IT course for visually impaired users. Our study underscores that visually impaired individuals value mobile ICT for enhancing their daily lives. We identify opportunities, including key motivations to learn about ICT, and compile a list of useful apps and devices for visually impaired people. Simultaneously, we identify challenges related to technical and universal design, competence and societal issues, motivation, and attitudes, as well as security, privacy, and fraud concerns.

Keywords. Visual Disability; Digital Skills; Mobile Technology; ICT; Motivation; Facilitator; Inhibitor; Accessibility; Usability; Universal Design; Adult Education

1. Introduction

Smartphones and tablets have become integral to daily life, serving numerous purposes including work, personal finance, communication, education, and entertainment [1]. The Covid-19 pandemic has further accelerated this reliance on technology [2]. On the one hand, mobile technologies pose unique challenges for individuals with disabilities, primarily in terms of accessibility and usability challenges in both hardware and software applications [3]. Further, visually impaired individuals often face higher levels of loneliness than the general population [4,5]. On the other hand, ICT provides immense advantages to visually impaired individuals [3]. Studies show that the development of digital skills can enhance self-sufficiency and social contact among people with disabilities [5–8]. Despite this, significant motivational challenges exist, particularly

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among the elderly, often due to insufficient universal design [8,9]. Additionally, digital skills training varies greatly among local authorities, with many Norwegian municipalities not meeting national legal requirements [8].

In this study, we identify both motivational and educational facilitators, along with technical and educational inhibitors to digital skill development in mobile ICT among visually impaired individuals. Our approach involves participating as silent observers in an IT course for visually impaired users, organized by The Norwegian Association of the Blind and Partially Sighted (NABP), to obtain firsthand insights.

This paper details our research methodology, findings on ICT's potential and limitations for the visually impaired, followed by a thorough discussion and brief conclusion summarizing our research.

2. Methodology

We followed a four-day in-person IT course, organized by the NABP at their continuing education retreat center in Northern Norway, focusing on digital media and screen reader use for individuals with visual impairments. A diverse group of fifteen participants, ranging in age from late 20s to 70s, participated in the ICT course. Two instructors and six assistants from NABP were present to conduct the teaching, in addition to three silent observers from the research group. The instructors and assistants were peer supporters, i.e., individuals with impaired vision themselves. Thus, all attendees were individuals with varying degrees of visual impairment, some of whom were completely blind, while others had some residual vision.

The ICT course was structured around individual one-on-one sessions, each involving a single participant and either an instructor or an assistant in the role of an instructor. These sessions lasted either 45 or 90 minutes, with periods of free time built into the schedule. In addition, joint sessions were held at the commencement of the course on the first day and at the conclusion on the last day. Each day also ended with a communal session. The content of each individual session was tailored to each participant, based on their specific needs and goals determined in consultation with the instructors before or at the start of the course. Topics during individual sessions typically included general digital skills, questions about specific apps or devices, or practicing with screen readers. The joint sessions covered broader topics related to useful apps and websites, how to obtain support and assistive devices, and internet safety.

The participants utilized their personal devices during the course, predominantly Windows PCs and iOS iPhones. Some used iPads with iOS, and a few had Android Samsung phones. Participants had varied experiences with ICT. Most participants had prior experience with computers, tablets, and smartphones.

The researchers attended the course in-person as silent observers during individual sessions and conducted informal and unstructured interviews with instructors, assistants, and participants during breaks and free time. During each session, we observed attendee learning and instructor teaching processes. Notes from these observations and interviews were then thematically analyzed and cross-compared among the researchers. From our direct observations and notes, we extracted related themes. This was achieved by identifying common patterns among the attendees, as observed by the researchers. The themes were then structured and summarized.

3. Results

We identified themes in three areas: motivation, opportunities, and challenges of using ICT for visually impaired people. The themes include internal and external motivators for skill development, useful apps and devices as opportunities, and challenges such as technological constraints, competency and societal barriers, motivation- and attitude-related obstacles, along with security, privacy, and fraud concerns.

3.1. Key motivations to learn about ICT

Participants of the ICT course expressed various motivations to learn and improve their ICT skills. The majority sought everyday independence, wanting to use smartphones to manage everyday tasks such as reading, sending messages and emails, or accessing their online banking. Some participants wanted to use their devices for personal finance management like online banking and mobile payment services. Other participants used their mobile devices as a safety measure when out and about, serving as a backup in case of emergencies. Despite acknowledging the potential challenges and frustrations of learning about ICT, they believed the long-term benefits were worth the effort.

Entertainment was a key motivation, including listening to podcasts and audiobooks, watching videos, or reading. Especially participants with age-related visual impairments, such as those with Age-related Macular Degeneration (AMD), expressed a desire to use screen readers for being able to continue reading digital content. Many participants wanted to use their smartphones to browse the internet. Some wanted to read the news, while others were interested in finding cooking inspiration and recipes online. Additionally, some participants with residual vision enjoyed viewing images sent by family members and preferred devices with larger screens, like iPads.

Communication and connectivity were another big motivation for participants. Most used their phones for calls to maintain contact with friends and family and wanted to learn how to save contact information, messaging via text or Messenger, and having their phones read aloud incoming messages and reply to them. Likewise, many participants wanted to learn how to send, receive, read, and organize emails. Some had specific goals such as sorting emails from certain senders into a separate folder or learning about filters in Gmail for automatic email sorting. Additionally, some participants wanted to learn about social media platforms like Snapchat and Facebook, either to receive messages from family members or to post their own content.

Lastly, many participants wanted to learn specific functions, like dictation, emoji use, and using VoiceOver for reading or controlling assistive devices like hearing aids.

3.2. Opportunities of ICT for visually impaired people

Our study indicates that visually impaired individuals view mobile ICT as an aid to simplify and enhance their daily lives. They see smartphones, with their myriads of applications, as a universal and comprehensive assistive tool that encourages self-reliance and increases self-sufficiency.

3.2.1. Helpful apps for visually impaired users

Applications, or "apps" are computer programs that perform specific functions to facilitate everyday activities. The App Store features a section titled "Apps that Support VoiceOver," which contains a list of useful apps for visually impaired people:

- *Authorities use public communication apps* to communicate with their citizens, like Digipost, Helsenorge or Hjelp113 in Norway [10–12].
- *Entertainment apps* offer a variety of podcasts and audiobooks, like Tibi (formerly Lydhør), Spotify, Apple Podcasts [13–15].
- *Personal finance apps* can be used to pay online or in-store. Vipps, a mobile payment service in Norway with a particularly good reputation for universal design, has been championed by the instructors. International apps can also be used like Apple Pay or Google Wallet [16–18].
- *Image and video interpreting apps* like Be My Eyes, TapTapSee, and SuperSense assist visually impaired people in interpreting images [19–21]. Cash Reader and SeeingAI can identify money, Lookout can read text, and other apps can help in identifying light sources and colors [22–24].
- *Mobility apps*, such as BlindSquare, provide GPS functionality, and others like Avinor for flights, or Ruter and Vy for public transportation in Norway, aid in travel [25–27]. Apps like ut.no can identify outdoor trails for daily walks [28].

3.2.2. Helpful devices for visually impaired users

Instructors highlighted how smartphones can control other electronic aids and devices to simplify everyday life for visually impaired individuals. They noted that phones can connect to devices via Bluetooth, providing more options as this technology becomes cheaper. They recommended considering Bluetooth compatibility when purchasing new equipment. Useful devices that can be controlled via a smartphone include:

- *GPS location devices* can be used to locate luggage and other objects like AirTags [29]. Using an app, the tags can make a sound, allowing users to locate them. On iPads and iPhones, AirTags can be combined with the "Find My" app, showing a map and the position of the AirTags [30].
- *Screen mirroring devices*, such as an HDMI adapter, can link a smartphone to a TV or projector, replicating the iPhone's display and audio. This can be paired with other aids like magnifying glasses to enhance readability.
- *Text reading aids*, like OrCam MyEye, can be utilized to scan and read text, offering assistance with text perception and comprehension [31].
- *Headphones and earplugs*, such as AirPods, can be used for screen reader output in public settings [32]. Alternatives include Shokz's Trekz Titanium, a headset that sits outside the ear and transmits sound through bone conduction, allowing users to stay aware of their surroundings [33]. Additionally, there are earphones by Sony that offer control through finger movements [34].
- For users who prefer tangible typing over dictation, *keyboards for smartphones and tablets* are recommended.

3.3. Challenges of mobile ICT for visually impaired people

Challenges faced by visually impaired individuals in utilizing ICT fall into several categories. First, technical limitations can partially or fully impede their ability to use mobile devices and other technologies. Second, competency-related and societal challenges arise when visually impaired individuals lack adequate ICT training in their municipalities. Third, personal attitudes and motivation towards learning new technology and their motivation to overcome challenges also play a significant role in their ability to utilize ICT. Last, security, privacy, and fraud concerns can pose obstacles to ICT use by visually impaired individuals.

3.3.1. Lack of universal design and technical challenges

Visually impaired users face various technical challenges and barriers due to the lack of universal design in smartphones and apps. *Inconsistent button placement across different apps* can lead to confusion, particularly for visually impaired users who prefer a uniform and consistent layout across all apps. For instance, the confirmation button and "Back" button might be in varying positions. Likewise, some users experience confusion due to *inconsistent button labels across different apps*. They express a preference for a standardized naming convention for buttons like "Ok," "Done," or "Next" across all apps. *Poor contrast, small font sizes, and complex background images* can impede text readability for users with residual vision. To mitigate this, users suggest using plain black backgrounds and increasing the font size across the entire device. The *dictation function* may be challenging for users with strong dialects or accents. Many websites and apps *lack a feedback function* for users to report issues, although this is part of the newly implemented Web Accessibility Directive (WAD) for websites in the public sector [35]. Furthermore, *functionality can vary across different versions of operating systems*. For instance, Apple's 2021 iPad update replaced the home button with a screen swipe, a change that could prove challenging for some users.

3.3.2. Competency-related and societal challenges

Visually impaired and blind individuals face several structural challenges to fully utilize mobile ICT. First, many municipalities lack life-long education offerings, possibly due to personnel shortages or lack of competence. Second, useful apps often come at a high cost, which public funds may not fully cover. Third, the rapid pace of technological change can overwhelm users with the constant need for knowledge and system updates. Fourth, managing identification and passwords due to security and privacy requirements can also pose challenges. Last, participants expressed a need for technical support and found accessing it difficult, pointing out limitations in courses and helplines for everyday usage.

3.3.3. Challenges related to motivation and attitudes

Participants reported several limitations related to attitudes, motivation, and personal experiences. Some exhibited *general skepticism towards ICT*, but still enrolled the course due to the aforementioned benefits. Even when aware of these potential benefits of tech use in emergency situations, some participants were *content with limited/minimal technology use* to avoid distractions and increase mindfulness of their surroundings and nature. Similarly, a few resisted *over-reliance* on mobile devices to avoid mobile dependency. Other participants reported *discomfort* when using touch screens on mobile ICT. A sense of *dependency* on others like family and friends for digital tasks, such as email registration, was also reported. Several participants saw no need for mobile ICT as they prefer familiar surroundings in the real world. Some participants had *privacy concerns* and were apprehensive about sharing too much personal information online as discussed further below. Additionally, some participants found learning new things more *challenging with age*.

3.3.4. Security, privacy, and fraud challenges

Digital opportunities also bring challenges like security and privacy concerns, especially for vulnerable groups like the visually impaired. They may be more susceptible to online

scams and fraud, due to limited accessibility of security mechanisms. This inaccessibility can prevent them from independently confirming the legitimacy of digital content. Additionally, their limited ability to access and interpret graphical materials may impede their detection of visual indicators that suggest security threats. Furthermore, the inadequacy of accessible security mechanisms sometimes forces visually impaired users to share sensitive information such as passwords or security codes to gain access [36]. Challenges include phishing and identity theft, where criminals deceive users into disclosing personal information for unauthorized access or loans. Countermeasures include sender verification, cautious personal data handling, and managing online visibility in social media and search engines. Dating frauds are another issue, where fraudsters pose as attractive individuals and trick users into sending money. A healthy skepticism and intuition trust are recommended. Additionally, frauds often come from abroad, suggesting precautions like region-locking bank cards and avoiding returning calls to unknown foreign numbers[2].

4. Discussion

First, our research indicates that visually impaired users perceive mobile ICT as an opportunity to simplify and enhance their daily lives. They view smartphones, with their multitude of apps, as a comprehensive assistive tool promoting self-reliance. Users with visual disabilities described mobile ICT as a universal assistive device that consolidates functionality in one device that previously required many different standalone assistive devices. This underscores the value of digital skills training, as it can lead to a decrease in the necessity for producing, instructing on, and servicing numerous specialized assistive devices. Furthermore, the potential of ICT to enhance communication with friends, family, and the world, offer entertainment options, and enable support for daily tasks like economic transactions, navigation in public spaces, and image recognition is a significant motivational factor for learning.

Second, our findings show various apps and devices catering to visually impaired individuals' needs, significantly enhancing their quality of life by facilitating everyday tasks and promoting safety. Although some of the apps are specific to the Norwegian community, we could identify equivalent apps in international settings. However, the cost of these apps could be a barrier for some, particularly those dependent on welfare or public funding for assistive devices.

Third, the study affirms that technical barriers and accessibility issues are the primary inhibitors to ICT access for people with disabilities. Many of these barriers could be mitigated by adhering to international standards like the Web Content Accessibility Guidelines (WCAG) that are already obligatory for many public-targeted ICT solutions. Consequently, there is an urgent need for consistent implementation of these rules and increased competency in universal design among ICT developers, as well as their enforcement by relevant authorities.

There is a notable deficiency in adult education offerings for visually impaired individuals, particularly in rural areas, due to limited resources or a lack of qualified personnel. The reasons for this shortage might include a municipality's limited financial resources, mismanagement or inappropriate allocation of existing funds, lack of

[2] While instructors highlight the prevalence of frauds originating from abroad, recent trends indicate a significant increase in domestic frauds as well.

awareness about the obligations a municipality has towards individuals with disabilities, or a lack of qualification among those responsible. Even with user organizations offering courses, there is a significant need for more capacity, support and funding for courses, and training for qualified instructors. Moreover, there is a need for enduring and subsequent support options to reinforce the knowledge and competence of both individuals with disabilities and instructors after completing relevant adult education courses. This is in line with previous research [9].

Our results indicate that personal concerns, such as digital privacy and security, must be addressed when teaching ICT skills to visually impaired individuals. While ICT can promote integration and combat loneliness, it is important to respect the choice of some individuals who consciously opt not to learn about mobile ICT. One participant, for example, observed their sighted spouse frequently using a mobile phone when bored and expressed a desire to avoid losing their current contentment and mindfulness by becoming "addicted" to mobile ICT.

5. Conclusion

Our study confirms that visually impaired individuals recognize the value of mobile technologies in enhancing their daily lives, by consolidating numerous applications previously scattered across multiple devices. They view smartphones as universal assistive devices that promote self-sufficiency and social contact. Furthermore, our study identifies key motivations related to communication, connectivity, entertainment, and convenience for day-to-day activities. For these purposes, we compile a list of useful apps and devices. However, challenges persist due to the lack of compatibility with assistive devices in many apps, and the variability in the quality of digital skills training across municipalities. Our study highlights challenges including substandard universal design in apps, societal issues, and security and privacy concerns for visually impaired users of mobile ICT.

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