The Educator

Technology and Artificial Intelligence in the Education and Daily Life of Persons with Visual Impairment

Volume 40 – Issue 2 – July 2026



A Publication of

ICEVI
INTERNATIONAL COUNCIL FOR EDUCATION OF PEOPLE WITH VISUAL IMPAIRMENT

International Partners

ONCE
OVERBROOK SCHOOL FOR THE BLIND
CLOVERNOOK CENTER FOR THE BLIND & VISUALLY IMPAIRED

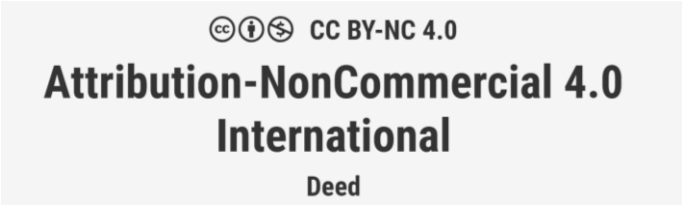
The Educator Volume 40, Issue 2, July 2026

Theme: Technology and Artificial Intelligence in the Education and Daily Life of Persons with Visual Impairment

Copyright © 2026 International Council for Education of People with Visual Impairment

ISSN 3051-1089

This work is licenced under Creative Commons Attribution-NonCommercial 4.0 International.



You are free to:

1. **Share** — copy and redistribute the material in any medium or format
2. **Adapt** — remix, transform, and build upon the material
3. The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

1. **Attribution** — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
2. **NonCommercial** — You may not use the material for commercial purposes.
3. **No additional restrictions** — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

To view a copy of this licence, visit https://creativecommons.org/licenses/by-nc/4.0/.

Published by the International Council for Education of People with Visual Impairment

Email: publications@icevi.org, Web Address: https://icevi.org/

For communication with any of the authors in this issue, please email *The Editor*, at publications@icevi.org

Image on the front cover: This image has been generated using AI.

ICEVI Executive Board, 2025-2028

Ms Susan LaVenture –President

Mr Akhil Paul –Vice President

Dr Frances Gentle – Immediate Past President

Dr Praveena Sukhraj-Ely – Treasurer

Ms Ana Peláez – ONCE (Spanish National Organization of the Blind)

Mr Todd Reeves – Overbrook School for the Blind

Mr Craig Brown – Royal National Institute of Blind People (RNIB)

Mr Samuel Foulkes – Clovernook Center for the Blind

Mr Hubert Perfler – World Blind Union

Mr Komivi Ayassou – President, ICEVI Africa

Mr Silatul Rahim Bin Dahman – President, ICEVI East Asia

Dr Judit Gombas – ICEVI Europe

Ms Gladys Viviana Correa – President, ICEVI Latin America

Dr Michael Bina – President, ICEVI North America and the Caribbean

To be confirmed – President, ICEVI Pacific

Dr Birendra Raj Pokharel – President, ICEVI West Asia

International Partner Members

Organización Nacional de Ciegos Españoles (ONCE, Spain) - www.once.es

Overbrook School for the Blind (USA) - www.obs.org

Royal National Institute of Blind People (RNIB) - www.rnib.org.uk

Clovernook Centre for the Blind and Visually Impaired - https://clovernook.org/

Organisational Members

Round Table on Information Access for People with Print Disabilities
www.printdisability.org

Trinidad and Tobago Blind Welfare Association - https://ttbwa.com/

Network Partners

World Blind Union - https://wbu.ngo/

The DAISY Consortium - https://daisy.org/

Accessible Books Consortium, WIPO - https://www.accessiblebooksconsortium.org/en/

Contents

ICEVI Executive Board, 2025-2028 3

International Partner Members 3

Organisational Members 3

Network Partners 3

About ICEVI and The Educator 6

President's Message 7

Feature Section: Technology and Artificial Intelligence 12

When AI Meets Blindness: Promise, Pitfalls, and Everyday Reality — Shannon Madar 12

Overcoming Barriers: My Journey with Low Vision, Technology, and the Desire to Create Impact — Chandra Bahadur Pun 15

Visual Impairment and Artificial Intelligence – Connell Simkin-Watt 16

Technology and AI: Accessibility of Digital Learning Environments in Post-Secondary — Megan Miller 17

Tech in Action: Transforming Young People's Access in Daily Living — Aasha Rose, Jessica Gallasch, & Jobina Johnson 21

Bridging Accessibility and Innovation: Teaching Technology and AI to Students with Visual Impairments through Inclusive Instructional Practices — Nantanoot Suwannawut, Ph.D. 27

Seeing Music Through Sound: Braille, Digital Audio and AI in Inclusive Music Education for Blind Students — Sevara Mirsidikova 34

The Application of Artificial Intelligence (AI) Technology in the Learning Skills Development for Visually impaired Students: A Case Study of the Bangkok School for the Blind — Pisit Prougestaporn, Ph.D., Ms. Nichapa Akethanapisan, Ms. Thanita Maneepong, and Ms. Kochaporn Buphakosum 41

Technology and Artificial Intelligence in the Education and Daily Life of Persons with Visual Impairment and Additional Disabilities — Akhil Paul 45

Digital-First School Readiness for Blind Children in Rural India: Practice-Based Evidence from a Six-Month Community-Based Intervention — Vania Desianti[1], Deepthi Telikicherla[2], Saumya Tripathi[2], Varsha Krishan Mishra[2], Satish Tripathi[1] 51

Less Waiting, More Reading: AI and Accessible Books for Learners with Visual Impairments — Prashant Verma 69

Playful Learning of Fundamental Technology Skills — Mrs Phia Damsma 72

Blind and Visually Impaired Students and the Need for Digital Literacy in Higher Education — Kassahun Yibeltal Sahilu, PhD 84

The Role of Emerging Digital Tools for Students with Visual Impairment at the University of Dar es Salaam (UDSM) — Mashukura Habibu Kabwogi 91

Technology for Access and Participation: Matching Educational Supports to Learner Requirements — Frances Gentle AO, PhD, DLitt (Hons) 106
The Transformative Power of Artificial Intelligence in Assistive Technologies for Blind and Visually Impaired People — Boureima Bouda Ismaila 117
Braille Literacy and Technology Development in Slovakia — Michal Tkáčik 118
Quiet AI: How Artificial Intelligence Is Subtly Reshaping Life for the Visually Impaired — Zaheer Ally 122
Digital Catalysts for Inclusion: The Saksharta Model, Artificial Intelligence, and the Transformation of Education for the Visually Impaired — Dr. Homiyar Mobedji 124
Expanding Access through Round Table Guidelines — Sonali Marathe 134
From Cricket Fields to Classrooms: Harnessing Technology and AI to Build an Inclusive World for Persons with Visual Impairment — Dr. Mahantesh G. Kivadasannavar 137
Empowering Braille Users Across Europe: The Work of the EBU Braille Working Group and the “Expert Table Talks” Series — Reiner Delgado and Michal Tkáčik 140
AI, Braille, and Screen Readers: Rethinking Literacy for Learners with Visual Impairment in the Global South — Dr. Muhammad Shabbir 142
From classroom to career: Braille, AI, and the future of opportunity — Amina Boukhedimi 146
From Classroom to Career: How Artificial Intelligence Can Create Inclusive Pathways for Learners with Visual Impairments — Amandipp Singh 151
AI-Enabled Accessibility in Digital Learning: A Human-Centered and Evidence-Based Approach to Inclusive Education — Kumar B.S.M. and Vijayshree Vethantham 153
Seeing Assistant Go: Your Essential Travel Companion — Sławomir Strugarek 159

Special Feature: ICEVI–WBU Global Braille Literacy Campaign 167

Global Braille Survey is now open! 167
Legal Recognition of Braille in Education: An Advocacy Framework — Michal Tkáčik and Members of Focus Area 1 (Advocacy and Media), Global Braille Literacy Campaign 168
Acknowledging our Campaign Sponsors - Joint ICEVI-WBU Braille Literacy Campaign 171
Call for Submissions – The Educator (January 2027) 174
Join ICEVI: Expand Access to Inclusive Education for People with Visual Impairment 176

About ICEVI and The Educator

The International Council for Education of People with Visual Impairment (ICEVI) is a global non-profit membership network committed to promoting inclusive, equitable, and high-quality education for individuals with visual impairment, including those with low vision, blindness, deafblindness, and multiple or additional disabilities.

Since 1952, ICEVI has been a leader in convening stakeholders worldwide, fostering collaboration, and driving meaningful change in the field of visual impairment.

ICEVI's flagship publication, *The Educator*, is a key platform for sharing insights, research, and advancements in the education of individuals with visual impairment. Published twice a year, *The Educator* is available for download from the ICEVI website: https://icevi.org/.

Acknowledgements

ICEVI acknowledges the contributions of the Editorial Committee:

Dr Frances Gentle (Editor)

Ms Susan LaVenture

Dr. Judit Gombás

Ms Sonali Marathe

Mr Zaheer Ally

Accessibility Review Support
Megan Miller, CNIB Intern

Disclaimer

This publication features contributions from individuals worldwide, sharing their ideas, experiences, and practices. The views expressed are those of the authors and do not necessarily reflect ICEVI's stance. References to products, services, organisations, or individuals are for information only and not endorsements. Readers should use their own judgment when applying the information.

President's Message



Dear Reader,

Warm greetings from the International Council for Education of People with Visual Impairment (ICEVI). I am very proud to share with you, our members and colleagues, that during the first 6 months of this year 2026 ICEVI has made significant progress towards our organization's mission with your support and involvement.

Our landmark initiative "The Global Braille Literacy Campaign: More Braille, More Empowerment" joint partnership between the International Council for the Education of People with Visual Impairment (ICEVI) and the World Blind Union (WBU) was officially launched on World Braille Day the 4th of January 2026. The Braillists Foundation hosted a webinar with a panel of International Guest speakers of leaders, advocates devoted to the cause of the importance of access to Braille and the learning of Braille. The event attracted 210 registrants from 67 countries. The campaign is led by Co-Chairs Dr. Frances Gentle, ICEVI Past President, and Santosh Kumar Rungta, WBU President. This is a multi-stakeholder partnership globally and from all sectors. We have enlisted support with international and regional organizations from developing and developed countries.

ICEVI is a non-governmental organization that has consultative status with the Economic and Social Council (ECOSOC) of the United Nations (UN) at UN Headquarters, New York. As ICEVI President, 27January 2026, I represented ICEVI at the 2026 ECOSOC Partnership Forum under the theme, "Transformative, equitable, innovative and coordinated actions for the 2030 Agenda for Sustainable Development and it's Goals" and submitted an intervention statement giving examples of key strategies of how innovative partnerships can be successful in meeting the implementation of SDG 17: Partnerships for the Goals that was posted in the UN journal.

During the week of 9-11 June 2026, Santosh Kumar Rungta, WBU President and I as ICEVI President represented our organizations and The Global Braille Literacy Campaign at COSP 19 Program of the 19th Session of the Conference of State Parties to the Convention of the Rights of Persons with Disabilities at United Nations Headquarters, New York. As ICEVI President I delivered the ICEVI Intervention Statement on "Resilient societies: strengthening care and support systems to ensure the empowerment, autonomy and independence of all persons with disabilities at the Civil Society Forum. During the COSP19 General Debate at the UN General Assembly as President I delivered the ICEVI Statement introducing the Global Braille Literacy Campaign of ICEVI

and WBU: More Braille; More Empowerment and Declaration the 9th of June 2026, full statement published in the UN journal. Additional meetings were held with the UNICEF Global Disability Team, the International Disability and Development Consortium (IDDC), and ATscale to advance our partnerships towards meeting sustainable goals.

More exciting efforts continue with our International and Regional Partnerships. Advancing “Visionary Learning through Technology Initiative” with the DAISY Consortium, we are looking at new regions to branch out to and expand so we can provide technology and training to more children, teachers and adults. In fact, at the upcoming ICEVI Africa Regional Conference to be held in Johannesburg, DAISY is hosting a pre-conference event to “Launch of DAISY Regional Network” in Africa.

ICEVI welcomes our members to join us at the ICEVI Africa Regional Conference to be held in Johannesburg, South Africa 28 September - 1st October hosted by the Prinshof School and ICEVI Africa Region and ICEVI Global to network and learn together and create new partnerships and collaborations to advance our efforts to ensure that children and adults who are blind, deaf-blind or have low vision or additional disabilities can access quality, inclusive education.

“The Teaching for All” project led by Professor Kay Ferrell and her team of experts are developing an educational curriculum for teaches of learners who are blind, visually impaired, and those with multiple Disabilities. The curriculum will be downloadable and accessible on the ICEVI website.

Announcing a new collaborative effort with the Canadian National Institute for the Blind, (CNIB), the CNIB International Youth Internship Program with ICEVI. We are pleased that ICEVI has started to work with our first cohort of Internships with four bright university students to assist us with many of our projects. We value their time, effort and perspectives as part of our team.

This issue of The Educator focuses on Technology and Artificial Intelligence in the Education of the Daily Life of Persons with Visual Impairment. Readers will benefit from the many different perspectives from blind adults, youth and dedicated educators and researchers. I extend my thanks to all the contributors for your insightful submissions. We encourage you to share this issue widely to raise awareness that every learner who needs Braille should have the opportunity to become Braille literate while also benefiting from extraordinary opportunities that modern technology provides. Braille and technology can complement each other by supporting literacy, independence, educational success, employment and full participation in society.

Warm regards,

Ms. Susan LaVenture
President



Caption: Susan LaVenture presenting the ICEVI-WBU *Global Declaration on Braille Literacy in Education* at the 19th Session of the Conference of States Parties to the CRPD (CoSP19) at the United Nations, New York.



Caption: [from left to right] Mr Todd Reeves, CEO Overbrook School for the Blind; Ms Susan LaVenture, President, ICEVI; Mr Santosh Kumar Rungta, President, WBU; and Mr Gopal Mitra, UNICEF Global Lead on Disability and Development.

Editor's Message



Welcome to the July 2026 issue of *The Educator*, the open-source publication of the International Council for Education of People with Visual Impairment (ICEVI).

The theme of this issue, *Technology and Artificial Intelligence in the Education and Daily Life of Persons with Visual Impairment*, could not be timelier. Around the world, technological innovation is transforming how people who are blind, deafblind, or have low vision learn, communicate, access information, work, travel, and participate in their communities throughout life. Artificial intelligence (AI), in particular, is reshaping education, employment, and independent living at an unprecedented pace. While these developments offer remarkable opportunities, they also challenge us to ensure that innovation advances equity, inclusion, and human rights rather than creating new barriers or widening existing inequalities.

This issue brings together an outstanding collection of contributions from around the world. Readers will discover practical examples of AI-enhanced learning, accessible digital environments, assistive technologies, digital literacy initiatives, inclusive instructional practices, community-based interventions, accessible publishing, music education, orientation and mobility, higher education, and workplace participation. Together, these contributions demonstrate that innovation is most powerful when it is designed with accessibility, inclusion, and the lived experiences of persons with visual impairment at its centre.

One message resonates throughout this issue: accessibility must be intentional. The promise of AI can only be realised if emerging technologies are developed according to universal design principles and in partnership with people with lived experience of blindness, deafblindness, and low vision. Inclusive innovation requires collaboration between educators, governments, technology companies, researchers, disability organisations, publishers, employers, and users themselves. The diverse perspectives represented in this issue demonstrate the value of that collaborative approach.

Although this is a themed issue on technology and AI, it is also fitting that we include a special feature on the ICEVI–World Blind Union Global Braille Literacy Campaign – *More Braille: More Empowerment*. Braille remains the foundation of literacy for people who are blind, deafblind, or have severe low vision. Rather than viewing braille and technology as competing approaches, this issue highlights their complementary relationship. Digital braille displays, eBraille, AI-powered accessibility tools, accessible publishing, and other emerging innovations are expanding opportunities for braille users and creating exciting

possibilities for education, lifelong learning, employment, and independent living. As technology continues to evolve, our commitment to braille literacy must remain unwavering.

The special feature includes *Legal Recognition of Braille in Education: An Advocacy Framework*, prepared by Michal Tkáčik and members of Focus Area 1 (Advocacy and Media) of the Global Braille Literacy Campaign. This practical resource supports national advocacy efforts to strengthen the legal recognition of braille as a fundamental component of inclusive education. We also acknowledge the generous organisations whose sponsorship is helping transform the campaign's vision into action. Their support is enabling international collaboration, advocacy, research, professional learning, and the sharing of resources that will advance braille literacy worldwide.

ICEVI extends its sincere appreciation to every author who contributed to this issue. The diversity of countries, experiences, and perspectives represented here reflects the strength of our global community and our shared commitment to improving educational opportunities and lifelong learning for children, young people, and adults who are blind or have low vision.

Finally, I encourage readers to explore the articles presented here, share them with colleagues, and consider how the ideas they contain might influence your own practice. Innovation occurs not simply through the development of new technologies but through the willingness of educators, researchers, organisations, and policymakers to embrace new ideas, evaluate emerging evidence, and work together to build more equitable, accessible, and inclusive societies.

On behalf of ICEVI and the members of the Publications Committee, I hope this issue informs, inspires, and encourages continued collaboration as we work together to ensure that technology, artificial intelligence, and braille literacy expand opportunities for learners and adults with visual impairment throughout every stage of life.

Frances Gentle

Feature Section: Technology and Artificial Intelligence

When AI Meets Blindness: Promise, Pitfalls, and Everyday Reality — Shannon Madar

Blind writer and disability advocate, Trinidad and Tobago

A few years ago, if someone had told me that one day I would regularly ask a machine to describe photographs, help me choose jewellery, explain complicated documents, and occasionally locate missing food items, I would have laughed.

Yet here we are. Artificial intelligence has arrived with all the subtlety of a marching band. Depending on who you ask, it is either the greatest technological advancement of our generation or the first chapter of a science fiction movie that ends badly for everyone involved.

As a blind woman, my opinion is considerably less dramatic. I think AI is useful, exciting, and undeniably flawed, often all at the same time. More importantly, I think many of the conversations surrounding it are missing the point entirely.

Much of the conversation around artificial intelligence focuses on what the technology can do. Can it write? Can it teach? Can it identify objects? Can it assist with navigation? Can it improve educational outcomes? These are important questions, especially because the answer is yes, AI can do all those things. The question I find myself asking, though, is much simpler than that.

What does artificial intelligence allow people to do? For many blind and visually impaired people, technology has never been just a convenience. It has been a gateway to information, education, employment, and independence. Long before AI entered the public conversation, screen readers, magnification software, accessible smartphones, and optical character recognition technology were already changing lives.

AI is simply the newest tool in a toolbox that many of us have been building for years. What makes it different is that it feels less like a tool and more like a conversation. Some of my favourite uses for AI are not particularly groundbreaking. Nobody is likely to feature them in a technology conference presentation. They are simply the little things that allow me to participate more fully in everyday life.

I use image description tools to help me choose jewellery before leaving home. Not because selecting earrings is a matter of national importance, but because I enjoy looking put together. Blind women care about their appearance too.

I use AI when my cousin sends photographs of her new baby. Like every proud relative, I want to know whether the baby is smiling, sleeping, making funny faces, or looking thoroughly unimpressed by the entire experience of being alive.

Recently, I used it to inspect a brand-new litter of kittens because apparently the cats in my family have no interest in responsible population management.

A friend of mine uses AI to help with makeup application. Another recently used Gemini Live after dropping a package of hotdogs in his kitchen. The hotdogs, for the record, were eventually located in the sink.

None of these examples are particularly dramatic, but that is precisely why they matter. The more I use AI, the more I find myself thinking about something sighted people rarely have to consider. How much of your life is made up of tiny pieces of information you never have to ask for? Not even important information, just information.

The expression on a child's face in a photograph. Whether your outfit matches. Whether someone is smiling when they walk into the room. How many kittens the cat actually had this time. Whether the thing you dropped landed under the table, behind the chair, or somewhere else entirely.

Most people gather this information effortlessly throughout the day. They glance, observe, and move on. For many blind people, those same moments often require another person. A family member. A friend. A colleague. Someone willing to be our eyes for a moment. There is nothing wrong with asking for help. We all need help sometimes. There is, however, something deeply satisfying about not always having to.

I don't think sighted people realise how much of the world is built on casual visual information. Not critical information. Not life-changing information. Just the thousands of tiny details that help people move through their day. Simple things like a glance at a family photograph. A look in the mirror before leaving home. A quick check to see where something fell.

For most people, these moments pass unnoticed because access to that information is immediate. For many blind people, it has traditionally involved a request.

Can you tell me what this picture shows?

Can you tell me if these colours match?

Can you tell me where that went?

Again, there is nothing wrong with asking.

But there is a certain kind of freedom in being able to answer some of those questions yourself. That, more than anything else, is what AI has given me. Not perfection, complete independence, or a futuristic world where technology magically solves every problem associated with blindness. It has simply returned pieces of the world that were often just out of reach. Small, ordinary pieces that make up everyday life.

Of course, AI is not magic. Anyone who uses it regularly discovers that very quickly. Sometimes it provides remarkable descriptions and genuinely useful insights. Other times it delivers answers with the confidence of a university professor and the accuracy of someone who completed an exam by guessing the answer to every single question.

I have seen AI misunderstand photographs, misidentify objects, and produce explanations that left me wondering whether we were discussing the same thing at all. The technology is impressive, but it is also wrong often enough to remind us that human judgment still matters.

That reality is particularly important in education. AI should be viewed as a tool, not a replacement for learning. Students still need critical thinking skills. We still need to know how to solve problems when the Wi-Fi is down, the battery dies, or the AI confidently informs us that a hotdog is a banana.

Educators still matter, and human judgment still matters. In fact, as AI becomes more sophisticated, our ability to question information may become even more important. The goal should not be to teach students to depend on artificial intelligence. The goal should be to teach them how to use it effectively, responsibly, and critically.

There is another challenge that deserves attention, too. Technology can improve accessibility, but it cannot solve every barrier faced by people with disabilities. A blind student may have access to excellent AI tools and still receive inaccessible learning materials. A blind employee may use advanced assistive technology and still encounter employers with low expectations. A blind traveller may have navigation apps and object recognition tools and still confront environments that were never designed with accessibility in mind.

Technology can create opportunities, but it cannot create inclusion on its own. People still do that. As conversations about artificial intelligence continue, I hope we remember that innovation is only part of the story. The real measure of success is not how impressive the technology becomes. It is whether people become more included, more independent, and more able to participate in the world around them.

For some of us, that participation may involve education, employment, or leadership. For others, it may involve knowing what a newborn family member looks like, admiring a litter of kittens, checking whether our earrings match, or locating escaped hotdogs before they become a kitchen mystery.

The point is not the task itself. The point is the choice.

It is the ability to access those thousands of tiny pieces of information that so many people move through the world without ever having to think about. Artificial intelligence is opening doors that were previously closed or difficult to access. That is worth celebrating. At the same time, we should remember that technology is at its most powerful when it helps people engage more fully with the things that matter to them.

Sometimes those things are life changing. Sometimes they are wonderfully ordinary. And sometimes they are hotdogs sitting quietly in a kitchen sink, waiting to be found.

About the Author

Shannon Madar is a blind writer and disability advocate from Trinidad and Tobago. She writes about accessibility and the lived experience of blindness, usually through everyday moments that most people don't think twice about. Her work often blends reflection with humour and honesty, and looks closely at how technology shapes independence, not just in education and employment, but in the small, ordinary details of daily life that often go unnoticed until they are missing.

Overcoming Barriers: My Journey with Low Vision, Technology, and the Desire to Create Impact — Chandra Bahadur Pun

Nepal

Introduction

Technology and artificial intelligence (AI) have transformed the lives of many people around the world, especially those with disabilities. For individuals with visual impairment, these tools are not just innovations—they are essential for independence and inclusion. As a person with low vision, I would like to share my personal journey, the challenges I have faced, and how technology has supported me in daily life and learning.

My Background and Challenges

Since my early life, I had a strong interest in music and singing. It was my passion and something I truly enjoyed. However, due to my low vision, learning music became difficult. I faced challenges in reading lyrics, following instructions, and practicing effectively. Over time, I lost confidence and eventually had to give up my dream of pursuing music.

Later, I came to Japan on a cook visa with the hope of earning money and improving my financial condition. However, my low vision created difficulties in performing work efficiently. Tasks that require speed, accuracy, and clear vision became challenging, and it was not always possible to continue work smoothly.

Living with Low Vision in a Foreign Country

Living in Japan with low vision has not been easy. Adapting to a new environment, language barriers, and work expectations added to my struggles. However, I did not give up. Instead, I started exploring ways to use technology to support my daily life.

Role of Technology in My Daily Life

Technology has become my biggest support system. I regularly use: Voice typing to write messages and search information; YouTube to learn new things and stay motivated; Google Maps for navigation and traveling safely; and Facebook to stay connected and share my thoughts. These tools help me perform tasks that would otherwise be very

difficult. For example, voice typing reduces the need to see clearly while writing. Navigation apps help me move independently without relying on others.

Artificial Intelligence and Opportunities

Artificial intelligence is creating new opportunities for people like me. Features such as speech recognition, text-to-speech, and smart assistants are making digital platforms more accessible. Even though I could not continue my music journey, I have started thinking about alternative ways to express myself, such as creating content online.

Technology has given me a new direction and hope.

Awareness and Late Realization

One important thing I have realized is that many people with low vision, including myself, do not take action early. We often hide our problems or ignore them, thinking we can manage. But as time passes, the situation becomes more difficult, and we regret not seeking solutions earlier.

I am now 35 years old, and I feel that if I had taken proper steps earlier, my journey might have been different. This realization has motivated me to spread awareness.

Future Goals and Social Contribution

My goal is not only to improve my own life but also to help others with low vision. I want to work in the field of social welfare and support people facing similar challenges.

I believe that:

- People should not hide their vision problems
- Early support and guidance are very important
- Technology should be made accessible to everyone

I want to encourage others to accept their condition and find solutions in time, so they do not face regret later like I did.

Conclusion

Technology and artificial intelligence have the power to change lives, especially for people with visual impairment. While challenges still exist, these tools provide independence, confidence, and new opportunities.

My journey has not been easy, but it has taught me the importance of resilience, awareness, and adaptation. I hope my story can inspire others to take action early, use available technologies, and work towards a better and more inclusive future.

Visual Impairment and Artificial Intelligence – Connell Simkin-Watt

CNIB International Internship Program 2026, supporting the International Council of Education for Persons with Visual Impairment (ICEVI).

In this engaging presentation, Connell Simkin-Watt explores the rapidly evolving intersection of visual impairment and artificial intelligence, considering the opportunities AI presents for accessibility, independence and inclusion. Connell is a university student and writer from Vancouver, British Columbia. Watch Connell's presentation to hear a young person's perspective on the potential of AI to shape the lives of people who are blind or have low vision.

https://www.youtube.com/watch?v=IdGRrJi-kyc



Caption: Thumbnail for YouTube recording of Connell Simkin-Watt.

Technology and AI: Accessibility of Digital Learning Environments in Post-Secondary — Megan Miller

CNIB International Internship Program with the Saint Lucia Blind Welfare Association (SLBWA) and the International Council of Education for Persons with Visual Impairment (ICEVI).

As a fourth-year Bachelor of Social Work student at a Canadian University, I have first-hand experience of how the accessibility of digital learning environments directly impacts learning. For the purposes of this article, I will consider digital learning environments to include any digital learning material, such as digital textbooks, digital journal articles, digital assignments, and online courses.

Digital learning environments and materials have several benefits for students with and without disabilities. For all students, digital learning environments can increase flexibility without needing to attend a physical location. For this reason, digital learning can also increase accessibility for students with disabilities, such as physical disabilities and chronic illnesses. For students with blindness or low vision, digital learning can be beneficial. However, this is highly dependent on the individual student and on how accessible the materials and environment are.

I think it is important to express that the points I share in this article demonstrate my perspective. Every individual who is blind or has low vision is unique. Placing people with blindness and low vision “in a box” and assuming that we all have the same needs is counterproductive and inaccurate.

Textbooks and Journal Articles

As a screen reader user myself, I read my textbooks and journal articles in an electronic format. Reading in this way can have benefits, such as quick navigation to headings within an article or book and locating specific key words or topics. There is also flexibility of reading speed, which is beneficial for many individuals with various disabilities. However, when they are not produced with accessibility in mind, digital textbooks and journal articles can lead to barriers for individuals using screen readers.

Digital textbooks and journal articles may be presented in a format that is not suitable for screen readers. Without accessible formatting, these documents are not read properly by screen readers, leading to inaccurate screen reader navigation. A document may appear to look accessible and easy to navigate from a visual standpoint, while behind the scenes, the screen reader reads the document completely different.

Digital textbooks and articles are most effective when they are made accessible for screen readers from the start. However, it is just as important that journal articles and textbooks that are not accessible are revised on an ongoing basis. This can be a challenge within a post-secondary environment when inaccessible textbooks and journal articles are selected for syllabi. This often leads to a process in which post-secondary accessible learning staff take the role of revising the textbook or article to make it accessible. However, this process in of itself can lead to barriers for the student when there are limited staff, delays, and difficulty revising a document to be accessible.

While selecting an accessible document from the start is often considered ideal, this may be difficult for post-secondary staff when the desired content is from a source which contains limited accessible options. Post secondary staff may also alter and update their textbook and article selection throughout a course, which can lead to delays for a student receiving accessible material when the updated selection is not accessible for the student.

This post-secondary process of only revising digital content to be accessible on an as needed basis is understandable based on the large collection of digital content. However, this process also limits the realm of readily available accessible content for students and can lead to time delays, placing a burden on students with disabilities to continually self-advocate.

Digital Assignments

Many assignments are now digital in post-secondary which has many benefits for students with blindness and low vision. However, similar to digital textbooks and articles,

the accessibility of digital assignments depends on how they are executed. From my experience, digital assignments that require large and complex tables to be filled out can be time consuming for screen reader users to navigate.

Providing students with the option to complete an assignment in an alternative format, such as a list with accessible headings, may make navigation more efficient for some screen reader users. Similarly, it is often helpful when professors provide flexibility with the format of assignments that require the student to create visual content, such as graphs and diagrams. Providing sufficient descriptions of graphs and diagrams is essential, along with providing an option for the student to complete the assignment in another format.

Providing feedback in an accessible format is also important for a student's learning and autonomy. I have had the experience of feedback being provided by digitally circling and marking parts of my assignment to indicate the aspect being referenced. I have found that explicitly providing feedback in the body of an assignment, with the start and end of comments indicated with a word or symbol, to be helpful. Additionally, indicating comments by using a visual cue such as a different colour, font, or bold text may not be indicated by a screen reader. All students deserve the ability to complete assignments in an accessible format and to be able to access their feedback.

Online Courses

I have taken several online courses at my university, with various experiences of accessibility. More recently, I have found that online courses provide improved accessibility features, such as alt text for images. However, sometimes these descriptions leave out key information, which limits the learning for students who are screen reader users.

Online courses may also contain videos as part of a lesson or assignment. Videos that contain visual information that do not provide sufficient auditory dialogue, narration, or description, create barriers to accessing relevant information for students with blindness and low vision. While using AI is helpful to learn about the takeaways from a video or to assist with description, it may leave out key information that would benefit the student and their learning.

Audio description is often considered the golden standard for accessibility. However, audio description is not always available for videos shown in an academic setting, especially when specific documentaries or platforms are used that do not contain audio description. I have also found that journal articles that are embedded within an online course that are inaccessible for screen readers can be problematic. These articles may fly under the radar and miss accessibility checks when they are not included in the syllabus. This can lead to a situation in which the student discovers that the article is inaccessible only once navigating it. As a result, there may be a time delay in receiving the article in an accessible format.

While there can be barriers within online courses, they may also offer flexibility and a more accessible environment compared to a live or in person class, which may involve real time visual content and issues with inaccessibility within the physical classroom. Therefore, online courses provide the most benefits for students with blindness and low vision when they are accessible and continually updated with screen readers in mind.

Resource: Accessibility within post-secondary

*The Web Content Accessibility Guidelines and higher education: Lessons from a blind grad student's and a sighted librarian's journeys (*Shaw & Weiler, 2024), is a valuable resource which covers topics of screen reader accessibility within higher education. The authors of this resource, Ashley Shaw and Mark Weiler, have personal and academic experience with accessible technology within post-secondary. Ashley Shaw is a blind graduate of Wilfrid Laurier University. Mark Weiler is a sighted Web & User Experience librarian at Wilfrid Laurier University and a Web Accessibility Specialist. Key quotes about accessible technology across four themes within Chapter 4, "Other Accessibility Issues in Academic Settings" are included below.

Technologies differ

"…different screen readers are designed for different operating systems".

"The most accessible format options may also differ depending on the screen reader and operating system being used".

Syllabus

"A common experience is reading a course syllabus. Accessibility guidelines don't just apply to web content".

"The most accessible format options may also differ depending on the screen reader and operating system being used".

Page numbers

"It is often the case that accessible format versions of books and journal articles do not contain page numbers accessible to the screen reader".

"Workarounds, such as counting paragraphs and using a paragraph number for a citation, take a great deal of time and are not an equitable solution. Instead, it's important to recognize that the problem is with the current reading environment, which can be improved".

"Blind students have often had a grade penalized or faced a lack of cooperation from instructors when we explain that we aren't able to access page numbers for some content".

"It can be intimidating for students to raise this issue with instructors, especially in environments where warnings about academic integrity are often repeated. The difficulty raising it can be compounded when educators are not familiar with digital formats or

screen reading technologies and so have difficulty understanding why the page number issue is such an obstacle".

"For educators with course assignments that require page numbers, the best strategy is probably to welcome the opportunity to collaborate with blind students to find a workable solution".

"Putting all the responsibility for determining what they need to succeed onto the student is neither fair nor effective in this situation".

Reading material that isn't proof-read

"Another major obstacle is that reading material provided to blind students is often not proofread for accessibility or accuracy. There are rigorous proofing processes involved in publishing a book or journal article, but when materials are remediated for accessibility, often no one verifies the material thoroughly".

"Remember that just because someone tells you content is accessible, doesn't mean it is. Ask yourself the following questions:

Who verified that this content is accessible and accurate?

How did they verify it?"

"People have sometimes told us that no students have reported problems with their material before, but quality control isn't the student's responsibility".

Reference

Shaw, A., & Weiler, M. (2024). *The Web Content Accessibility Guidelines and higher education: Lessons from a blind grad student's and a sighted librarian's journeys*. eCampus Ontario. https://ecampusontario.pressbooks.pub/wcaghighered

Tech in Action: Transforming Young People's Access in Daily Living — Aasha Rose, Jessica Gallasch, & Jobina Johnson

See Differently

Transforming Daily Living through Technology

Children and young people living with blindness/low vision frequently experience reduced opportunities to develop practical daily living skills, including food preparation and safe kitchen participation, leading to negative impacts on independence and well-being (Milde et al., 2026). In comparison to their sighted peers, they often encounter additional barriers when accessing and operating standard household appliances, many of which rely heavily on visual displays such as screens, buttons, indicators, and written instructions (Rudinger, 2023). These barriers can contribute to increased reliance on caregivers or support persons to complete routine tasks, potentially limiting opportunities

for the development of independence and functional life skills as children transition toward adolescence and adulthood (Whittaker et al., 2024).

On 3 March 2026, staff from the South Australian based blindness organisation See Differently, facilitated an interactive daily living skills workshop for young people with blindness/low vision. The workshop was designed to increase participants' awareness, understanding, and practical use of specialised assistive technologies that support independence in everyday activities. It provided a structured yet interactive learning environment where participants could explore a range of tools tailored to diverse needs. A key focus of the workshop was building awareness of the wide variety of assistive technologies available and how these tools can be personalised to suit individual goals and preferences. Participants were introduced to real-world applications, helping them recognise how technology can remove barriers and enable greater autonomy in tasks such as daily living, communication, household management, and community participation.



Caption: Person preparing cookies.

In addition to building foundational knowledge, the workshop emphasised developing practical skills through hands-on demonstrations and guided activities. Participants had the opportunity to trial different devices and applications, allowing them to gain confidence in using the technologies effectively. This experiential approach helped bridge the gap between theory and practice, ensuring that participants felt more capable of integrating these tools into their daily routines.

The workshop also encouraged discussion and reflection, enabling participants to share experiences, challenges, and strategies. This collaborative aspect fostered peer learning and helped participants better understand how assistive technology can be adapted across different contexts (Cain et al., 2022). Overall, the workshop aimed not only to inform but to empower individuals to make informed decisions, increase independence, and enhance quality of life through the effective use of assistive technologies (Sri Takshara & Bhuvaneswari, 2025).

A particular focus was placed on the use of low vision kitchen aids and braille supports to enhance accessibility and participation in meal preparation tasks.

Assistive aids used throughout the workshop included:

- Talking kitchen scales
- Talking air fryers
- Talking microwaves
- Braille labels
- Braille recipes
- High-contrast kitchen utensils

Participants included school-aged children with varying levels of blindness/low vision who attend the South Australian School for Vision Impaired. During the workshop, participants were supported to engage in a structured cooking activity using a combination of assistive technology and braille. Talking kitchen appliances provided auditory feedback (e.g. speech, tones, or verbal prompts), enabling participants to operate equipment safely and accurately without reliance on visual information. These tools were used in conjunction with braille-labelled ingredients and a braille recipe for chocolate chip cookies. Braille was provided in contracted, uncontracted, single- and double-line spacing to meet the needs of beginner, intermediate and advanced braillists. This enabled all participants to engage with written information in their preferred format and have autonomy to lead the task (Rose, 2026).



Caption: "Australian Regional Braille Challenge 2026" facilitators interacting with kitchen appliances on a counter.

Following demonstration and guided instruction from facilitators, participants enthusiastically engaged in the activity and demonstrated independence across many tasks (Morelli et al., 2025). Participants were able to identify ingredients using braille labels, measure ingredients independently using talking scales, combine ingredients,

shape cookie dough, and operate the air fryer and microwave with verbal guidance from the appliance. The use of assistive aids reduced the need for direct sighted assistance during the task. Without these supports, participants would likely have required continuous assistance from a sighted support to identify ingredients, read recipes and measurements, and safely operate kitchen appliances leading to dependence rather than independence (Nuzzi et al., 2024).

Participants responded positively to the workshop and expressed excitement regarding the increased accessibility and independence made possible with assistive technologies. The session provided an opportunity for participants to experience success in a practical and age-appropriate daily living activity that many had not previously completed independently (Elsman et al., 2021).

At the conclusion of the workshop, participants were able to enjoy the food they had prepared and demonstrated a clear sense of achievement, confidence, and pride in their developing skills and capabilities.

Key outcomes and benefits identified through the workshop included:

- Increased independence in meal preparation tasks
- Improved safety and confidence when operating kitchen appliances
- Enhanced participation in age-appropriate household activities and routines
- Development of functional daily living and self-management skills
- Reduced reliance on sighted supports during cooking activities
- Reduced cognitive load and fatigue associated with visual scanning and magnification use
- Increased confidence, autonomy, and engagement in practical learning activities.



Caption: "Australian Regional Braille Challenge 2026" facilitator listening to a talking Air Fryer.

The workshop demonstrated the significant role that assistive technology and braille can play in promoting functional independence, inclusion, and skill development for children and young people with blindness/low vision. Looking ahead, there are growing opportunities to further enhance these outcomes through emerging technologies such as AI-powered accessibility tools, smart wearable devices, and more affordable digital braille solutions. Continued collaboration between blindness organisations, education systems, families, and technology developers has the potential to create more personalised learning experiences, improve access to education and employment pathways, and foster greater social participation and independence across the lifespan.



Caption: Australian Regional Braille Challenge 2026 facilitators engaged in a cooking session.

References

Cain, M., Blackstock, D. R., Fanshawe, M., Sukhai, M., & Latour, A. (2022). The role and place of mentorship for young people with blindness and low vision in educational contexts. *International Journal of Mentoring and Coaching in Education*, *12*(1), 33-46. https://doi.org/10.1108/ijmce-01-2022-0004

Elsman, E. B. M., Koel, M., van Nispen, R. M. A., & van Rens, G. H. M. B. (2021). Quality of Life and Participation of Children With Visual Impairment: Comparison With Population Reference Scores. *Investigative ophthalmology & visual science*, *62*(7), 14-14. https://doi.org/10.1167/iovs.62.7.14

Milde, N., Kessel, L., Larsen, A.-C., & Larsen, K. (2026). “Do not act blind”: findings from qualitative interviews with adolescents and adults living with a visual impairment or blindness. *BMC Public Health*. https://doi.org/10.1186/s12889-026-27308-1

Morelli, F., Grumi, S., Catalano, G., Scognamillo, I., Reffo, M. E., Zumiani, R., Strazzer, S., Cocchi, E., Provenzi, L., Signorini, S., & Group, T. V. (2025). Autonomy in children and adolescents with visual impairment: Validation of the Visual Impairment Developmental Autonomy scale. *Developmental Medicine & Child Neurology*, *67*(11), 1472-1481. https://doi.org/https://doi.org/10.1111/dmcn.16326

Nuzzi, A., Becco, A., Boschiroli, A., Coletto, A., & Nuzzi, R. (2024). Blindness and visual impairment: quality of life and accessibility in the city of Turin. *Frontiers in Medicine*, *11*, 1361631. https://doi.org/10.3389/fmed.2024.1361631

Rose, A. (2026). The impact of braille literacy on life outcomes of people with blindness or low vision: A secondary analysis of oral histories in Australia. *Journal of Research in Special Educational Needs*, *26*(1), e70053. https://doi.org/https://doi.org/10.1111/1471-3802.70053

Rudinger, B. (2023). Bridge or barrier: technology, well-being, and blindness. *Disability and Rehabilitation: Assistive Technology*, *18*(6), 904-912. https://doi.org/10.1080/17483107.2021.1937342

Sri Takshara, K., & Bhuvaneswari, G. (2025). Empowering visually impaired individuals: The transformative roles of education, technology, and social connections in fostering resilience and well-being. *British Journal of Visual Impairment*, *0*(0), 02646196241310995. https://doi.org/10.1177/02646196241310995

Whittaker, S., Scheiman, M., & Sokol-McKay, D. (2024). *Low vision rehabilitation: A practical guide for occupational therapists*. Taylor & Francis.

About the Authors

Aasha Rose has worked in with people with blindness and low vision (BLV) for over 20 years and has a keen interest in the ways braille can improve independence, access and life outcomes. As a braille trainer at See Differently, Aasha collaborates with team members to implement braille at every opportunity.

Jobina Johnson is an Occupational Therapist at See Differently who has been working in the blindness and low vision sector for the past two years. She has a keen interest in assistive technology, environmental modifications, and functional assessment to maximise independence, participation, and quality of life for people who are blind or have low vision. Jobina enjoys working collaboratively with clients and multidisciplinary team members to develop practical, person-centred solutions that support meaningful everyday activities and long-term outcomes.

Jessica Gallasch is an Occupational Therapist at See Differently who is passionate about supporting people who are blind or have low vision to live independently and engage fully in everyday life. She has a strong interest in ways that assistive technology, environmental modifications, and functional assessment enhance participation, confidence, and quality of life. Jessica enjoys working collaboratively with the team to ensure we deliver strategies that empower clients to achieve their goals and maximise long-term outcomes.

Bridging Accessibility and Innovation: Teaching Technology and AI to Students with Visual Impairments through Inclusive Instructional Practices — Nantanoot Suwannawut, Ph.D.

Director of the Research, Monitoring and Evaluation section, Department of Empowerment of Person with Disabilities, Thailand.

Abstract

Artificial Intelligence (AI) and digital technologies are transforming education worldwide, including educational opportunities for learners with disabilities. For students with visual impairments (VI), technology functions not only as an assistive tool but also as a pathway to participation, creativity, and future employment in the digital economy. This article explores practical approaches to teaching technology and AI-related skills to students with visual impairments through inclusive instructional design and adaptive teaching strategies. Drawing upon experiences from Thailand's preparatory program for youth with disabilities participating in the Global IT Challenge for Youth with Disabilities (GITC), this paper discusses accessible instructional practices in teaching subjects such as Excel, audio editing, IoT, programming concepts, and AI-supported learning. The article highlights how accessible digital environments, individualized assessment, collaborative teaching, and AI-assisted instructional planning can support meaningful participation for learners with visual impairments. The findings suggest that inclusive technology education requires flexibility, accessibility-oriented pedagogy, and recognition of the distinct strengths of blind learners rather than attempts to replicate sighted learning experiences identically.

Introduction

Artificial Intelligence (AI) and digital technologies are rapidly reshaping educational systems across the globe. Schools and universities increasingly integrate AI tools, online collaboration platforms, programming environments, and digital learning systems into everyday teaching and learning. However, despite these advancements, equitable access to digital education remains a significant challenge for learners with disabilities, particularly students with visual impairments.

For learners who are blind or have low vision, technology serves a dual purpose. First, it acts as an assistive medium that enables access to information, communication, and educational content. Second, technology itself becomes an important area of study that can create pathways toward higher education, employment, independence, and social inclusion. Access to technology education is therefore not simply an accommodation issue but also an issue of educational equity and empowerment (UNESCO, 2020).

Recent developments in screen readers, cloud-based learning platforms, optical character recognition (OCR), voice assistants, AI chatbots, and accessible mobile technologies have significantly improved opportunities for learners with visual

impairments. At the same time, many technology-related learning environments remain highly visual, relying heavily on graphical interfaces, drag-and-drop systems, mouse navigation, and visual demonstrations. As a result, educators must continuously adapt instructional strategies to ensure meaningful participation for blind learners.

This article discusses inclusive approaches to teaching technology and AI-related content to students with visual impairments in the context of Thailand's preparation program for the Global IT Challenge for Youth with Disabilities (GITC). The paper also considers the broader implications of AI and accessible technology for disability-inclusive education.

The Global IT Challenge for Youth with Disabilities (GITC)

The Global IT Challenge for Youth with Disabilities (GITC) is an international initiative designed to promote information and communication technology (ICT) competencies among youth with disabilities. Originally initiated in the Republic of Korea, the competition brings together students with various disabilities from multiple countries to demonstrate their technological skills, creativity, collaboration, and problem-solving abilities.

The competition includes diverse categories such as e-Tool challenges, e-Life Map, e-Content creation, programming, multimedia production, and emerging technology-related activities. In recent years, topics associated with AI, digital creativity, and problem-solving have become increasingly integrated into the competition structure. GITC emphasizes not only technical competence but also international cooperation, digital inclusion, and empowerment of young persons with disabilities.

In Thailand, the Department of Empowerment of Persons with Disabilities has supported preparatory training programs for students participating in the competition for over ten years. These programs provide intensive instruction in areas such as Microsoft Excel, multimedia editing, IoT concepts, coding principles, AI-related activities, and collaborative digital projects. Students with visual impairments participate alongside peers with other disabilities, creating an inclusive learning environment where instructional adaptation and accessibility become essential components of the educational process.

The GITC model demonstrates that learners with disabilities can actively engage in advanced digital learning when appropriate support systems and inclusive teaching practices are implemented. It also highlights the importance of preparing students not only for competitions but for long-term participation in a technology-driven society (World Health Organization [WHO], 2022).

Preparing Accessible Learning Environments

One of the most important aspects of inclusive technology education is the preparation of accessible learning environments before instruction begins. In practice, educational materials, worksheets, practice files, and examination documents are often uploaded to students' computers or shared through cloud-based systems such as Google Drive. This ensures that learners using screen readers can independently access instructional

resources. In Thailand, the most widely used screen reader is NonVisual Desktop Access (NVDA), an open-source screen reader application for Microsoft Windows. Accordingly, NVDA was adopted as the primary screen reader throughout the GITC training sessions

Online communication platforms such as Google Meet and Zoom also play a central role in facilitating instruction. Following the COVID-19 pandemic, many students with visual impairments became more familiar with online learning environments and virtual communication tools. Nevertheless, some learners still require orientation and training before participating effectively in online instruction.

Orientation activities are particularly important for blind learners because successful participation depends heavily on keyboard navigation and auditory feedback. Students may need explicit instruction regarding keyboard shortcuts, navigation commands, chat functions, microphone controls, and file downloading procedures. Such preparation supports confidence, independence, and active participation in the learning process.

Another important issue concerns the accessibility of communication practices. In many large-group learning environments, instructors share visual URLs, file codes, or links displayed only on presentation screens. These practices can unintentionally exclude blind learners. To address this challenge, accessible links and downloadable resources must be distributed through screen-reader-friendly communication channels such as chat systems, email, or messaging applications.

These examples demonstrate that accessibility is not achieved solely through assistive technologies themselves, but also through thoughtful instructional planning and inclusive communication practices. Such approaches align closely with the principles of Universal Design for Learning (UDL), which emphasize providing multiple means of access, engagement, and participation for diverse learners (Al-Azawei et al., 2016).

Inclusive Teaching Strategies in Technology Education

Inclusive technology instruction requires flexible teaching methods that accommodate differences in access, navigation, and learning pace. In some subjects, students with visual impairments can participate fully alongside their peers through listening-based instruction. For example, theoretical topics such as Internet of Things (IoT) concepts can often be delivered effectively through verbal explanation, discussion, and collaborative problem-solving activities.

However, subjects involving visually complex software interfaces require more individualized support. During multimedia instruction, for instance, blind learners may need separate explanations or individualized guidance while mainstream instruction continues simultaneously. This often involves providing additional auditory descriptions and clarifying visual processes that sighted learners observe directly.

An important principle emerging from these practices is that inclusion does not necessarily require identical learning experiences. Rather, inclusive education seeks to

ensure equitable participation and meaningful learning outcomes through differentiated instructional approaches.

Video editing provides a useful example. Video production software is highly visual and timeline-based, making full visual editing inaccessible for many blind learners. Instead of excluding students with visual impairment from multimedia instruction, educators can redesign learning activities to emphasize accessible components such as audio editing, sound design, sequencing concepts, and production planning. Students can learn how transitions function, how multimedia content is organized, and how audio components contribute to storytelling.

Blind learners can also contribute meaningfully to collaborative multimedia projects through tasks such as locating copyright-safe music, editing sound files, trimming audio clips, balancing sound levels, and rendering audio outputs. These instructional adaptations emphasize strengths-based participation rather than deficit-oriented exclusion. This strengths-based perspective reflects broader disability-inclusive education frameworks that focus on learner capacity and participation rather than limitations (UNESCO, 2020).

Teaching Office Applications and Digital Skills

Teaching office applications such as Microsoft Excel presents unique accessibility challenges because spreadsheet environments are highly visual and spatially organized. Sighted learners typically rely on visual scanning, mouse navigation, and graphical interaction when using spreadsheets. In contrast, learners with visual impairments interact sequentially through keyboard commands and screen reader feedback.

As a result, blind learners often require significantly more instructional time to master the same concepts. While sighted students may quickly identify spreadsheet layouts and formula structures visually, blind learners must first explore worksheet organization systematically. They need to identify rows, columns, cell references, and data structures through auditory navigation.

In addition, many visual shortcuts used by sighted learners are inaccessible to keyboard-only users. For example, drag-and-select functions cannot easily be replicated non-visually. Consequently, blind learners frequently rely on precise keyboard input and memorization of cell ranges when entering formulas and functions.

Despite these challenges, students with visual impairments can successfully learn advanced spreadsheet concepts when instruction is appropriately adapted. The key requirement is additional exploration time, structured navigation support, and accessible teaching methods focused on keyboard interaction. These practices are consistent with research emphasizing the importance of accessible assistive technologies and adaptive learning environments for persons with disabilities (Borg et al., 2011).

Programming instruction presents another accessibility issue. Some educational coding platforms, such as Scratch, rely heavily on graphical drag-and-drop interfaces that are

not fully accessible to screen readers. In such situations, educators may shift the learning emphasis toward conceptual understanding rather than graphical manipulation.

Students with visual impairments can still engage meaningfully with computational thinking by designing storyboards, planning character interactions, describing narrative sequences, and developing logical structures for digital projects. These activities support creativity, sequencing skills, problem-solving, and algorithmic thinking even when graphical programming environments remain inaccessible.

Accessible Assessment Practices

An important feature of disability-inclusive education is the adaptation of assessment practices to ensure fairness and accessibility. Equitable assessment does not necessarily mean that all learners complete identical tasks in identical ways. Rather, assessments should measure intended learning outcomes while accommodating differences in access and interaction.

For example, in multimedia courses, sighted students may be evaluated based on visual editing quality, transitions, and graphical presentation. In contrast, blind students may demonstrate learning outcomes through audio editing, sound arrangement, and conceptual understanding of production processes.

Similarly, in programming-related activities, learners with visual impairment may be assessed through detailed storyboard design and conceptual planning rather than direct manipulation of inaccessible graphical programming blocks. Students can demonstrate understanding through descriptions of scenes, character movement, dialogue, sequencing, and interaction design.

Digital assessment tools such as Google Forms and Microsoft Word can also support accessible testing environments when designed appropriately. Screen-reader-compatible formats allow students to independently complete written responses, assignments, and examinations.

Equally important is the role of feedback. In accessible learning environments, feedback often occurs through ongoing dialogue, online discussion, and individualized support. Immediate verbal feedback can help students identify navigation errors, incorrect formula structures, or misunderstandings during digital tasks. Such flexible assessment and feedback practices align with inclusive assessment approaches promoted within Universal Design for Learning frameworks (Al-Azawei et al., 2016).

AI as a Tool for Inclusive Education

AI technologies are increasingly influencing disability-inclusive education in both teaching and learning contexts. AI tools can assist educators in generating instructional ideas, designing exercises, organizing content, and analyzing learning activities. In technology-focused instruction, AI can also support the development of integrated assignments that combine multiple digital skills and concepts.

For students with visual impairments, AI may offer particularly significant benefits because conversational interaction aligns naturally with auditory learning methods. AI chatbots and large language models enable learners to ask questions, request explanations, receive coding guidance, and explore new topics independently through text-based or voice-based interaction.

For example, students interested in learning programming languages such as Python may find traditional video tutorials inaccessible because these resources are usually designed for sighted audiences. AI systems, however, can provide interactive explanations tailored to learners' questions and pace of learning.

At the same time, educators must encourage responsible and critical use of AI. AI should support learning rather than replace independent thinking and problem-solving. Students need guidance in evaluating AI-generated information, verifying accuracy, and using AI ethically and effectively.

AI therefore represents both an instructional tool and a literacy domain that students with disabilities must increasingly understand in order to participate fully in future educational and employment environments. This perspective is consistent with international calls for inclusive and equitable access to emerging technologies for persons with disabilities (WHO, 2022).

Implications for Disability-Inclusive Education

The experiences discussed in this article highlight several important implications for inclusive education policy and practice.

First, accessibility must be integrated into instructional design from the beginning rather than added afterward as an accommodation. Accessible file formats, keyboard navigation, screen-reader compatibility, and flexible communication methods should become standard educational practices.

Second, inclusive technology education requires collaboration among mainstream instructors, assistive technology specialists, support staff, and students themselves. Effective communication among teaching teams is essential to ensuring that learners with visual impairment remain connected to shared instructional goals.

Third, disability-inclusive assessment practices should focus on meaningful demonstration of knowledge rather than rigid standardization of task performance. Students with visual impairments may demonstrate learning outcomes differently while still achieving equivalent educational objectives.

Finally, AI and emerging technologies present valuable opportunities for expanding educational access. However, accessibility considerations must remain central to technological development and implementation. Without intentional inclusion efforts, technological innovation may unintentionally reproduce existing educational inequalities. These concerns reflect broader global discussions regarding equitable access to

education and assistive technologies for persons with disabilities (Borg et al., 2011; UNESCO, 2020).

Conclusion

Technology and AI are creating new possibilities for learners with visual impairments to participate more fully in education, communication, creativity, and future employment opportunities. Nevertheless, meaningful inclusion depends not only on access to digital devices and software but also on accessible pedagogy, differentiated instruction, collaborative support systems, and equitable assessment practices.

The experiences discussed in this article demonstrate that students with visual impairments can successfully engage in advanced technology education when instructional approaches are thoughtfully adapted. Rather than attempting to replicate sighted learning experiences identically, inclusive education should recognize and support alternative pathways for participation and achievement.

As AI technologies continue to evolve, they may become increasingly important tools for independent learning, personalized instruction, and accessibility support. Educators, researchers, and policymakers therefore have an important responsibility to ensure that learners with disabilities are included in the future of digital education.

Ultimately, disability-inclusive technology education is not only about accessibility. It is about empowering learners with visual impairments to become creators, collaborators, innovators, and active participants in an increasingly digital world.

Acknowledgement

The author would like to acknowledge Mr. Jane Chaiyadech, Assistive Technology Specialist at the Ratchasuda Institute, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand, for sharing valuable professional experiences and practical insights related to teaching technology and AI to students with visual impairments in the context of Thailand's preparation program for the Global IT Challenge for Youth with Disabilities (GITC).

References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A content analysis of peer-reviewed journal papers from 2012 to 2015. Journal of the Scholarship of Teaching and Learning, 16(3), 39–56. Retrieved from https://doi.org/10.14434/josotl.v16i3.19295

Borg, J., Lindström, A., & Larsson, S. (2011). Assistive technology in developing countries: A review from the perspective of the Convention on the Rights of Persons with Disabilities. Prosthetics and Orthotics International, 35(1), 20–29. Retrieved from https://doi.org/10.1177/0309364610389351

UNESCO. (2020). Global education monitoring report 2020: Inclusion and education: All means all. UNESCO Publishing. Retrieved from https://unesdoc.unesco.org/

World Health Organization. (2022). Global report on health equity for persons with disabilities. World Health Organization. Retrieved from https://www.who.int/publications/i/item/9789240063600

About the Author

Dr. Nantanoot Suwannawut is a specialist in inclusive education, accessibility, and learning technologies for persons with disabilities. She currently serves at the Department of Empowerment of Persons with Disabilities under the Ministry of Social Development and Human Security, Thailand, and previously worked as an educational researcher at the Bureau of Special Education Administration, Ministry of Education.

Dr. Suwannawut holds a Ph.D. in. Information and Library Science from Indiana University, Bloomington, and a Master's degree in Special Educational Needs through the Erasmus Mundus program in Europe. Her academic and professional work focuses on inclusive education, universal design for learning (UDL), assistive technology, accessible online learning systems, and pedagogy for learners with visual impairments. She has presented her research at numerous international conferences, including the International Technology and Persons with Disabilities Conference and the Assistive Technology Industry Association Conference. Dr. Suwannawut has also contributed to policy development, teacher training, and disability-inclusive education initiatives at both national and international levels through her engagement with organizations such as the World Blind Union and the Thailand Association of the Blind.

Seeing Music Through Sound: Braille, Digital Audio and AI in Inclusive Music Education for Blind Students — Sevara Mirsidikova

PhD candidate, State Conservatory of Uzbekistan, Tashkent, Uzbekistan

Introduction

Digital technologies and artificial intelligence (AI) are rapidly changing the way blind and low-vision people study, work, and take part in everyday life. Yet professional music education at the university level has traditionally been one of the hardest fields for blind students to enter, because it relies so heavily on sight-reading and analyzing musical notation. For a blind student, the ability to read and interpret musical scores, which serves as the main entry point into the profession, is largely unattainable in practice.

An innovative approach to inclusive music education for visually impaired students was developed in Uzbekistan and is presented in this article. Using a combination of Braille music notation, digital audio support, and the growing capabilities of AI, the system enables blind trainees to gain access to music theory as well as the traditional maqom history of Uzbekistan. Maqom is a centuries-old professional tradition and its core form,

Shashmaqom, is recognised by UNESCO as part of the intangible cultural heritage of humanity (UNESCO, 2008). Similar to how blind musicians learn, it is passed down orally, via ear. The study is based on a practice-based approach to inclusive music education and is inspired by the author's personal experience as a blind musician and music instructor. From this vantage point, the essay is able to look at Braille notation, digital audio, and AI as ways to increase involvement, autonomy, and access to music education.

Cultural and social models of disability inform this effort. According to the social model, people's disabilities are the result of systems that are biased toward certain groups, such as a visual emphasis in music school. Taking it a step further, the cultural model sees disability as a source of unique knowledge and a component of human diversity. According to this view, the listening-centered perspective of a visually impaired musician is not a shortcoming that has to be addressed, but rather a legitimate avenue that, with the help of appropriate technology, can lead to the same professional objective.

The Challenge: Access to Music Education for Blind Students

Traditional music education focuses on sight reading of notation. Students are expected to glance at a score, take in multiple musical lines at once, and follow the notes as they play. This visual pathway is inaccessible to visually impaired students, leading to a number of additional challenges.

First, harmony is particularly difficult to grasp: a chord is a vertical "stack" of notes designed to be seen and heard at a single moment, whereas a blind student must reconstruct it step by step, by ear. Second, the lack of music literacy is a problem in and of itself due to the fact that Braille music notation is an independent system that is seldom taught. The third issue is the lack of or inadequacy of Braille resources that are appropriate for teaching national traditions like maqom.

These hurdles don't stop in the classroom. Blind musicians frequently face the same challenges later in their professional careers, where chances are restricted even for those who are exceptionally accomplished and prepared.

An Innovative Model: Braille Notation and Digital Audio

The model proposed here rests on two connected ideas: that Braille music notation is not a limited replica of the printed score, but a complete musical “text” in itself; and that this language is most powerful when it is accompanied by sound.

Using Braille, one may read and write music line by line, note by note. Braille readers must read a series of intervals in order to decipher a chord that a sighted reader may identify at first glance. The model interprets this as an advantage, since it mirrors the natural process by which a visually impaired musician learns music by relying on their ears and memories instead of seeing it as a disadvantage (Sabourin et al., 2022; Mirsidikova, 2026).

Three realistic principles form the basis of the model. Separately mastering rhythm and melody is the initial stage. To help students learn the rhythmic "skeleton" of maqom before adding melody, the usul (rhythmic formula) is presented separately from the melodic line. A blind student can study a complicated piece in stages instead of trying to master it all at once.

The second principle is the concurrent development of hearing and notation. Each new music text is established through both hearing and reading: the learner plays or sings a pattern, then locates it in the Braille text; any pattern heard by ear is later written down. This continual back-and-forth substitute the fast visual verification that sighted students are accustomed to.



Figure 1. Tasnifi Buzruk. A rhythmic exercise shown in Braille music notation, with a QR code linking to a reference recording of the usul (rhythmic formula) performed on the doira (frame drum).

The third principle is digital audio support using QR codes. Each practice is linked to a reference recording: after reading a rhythmic pattern, such as *Tasnifi Buzruk*, the student can immediately hear the usul performed on the doira (frame drum) by the artist Umidjon Malikov and compare the written text to the live sound. The end result is a dual tactile-and-audio format in which touch and hearing reinforce one another, and the recording functions almost as a "second teacher," evoking the old master-student relationship in which knowledge is transmitted by ear (Figure 1.).

Digital Tools and the Role of AI

The model is compatible with a broader range of easily available digital resources. The Duxbury Braille Translator (DBT) is used to create the Braille scores; it takes musical notation and converts it to Braille in accordance with international Braille music standards (Braille Authority of North America, 2015; Krolick, 1996). Digital audio tools are utilised to create the recorded samples that are connected by QR codes, and screen-reading software allows visually impaired students to access digital texts and learning platforms.

Computer systems with artificial intelligence (AI) can do things that humans can see or assess. This offers up new possibilities, and they're starting to materialise. Converting written scores into Braille is already a laborious and time-consuming procedure; however, optical music recognition powered by AI could one day make this process much faster (e.g., Goto et al., 2007). AI-powered audio tools have the potential to create or modify reference recordings, while AI-powered tutoring platforms could provide visually impaired students with tailored practice and feedback. Navigation and information access are already made easier with voice assistants.

Being forthright about the current state of the model is crucial. Rather than AI per se, its current strength is in digital and assistive tools that have been thoughtfully selected, such as Braille translation, screen access, and audio support. In this context, artificial intelligence is better seen as an exciting new addition rather than an established system.

The second reason this candor is important is because it promotes fairness and ethics. The accessibility and affordability of assistive and AI technologies is a major issue, particularly in areas with lower incomes. The danger of putting too much faith in machines and not enough on human educators is another concern. The relationship between a music teacher and their student should remain central to music education, and technology should supplement this relationship rather than replace it. With caution, AI and digital technologies have the potential to exacerbate existing disparities, but with good application, they may expand access.

Outcomes: Materials and the Course

The model is not merely a set of ideas, but has resulted in concrete teaching materials and an actual course. On the basis of the musical courses produced by the professor S. K. Matyakubova in the State Conservatory of Uzbekistan, the complex of teaching aids in Braille for blind students was developed. They cover maqom solfège – one texbook on maqom rhythms and one on namuds (the unique melodic patterns of maqom). Together they make the first systematic Braille training set of its sort in Uzbekistan. The materials are released as co-authored works with professor Matyakubova. The author's contribution is the transcription in Braille, methodical adaption for blind learners and the digital audio support (Matyakubova & Mirsidikova, 2025a, 2025b).

For each musical sample, both Braille notation and a reference recording are provided, with a QR code to allow the student to read and listen simultaneously. Vocal practice is

central: pupils sing typical motifs and namuds to establish a secure sense of mode. Each lesson begins with a clear strategy that includes the scale of the specific maqom, its modal cells, and a brief intonation exercise. This is followed by examples that are labeled according to their function within the musical form (Figure 2.).

Namud Buzruk

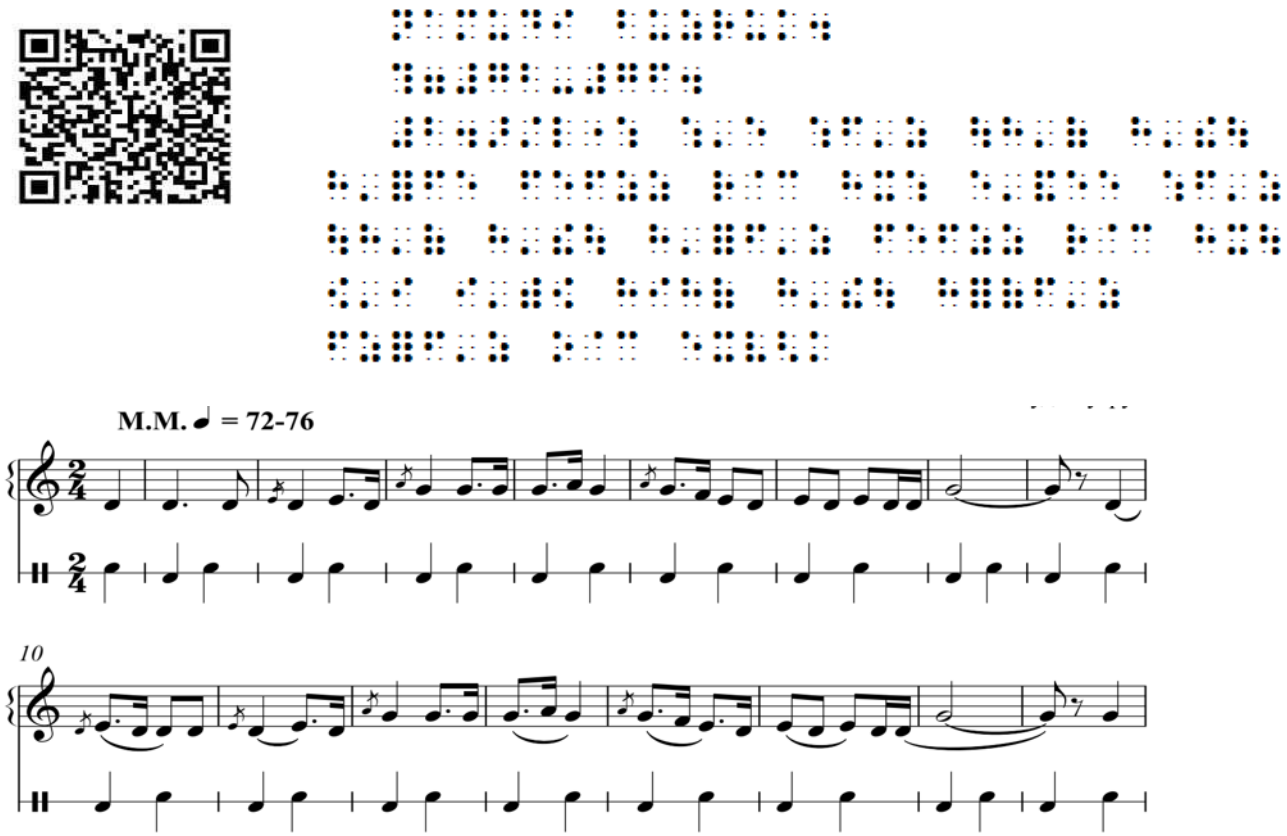


Figure 2. Namud Buzruk. A melodic pattern (namud) shown in Braille music notation, paired with a QR code linking to its reference recording.

This program has two qualities that make it unique. First, it does not dumb down the musical content, it re-thinks the presentation of that information so that blind students experience the same professional material as their sighted colleagues. Teachers and students say the combination of Braille and audio makes the content stick much better. Second, it connects a national heritage “maqom” with accessible methods, opening this rich tradition to blind musicians who had previously been left at its edges.

My View as a Visually Impaired Educator

This concept did not originate in a theoretical vacuum. Similar obstacles, such as closed scores, missing resources, and scepticism regarding a blind student's ability to excel in challenging theoretical courses, have been encountered by me in my work as a blind professional musician and educator. Each component of the model was influenced by that experience.

Additionally, I learned a basic lesson from it: technology is most useful when it is designed to be heard, not seen. A blind musician doesn't require a watered-down form of music instruction; rather, she requires an alternative path to the same career goal. There

is no "lowering the bar" in using Braille notation, audio support, or, more and more, AI. They are tricks for getting into a room where no one has ever been before. There is a world outside of school for visually impaired pupils when they see this door open. It reassures them that they can have a successful career in music despite whatever challenges they may face, and that their way of perceiving music is a strength, not a limitation.

Conclusion

This model demonstrates how accessible technology may be used with care to allow blind students to learn, play, and contribute to the preservation of the rich musical heritage. It transforms a living musical tradition into a teachable, shareable course by integrating Braille music notation, digital audio, and the developing possibilities of artificial intelligence.

Much remains to be done: testing the model with more learners, developing AI-based tools for Braille transcription and audio, and sharing experience across countries, facilitating international collaboration. But the direction is clear, and it is one worth pursuing together.

References

Braille Authority of North America. (2015). *Music Braille Code 2015.* Braille Authority of North America. https://www.brailleauthority.org/music/Music_Braille_Code_2015.pdf

Goto, D., et al. (2007). A transcription system from MusicXML format to Braille music notation. *EURASIP Journal on Advances in Signal Processing.*

Krolick, B. (Comp.). (1996). *New International Manual of Braille Music Notation.* World Blind Union, Braille Music Subcommittee.

Matyakubova, S. K., & Mirsidikova, S. A. (2025a). *Maqom solfège (Maqom rhythms), in Braille music notation* (Vols. 1–2). Tashkent.

Matyakubova, S. K., & Mirsidikova, S. A. (2025b). *Maqom solfège (Namuds), in Braille music notation* (Vols. 1–2). Tashkent.

Mirsidikova, S. A. (2026). Music perception in blind students: Cognitive, intonational and neuroplastic foundations of artistic thinking. *European Journal of Arts,* (2), 61–66. https://doi.org/10.29013/EJA-26-2-61-66

Sabourin, C. J., Merrikhi, Y., & Lomber, S. G. (2022). Do blind people hear better? *Trends in Cognitive Sciences,* 26(11), 999–1012. https://www.sciencedirect.com/science/article/pii/S1364661322002121

UNESCO (2008). *Shashmaqom, inscribed on the Representative List of the Intangible Cultural Heritage of Humanity.* https://ich.unesco.org/en/RL/shashmaqom-music-00089

About the Author

Sevara Mirsidikova is a blind musician and music educator, and a PhD candidate at the State Conservatory of Uzbekistan. She is a 2025 recipient of the World Blind Union (WBU) Mary Hochhausen Prize for Music and Braille Literacy. Her work focuses on inclusive music education and on teaching music-theory subjects to blind students, as well as the Uzbek maqom tradition, through Braille notation and digital audio.

The Application of Artificial Intelligence (AI) Technology in the Learning Skills Development for Visually impaired Students: A Case Study of the Bangkok School for the Blind — Pisit Prougestaporn, Ph.D., Ms. Nichapa Akethanapisan, Ms. Thanita Maneepong, and Ms. Kochaporn Buphakosum

Bangkok School for the Blind, Thailand

1. Introduction

Artificial Intelligence (AI) technology has become increasingly important in various aspects of society, particularly in education. AI technology serves as a powerful tool for enhancing learning, improving access to information, and developing essential 21st-century skills among learners. Visually impaired students often face barriers in accessing educational resources and information, and AI has significant potential to reduce such limitations and promote equal educational opportunities and accessibility.

AI technology enables support for visually impaired students in many areas of learning, including information searching through voice-based interaction (speech-to-text), information summarization and organization, image generation from textual descriptions, communication skills development, language learning, and access to diverse and up-to-date knowledge resources. Furthermore, AI encourages self-directed learning and independent living skills, which are key objectives of education for students with visual impairments.

The Bangkok School for the Blind places strong emphasis on developing students' technological competencies and digital literacy. The school supports teachers in integrating AI technology into teaching and learning activities across various subjects while promoting ethical and responsible AI use. Students are encouraged to use AI as a learning support tool without becoming overly dependent on it, ensuring that critical thinking, analytical thinking, and problem-solving skills continue to be developed. This approach aligns with the school's strategic goals of fostering excellence in technology, promoting digital literacy, and enabling students to utilize technology effectively for lifelong learning and independent living.

This article presents the application of Artificial Intelligence technology in developing learning skills among visually impaired students, using a case study of the Bangkok School for the Blind.

2. Strategies of the Bangkok School for the Blind

The Bangkok School for the Blind has established a three-year operational strategy for academic year 2024 – 2026, which consists of five strategies covering curriculum and instruction, professional development, management, learning and working environment, and interaction with parents and communities.

The Curriculum and Instructional Strategy focuses on promoting the development of skills in technology, music, sports, language, and daily living skills, and ensuring students are aware of and know how to use technology appropriately, as follows:

- Develop students to have excellence in technology, music, sports, and language, and to know how to use technology appropriately**.**
- Develop students to have daily living and independent living skills

3. Artificial Intelligence and Learning Skills Development

The Bangkok School for the Blind strongly encourages students to develop AI literacy through the use of school computers and personal devices such as smartphones and tablets. Students from Grade 4 onwards are permitted to use personal devices at school under teacher supervision. AI applications are integrated into learning activities across different subjects rather than being limited to computer classes.

3.1 Information Searching

AI enables visually impaired students to access information efficiently through voice commands and screen-reader technologies. Students can search for information from various knowledge sources independently, reducing barriers to information access and supporting lifelong learning and to search for general knowledge beyond what they have learned in class. For example, teachers in such subjects like Social Studie or Science encourage students to search for topics they interested in.

3.2 Information Organization and Summarization

AI tools assist students in analyzing, organizing, and summarizing information from multiple sources. These capabilities help students understand complex content more effectively while encouraging them to evaluate the accuracy and reliability of AI-generated information.

The Bangkok School for the Blind encourages students to develop summarising and analytical thinking skills. For example, teachers in Thai language classes ask students to summarise articles and compare their work with AI-generated summaries.

3.3 Imagination and Creative Expression

AI image-generation technologies allow students to transform their ideas and verbal descriptions into visual representations. Although visually impaired students may not perceive images directly, this technology enables them to communicate creative ideas and abstract concepts to others, fostering creativity and self-expression.

Arts teachers, together with computer teachers, integrate learning by allowing students to design art images based on their imagination, which are then printed on T-shirts and sold to those who are interested as a part of their charity activities.

3.4 Communication Skills Development

AI Technology serves as an interactive learning companion for practicing conversations, presentations, and communication skills. Students can receive feedback on their communication styles and improve their confidence in expressing ideas and interacting with others.

Students at the Bangkok School for the Blind are able to practise their communication skills through AI Technology, particularly in writing effective prompts.

3.5 Language Skills Development

AI supports language learning through reading, listening, pronunciation practice, translation, and grammar checking. Students can engage in personalized language-learning experiences that accommodate their individual needs and learning pace.

Teachers of English at the Bangkok School for the Blind encourage students to engage in conversations with AI, allowing them to practise English writing and listening skills.

4. Ethics of Artificial Intelligence use

Although AI offers significant educational benefits, its use must be guided by ethical principles and responsible practices. The Bangkok School for the Blind emphasizes the development of students' awareness and understanding of ethical AI use.

First, AI should support learning rather than replace students' thinking processes. Students are encouraged to use AI as a tool for research and learning while continuing to develop their own analytical, critical-thinking, and problem-solving skills.

Second, students should be aware that AI-generated information may sometimes be inaccurate or misleading. Therefore, they must learn to verify information through reliable sources and exercise critical judgment when evaluating AI-generated content.

Third, students should respect privacy and intellectual property rights. Personal information should not be shared irresponsibly with AI systems, and appropriate attribution should be provided when AI-generated content is used in academic work.

The school also promotes academic integrity by prohibiting students from using AI to complete homework on their behalf or to solve mathematical problems intended to assess individual competencies. These guidelines ensure that students continue to develop genuine understanding and independent learning skills.

Ultimately, ethical AI use involves leveraging technology as a supportive educational tool while maintaining responsibility, honesty, and digital literacy. Such an approach enables students to benefit from AI safely, appropriately, and effectively in both education and everyday life.

References

Behera, D. K., & Nayak, N. (2026). “AI-powered assistive tools for visually impaired students in STEM education.” *The International Journal of Indian Psychology*, *14*(2), 971–982.

Filipova, E**.** (2025). “Enhancing educational accessibility for visually impaired individuals through artificial intelligence: Challenges and opportunities.” *International Journal of Computer Applications*, *186*(67), 25–32.

Fitria, T. N. (2021). “*Artificial Intelligence (AI) in education: Using AI tools for teaching and learning process*.” Retrieved from researchgate.net

The Bangkok School for the Blind (2024). “Strategies of Bangkok School for the Blind 2024 – 2026” Retrieved from http://www.blind.or.th

Wang, S., Wang, F., Zhu, Z., Wang, J., Trann, T., & Du, Z. (2024). “Artificial intelligence in education: A systematic literature review.” *Expert Systems with Applications*, *238*(Part A), Article 122245. Retrieved from https://www.sciencedirect.com/science/article/pii/S0957417424010339

About the Authors

The authors are employed at the Bangkok School for the Blind, Thailand.
Pisit Prougestaporn, Ph.D, is the Technology and Research Officer; and Ms. Nichapa Akethanapisan, Ms. Thanita Maneepong, and Ms. Kochaporn Buphakosum are teachers at the school.

Technology and Artificial Intelligence in the Education and Daily Life of Persons with Visual Impairment and Additional Disabilities — Akhil Paul

Vice President (ICEVI), Chief Mentor (Sense India)

1. Introduction

The rapid evolution of assistive technology and Artificial Intelligence (AI) has significantly reshaped the educational and daily life experiences of persons with visual impairment, particularly those with additional disabilities such as deafblindness. Emerging technologies are enhancing access to information, communication, mobility, and independent living, thereby promoting inclusion and participation. At the same time, persistent challenges related to affordability, accessibility, and capacity continue to limit equitable access. Drawing from global practices and the Indian context, this paper highlights the importance of inclusive design, multisensory approaches, and collaborative frameworks to ensure that technological advancements translate into meaningful outcomes for all learners (World Health Organization [WHO], 2022; United Nations, 2016).

For persons with visual impairment and additional disabilities, barriers to education and independent living have historically been systemic and deeply embedded within social, institutional, and infrastructural contexts. Limited access to accessible learning materials, lack of inclusive educational practices, and inadequate support systems have contributed to exclusion from mainstream opportunities. In many cases, children with multiple disabilities have been placed in segregated environments with minimal exposure to technology, further restricting their educational and developmental potential (WHO, 2022).

The emergence of assistive technology, combined with advances in Artificial Intelligence (AI), is redefining this landscape by enabling individuals to access, process, and interact with information in new ways. Technology is no longer limited to compensating for sensory loss; rather, it is facilitating active participation, communication, and engagement. AI-driven systems offer adaptive and personalized learning experiences that respond to individual needs and preferences. This shift is especially significant for persons with multiple disabilities, where solutions must address complex and intersecting barriers through flexible and multisensory approaches (UNESCO, 2021).

2. Understanding the Intersection

Persons with visual impairment and additional disabilities, including deafblindness, intellectual disabilities, and physical impairments, experience compounded challenges that extend beyond a single dimension of disability. Access to information remains a primary barrier, as educational content is often not available in accessible or adaptable

formats. Even when materials are digitized, they may not be suitable for individuals with cognitive or sensory complexities (UNESCO, 2021).

Communication barriers are particularly significant for individuals with deafblindness, where both visual and auditory channels are limited. This affects language acquisition, social interaction, and access to education. Alternative communication systems, such as tactile signing, Braille, and object-based communication, require specialized support and training, which are often unavailable or insufficient (Miles & Riggio, 2019).

Mobility and orientation challenges further restrict independence and participation, limiting opportunities for exploration and engagement with the environment. These barriers can lead to social isolation and reduced self-confidence. Addressing these challenges requires technology solutions that are multisensory, integrating auditory, tactile, and AI-driven adaptive features to provide holistic support (WHO, 2022).

3. Assistive Technology in Education



Caption: Learner reading braille on an electronic braille device.

Assistive technology has long played a critical role in enabling access to education for learners with visual impairment. Tools such as screen readers convert digital text into speech or Braille, allowing students to navigate computers and digital platforms independently. Refreshable Braille displays provide tactile access to information, supporting literacy and academic engagement, while Optical Character Recognition (OCR) technologies convert printed materials into accessible digital formats. Additionally, accessible digital content, including DAISY books and audiobooks, has significantly improved access to curriculum materials (UNESCO, 2021).



Caption: Students engaged in a technology class wearing headphones.

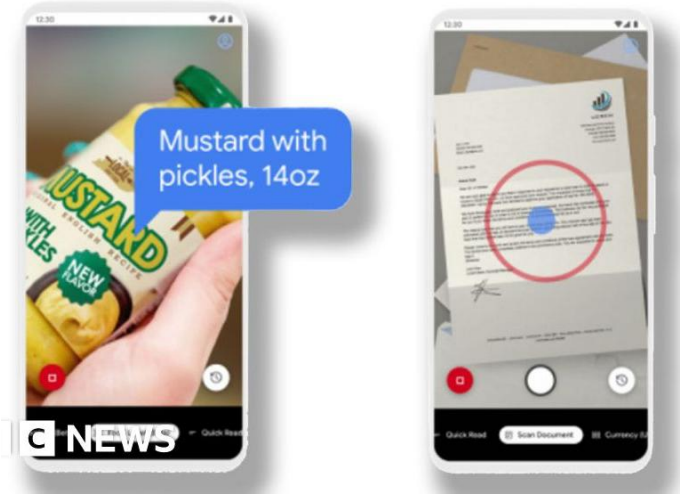
Artificial Intelligence is further enhancing these technologies by introducing adaptive and intelligent functionalities. AI systems can personalize learning by analyzing user behavior and adjusting content according to individual pace and preferences. This is particularly beneficial for learners with additional cognitive or developmental disabilities. AI-powered image recognition tools can describe visual content such as diagrams, charts, and maps, thereby improving access to subjects like science and mathematics. Furthermore, conversational AI tools enable learners to interact with content, ask questions, and receive explanations, promoting independent and self-directed learning (Holmes et al., 2019).



Caption: Device for reading audio books, together with an audio book in a case.

For learners with deafblindness, the integration of AI with tactile technologies is creating new possibilities. Haptic feedback systems, audio-tactile interfaces, and tactile graphics are enabling access to information and supporting concept development in innovative ways. These advancements highlight the importance of multisensory approaches in inclusive education (Miles & Riggio, 2019).

4. Technology in Daily Life



Caption: Demonstration of Google Lookout App reading grocery labels

Beyond education, technology plays a transformative role in enhancing independence and quality of life for persons with visual impairment and additional disabilities. In the area of mobility, AI-enabled tools such as smart canes equipped with sensors detect obstacles and provide real-time feedback, while GPS-based navigation applications offer step-by-step guidance. Wearable AI devices can recognize objects, read text, and provide environmental information, thereby improving safety and confidence in navigating public spaces (WHO, 2022).



Caption: US Bureau of Engraving and Printing operates the U.S. Currency Reader Program to provide free iBill Talking Banknote Identifier devices to eligible U.S. citizens and legal residents who are blind or visually impaired.

In communication, voice assistants and accessible digital platforms facilitate interaction and access to information. These tools enable users to perform tasks such as sending messages, accessing services, and obtaining information through voice commands. For individuals with deafblindness, communication technologies incorporating Braille

displays, tactile feedback, and AI-driven interpretation systems are particularly valuable in enabling meaningful interaction (Miles & Riggio, 2019).

AI-powered applications also support daily living by assisting with tasks such as reading labels, identifying currency, recognizing objects, and managing schedules. These technologies reduce dependency on others and enhance autonomy, enabling individuals to participate more actively in everyday life (UNESCO, 2021).



Caption: Accessible e-cooking using induction burners.

5. Benefits and Impact

The integration of technology and AI has resulted in significant benefits for persons with visual impairment and additional disabilities. One of the most notable outcomes is increased independence, as individuals can perform tasks without constant assistance. Educational outcomes have also improved, with greater access to learning materials and personalized support contributing to better comprehension and academic performance (Holmes et al., 2019).

In addition, technology has expanded employment opportunities by enabling access to digital platforms and remote work environments. This has opened new avenues for participation in the workforce and economic independence. Social inclusion has also been enhanced, as improved communication and mobility enable individuals to engage more fully in community life. Overall, technology is shifting the focus from limitations to capabilities, promoting dignity, self-determination, and inclusion (United Nations, 2016).

6. Challenges

Despite these advancements, several challenges continue to limit the impact of technology. Affordability remains a significant barrier, particularly in low- and middle-income countries, where assistive devices are often expensive and not widely available. The digital divide further exacerbates inequalities, as access to technology and internet connectivity is uneven across regions (WHO, 2022).

Capacity and training are also critical concerns, as educators, families, and users may lack the knowledge and skills required to effectively use assistive technologies. Additionally, many mainstream digital platforms are not fully accessible, limiting

participation in education and employment. There is also a lack of technologies specifically designed for individuals with multiple disabilities, highlighting the need for more inclusive and user-centered innovation (UNESCO, 2021).

AI systems present additional challenges related to accuracy, bias, and cultural relevance. Ensuring that AI technologies are inclusive, ethical, and contextually appropriate is essential for their effective implementation (Holmes et al., 2019).

7. The Way Forward

To maximize the potential of technology and AI, a comprehensive and inclusive approach is required. Universal design principles must be adopted to ensure that accessibility is integrated into technology from the outset. Capacity building for educators, families, and users is essential to enable effective use of assistive tools. Affordability and localization, including support for local languages and contexts, are critical for wider adoption (WHO, 2022).

Importantly, persons with disabilities must be actively involved in the design and development of technologies to ensure that solutions are relevant and effective. The integration of AI with multisensory approaches offers significant potential for addressing the complex needs of individuals with deafblindness and multiple disabilities. Collaboration between governments, organizations, and the private sector will be key to advancing inclusive innovation (United Nations, 2016).

8. Conclusion

Technology and Artificial Intelligence are powerful enablers of inclusion, independence, and dignity for persons with visual impairment and additional disabilities. They have the potential to transform education, enhance daily living, and create opportunities for meaningful participation in society. However, achieving these outcomes requires more than technological innovation; it demands equitable access, inclusive policies, and sustained collaboration.

An inclusive future will depend on our ability to ensure that technology is designed and implemented in ways that reflect the diverse needs and aspirations of persons with disabilities. By prioritizing accessibility, participation, and equity, it is possible to create a world where no learner is left behind (UNESCO, 2021).

References

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.

Miles, B., & Riggio, M. (2019). *Remarkable conversations: A guide to developing meaningful communication with children and young adults who are deafblind.* Perkins School for the Blind.

UNESCO. (2021). *Reimagining our futures together: A new social contract for education.* UNESCO.

United Nations. (2016). *Convention on the Rights of Persons with Disabilities (CRPD). United* Nations.

World Health Organization. (2022). *Global report on health equity for persons with disabilities.* WHO.

Digital-First School Readiness for Blind Children in Rural India: Practice-Based Evidence from a Six-Month Community-Based Intervention — Vania Desianti[1], Deepthi Telikicherla[2], Saumya Tripathi[2], Varsha Krishan Mishra[2], Satish Tripathi[1]

[1]Ek Kadam Aur, USA
[2]Ek Kadam Aur Foundation for Education and Health, Mumbai, India

ORCID: *0009-0000-0768-2380*

Abstract

Blind children living in rural and economically disadvantaged communities often experience significant barriers to education, independent living, and social participation due to shortages of specialist educators, limited access to assistive technology, inadequate family support, and delayed identification. The Arunodaya (Sunrise) Programme was developed as a digital-first, community-based intervention to improve school readiness and functional independence by combining accessible technology with individualized instruction delivered by trained local educators.

This manuscript presents practice-based evidence from 229 blind children who completed baseline, midline (3-month), and endline (6-month) assessments across seven Indian states. The intervention combined smartphone-based learning, digital literacy instruction, orientation and mobility, daily living skills, sensory development, social-emotional development, and structured caregiver engagement. Outcomes were assessed using a standardized 30-point school readiness assessment, comprising three equally weighted domains (10 points each): Digital Literacy; Social-Emotional Well-being and Family Support; and Daily Living, Mobility, Sensory, and Foundational Skills.

Mean total scores increased from 10.72 at baseline to 22.01 at midline and 25.36 at endline, representing an average improvement of 14.63 points over six months. Significant improvements were observed across all three domains. Improvement patterns were consistent across age groups and gender, while variation across states primarily reflected differences in the timing of smartphone procurement and access to digital learning resources. Digital Literacy demonstrated the largest gains, highlighting the

potential of accessible smartphone technology to accelerate learning and independence among blind children in underserved communities.

The findings suggest that a digital-first, community-based model can substantially improve functional, educational, and participation-related outcomes for blind children. The study provides practice-based evidence supporting the integration of assistive technology, family engagement, and community-based instruction as scalable strategies for promoting inclusive education in low-resource settings.

Keywords: Blind children; Digital literacy; Assistive technology; Digital inclusion; Smartphone-based learning; Inclusive education; School readiness; Rural India

Introduction

Worldwide, children with disabilities continue to experience lower rates of school enrolment, educational participation, and learning achievement than their peers without disabilities (World Health Organization & World Bank, 2011; World Bank, 2025). Among them, blind children face particularly significant challenges because successful participation in education often depends on access to specialized instructional methods, trained educators, assistive technology, accessible learning materials, and supportive family environments. In many low- and middle-income countries, these supports remain limited, resulting in delayed school enrolment, interrupted learning, reduced independence, and restricted participation in community life.

In India, educational exclusion among children with blindness remains a major concern, particularly in rural and economically disadvantaged communities. Although inclusive education is recognized as a fundamental right under Article 24 of the United Nations Convention on the Rights of Persons with Disabilities (United Nations, 2006), and is further reinforced through the Rights of Persons with Disabilities Act, 2016 (Government of India, 2016), many children continue to face barriers including poverty, limited availability of teachers trained in visual impairment, inadequate rehabilitation services, delayed identification, and poor access to assistive technology. While Braille remains an essential medium for literacy instruction, shortages of Braille materials, limited opportunities for Braille training, and the growing importance of digital learning have created a need for complementary educational approaches that enable children to access information and participate in learning independently.

Recent advances in accessible smartphone technology have transformed opportunities for education and participation among persons with blindness. Screen readers such as TalkBack and VoiceOver, digital libraries, voice assistants, optical character recognition applications, accessible educational platforms, and wireless keyboards enable children to independently access educational content, communicate, complete academic tasks, and participate in everyday activities. Recognising these developments, the World Health Organization and UNICEF identify assistive technology as a critical enabler of education, communication, participation, and independent living for persons with disabilities (World

Health Organization & UNICEF, 2022). Despite these advances, substantial inequities in access to assistive technology continue to exist, particularly in rural and underserved communities, and evidence describing large-scale implementation of digital-first educational models for blind children remains limited.

The Arunodaya Programme specifically serves children with complete blindness who remain excluded from education because they have either never entered school or, despite being officially enrolled, are not actively participating in education. To prepare these children for successful transition into formal schooling, the programme combines school readiness with the development of functional independence, digital competence, and active caregiver engagement.

Developed by Ek Kadam Aur Foundation, the Arunodaya (Sunrise) Programme delivers this support through a digital-first, community-based model. Rather than relying primarily on institution-based services, trained local educators provide individualized instruction within children's homes and communities using accessible smartphones and other assistive technologies. The curriculum integrates digital literacy, orientation and mobility, activities of daily living, sensory development, foundational learning, social-emotional development, and structured caregiver engagement to promote successful participation in inclusive education.

The present manuscript reports outcomes from a six-month implementation of the Arunodaya Digital-First School Readiness Programme across seven Indian states. Using repeated assessments conducted at baseline, three months, and six months, the study examines changes in overall functioning, digital literacy, social-emotional well-being and family support, and daily living, mobility, sensory, and foundational skills among participating blind children.

The objectives of this study were to:

- Examine changes in overall assessment scores during a six-month digital-first school readiness programme.
- Evaluate changes across Digital Literacy, Social-Emotional Well-being and Family Support, and Daily Living, Mobility, Sensory, and Foundational Skills.
- Examine whether outcomes differed according to age, gender, or state.
- Identify implementation lessons relevant to practitioners and policymakers seeking scalable digital approaches to inclusive education in low-resource settings.

Rather than establishing causal effectiveness, this study presents practice-based evidence from a large-scale field implementation and contributes to the growing body of literature examining how accessible digital technologies can improve educational participation and independence among blind children who have historically remained excluded from learning opportunities.

The Arunodaya Digital-First School Readiness Programme

Programme Description

The Arunodaya (Sunrise) Programme is a community-based, digital-first intervention designed to prepare blind children living in rural and underserved communities for successful participation in inclusive education. The programme was developed to address multiple barriers that contribute to educational exclusion, including delayed identification, limited availability of trained professionals, inadequate access to assistive technology, insufficient family support, and restricted access to specialized educational and rehabilitation services.

The programme combines accessible technology with individualized instruction delivered by trained local educators within children's homes and communities. The curriculum focuses on digital literacy, orientation and mobility, daily living skills, sensory development, foundational learning, social-emotional development, and structured caregiver engagement.

The primary objective is to develop functional independence and school readiness by enabling children to access learning through digital technology. The digital-first approach is based on the premise that accessible smartphones can serve as powerful educational tools for children with blindness. Digital literacy instruction includes smartphone navigation using TalkBack, wireless keyboards, digital reading and writing, note-taking, educational applications, voice assistants, optical character recognition (OCR) applications, internet safety, communication tools, and independent access to accessible educational resources. Rather than being taught as a separate subject, these skills are integrated with instruction in daily living, orientation and mobility, sensory development, and foundational educational competencies, allowing children to apply technology in meaningful real-life contexts while supporting independent learning.

Each child participated in a structured six-month programme delivered by trained local educators through regular home visits conducted two to three times per week, supplemented by technology-enabled learning, caregiver-supported practice between sessions, and continuous monitoring.

Participants

A total of 260 children with complete blindness were enrolled in the Arunodaya Digital-First School Readiness Programme across seven Indian states: Andhra Pradesh (AP), Chhattisgarh (CG), Maharashtra (MH), Rajasthan (RJ), Telangana (TL), Uttar Pradesh (UP), and West Bengal (WB). Eligibility was restricted to children with complete blindness who had either never been enrolled in school or who were formally enrolled but were not actively participating in education despite being officially enrolled.

Of the 260 enrolled participants, 229 children (88.1%) completed baseline, midline, and endline assessments and were included in the complete-case longitudinal analysis. Thirty-one children (11.9%) discontinued programme participation before completing all

scheduled assessments and were therefore excluded from the longitudinal analyses. Programme records indicated that discontinuation was primarily associated with family-level circumstances, including bereavement, household crises, migration, caregiving responsibilities, loss of parental support, and other personal or socioeconomic challenges. Consistent with the programme's long-term commitment to each child, these families continue to receive follow-up and support, and programme services are intended to resume once the underlying challenges have been resolved.

Participants ranged in age from 4 to 17 years. For subgroup analyses, children were classified into three age groups: 4 to under 9 years (n = 54), 9 to under 14 years (n = 97), and 14 to 17 years (n = 78). The final sample included 105 girls (45.9%) and 124 boys (54.1%).

Assessment Instrument, Procedures, and Data Analysis

Assessment Instrument

Programme outcomes were assessed using a standardized monitoring instrument developed specifically for the Arunodaya Digital-First School Readiness Programme. Assessments were conducted at programme enrolment (baseline), three months (midline), and six months (endline).

The assessment generated a total score out of 30 points across three domains:

Digital Literacy (0–10 points): This domain evaluated children's ability to independently use accessible smartphone technology for learning, communication, digital reading, digital writing, note-taking, internet access, use of accessibility applications, educational applications, voice assistants, and wireless keyboards.

Social-Emotional Well-being and Family Support (0–10 points): This domain assessed social participation, emotional expression, family engagement, community participation, sibling relationships, awareness of disability-related entitlements, access to learning resources, and caregiver involvement in educational activities.

Daily Living, Mobility, Sensory, and Foundational Skills (0–10 points): This domain evaluated independence in activities of daily living, organization of personal belongings, orientation and mobility, sensory discrimination, use of assistive learning materials, and other foundational functional skills required for successful participation in school and community life.

Assessment scores were derived from direct observations, structured interviews, caregiver responses, and educator-verified demonstrations. For several performance-based indicators, educators submitted video evidence to support scoring consistency and strengthen the reliability of programme monitoring.

Procedures

Baseline assessments were completed at the time of programme enrolment before children began receiving programme services. Following enrolment, participants received individualized instruction from trained local educators over a six-month period. Programme activities included digital literacy training, orientation and mobility instruction, daily living skills training, sensory development activities, school readiness instruction, and structured caregiver engagement. Caregivers reinforced learning activities between educator visits, allowing children to practise newly acquired skills within their everyday home environments.

Midline assessments were conducted approximately three months after enrolment, and endline assessments were completed after six months of programme participation. Assessment data were collected using standardized programme tools and reviewed through the programme's monitoring and quality assurance processes. Performance-based indicators requiring demonstration of functional skills were supported through educator-submitted video evidence to promote consistency across programme sites.

Data Analysis

The primary outcome measure was the total assessment score, while secondary outcomes included scores for the three assessment domains.

Repeated-measures analyses of variance (ANOVA) were used to evaluate changes in mean scores across baseline, midline, and endline assessments. Additional analyses examined whether patterns of improvement differed according to age group, gender, and state through time-by-group interaction analyses.

Descriptive statistics were calculated for all assessment time points. Baseline-to-midline, midline-to-endline, and baseline-to-endline changes were examined to understand both the magnitude and timing of programme-related improvements. Statistical significance was defined as $p < 0.05$.

Because the study was conducted as a real-world programme evaluation without a comparison group, findings are interpreted as practice-based evidence of programme-associated change rather than definitive evidence of causal effectiveness.

Results

Overall Outcomes

Among the 229 children who completed baseline, midline, and endline assessments, mean total scores increased from 10.72 at baseline to 22.01 at midline and 25.36 at endline, representing an average improvement of 14.63 points on the 30-point assessment over six months (Table 1; Figure 1). Every participant included in the complete-case analysis demonstrated a higher endline score than baseline score.

Repeated-measures ANOVA demonstrated a highly significant effect of time, $F(2,456) = 1406.56$, $p < .001$.

Most improvement occurred during the first three months of programme participation. Participants gained an average of 11.29 points between baseline and midline, followed by an additional 3.34-point increase between midline and endline. These findings suggest rapid acquisition of foundational skills during the early stages of the programme, followed by continued consolidation and refinement of skills over time.

Outcomes by Age Group

Children across all age groups demonstrated substantial improvements in overall scores (Table 2; Figure 2). Participants aged 4 to under 9 years improved by an average of 13.61 points, those aged 9 to under 14 years improved by 14.96 points, and participants aged 14 to 17 years improved by 14.94 points. Every child demonstrated a higher endline score than baseline score.

The time-by-age interaction was not statistically significant ($F(4,452) = 1.71$, $p = .147$), indicating that the pattern of improvement was similar across age groups. Although older children entered the programme with slightly higher baseline scores, children of all ages benefited substantially from participation, suggesting that meaningful improvements can be achieved even among learners who begin receiving support later in childhood.

Outcomes by Gender

Both girls and boys demonstrated substantial improvements throughout the intervention (Table 3; Figure 3). Mean scores among girls increased from 10.56 at baseline to 24.71 at endline, representing an average gain of 14.15 points. Boys improved from 10.86 to 25.90, corresponding to an average gain of 15.04 points.

No significant time-by-gender interaction was observed ($F(2,454) = 1.85$, $p = 0.159$), indicating comparable rates of improvement for both groups. These findings suggest that the digital-first model was equally effective in supporting girls and boys with blindness, an important consideration in settings where girls with disabilities frequently encounter additional barriers to educational participation.

Outcomes by State

Programme-associated improvements were observed across all participating states, although the magnitude of improvement differed significantly ($F(12,444) = 22.35$, $p < .001$) (Table 4; Figure 4). Rajasthan recorded the largest average improvement (17.42 points), followed by Telangana (16.60 points), Maharashtra (15.31 points), Andhra Pradesh (15.00 points), and Uttar Pradesh (13.61 points). Children in Chhattisgarh (11.14 points) and West Bengal (5.94 points) also demonstrated positive gains, although the magnitude of improvement was comparatively smaller.

The comparatively smaller gains observed in Chhattisgarh and West Bengal should be interpreted in the context of programme implementation. Operational challenges delayed the procurement and distribution of smartphones and other digital learning resources during the study period, resulting in reduced exposure to the digital-first components of the programme for some participants. These children subsequently received smartphones during the next phase of programme implementation, and outcomes from that phase will be reported in a separate follow-up manuscript.

Overall, the state-level findings demonstrate that the programme was successfully implemented across diverse geographic settings while highlighting the importance of timely access to assistive technology for maximizing programme outcomes.

Domain-Level Outcomes

Digital Literacy

Digital Literacy demonstrated the largest improvement among the three assessment domains (Table 5; Figure 5). Mean scores increased from 0.24 at baseline to 4.53 at midline and 6.84 at endline, representing an average improvement of 6.60 points ($F(2,456) = 597.12$, $p < 0.001$).

The greatest gains were observed in smartphone navigation using TalkBack, independent use of educational applications, digital reading, voice assistants, and wireless keyboards. These findings indicate that many children entered the programme with little or no prior experience using accessible digital technology but acquired meaningful digital competencies within six months.

Although Digital Literacy demonstrated the largest overall improvement, it also showed the greatest variability. Twenty-nine children demonstrated no change and four showed lower endline scores than baseline scores, suggesting that sustained progress in digital skills depends not only on access to devices but also on continued opportunities for practice, caregiver support, and individualized instruction.

Social-Emotional Well-being and Family Support

Scores within the Social-Emotional Well-being and Family Support domain increased from 6.23 at baseline to 9.76 at endline, representing an average improvement of 3.53 points ($F(2,456) = 552.08$, $p < 0.001$). Nearly all participants (98.7%) demonstrated improvement in this domain.

The findings suggest increased social participation, stronger caregiver involvement, improved emotional expression, and greater engagement with learning activities. These improvements likely reflect the combined influence of individualized instruction and structured family engagement throughout the intervention.

Daily Living, Mobility, Sensory, and Foundational Skills

Mean scores increased from 4.26 at baseline to 8.76 at endline, representing an average gain of 4.50 points ($F(2,456) = 699.16$, $p < .001$). Nearly every participant (99.6%) demonstrated improvement within this domain.

Children demonstrated increased independence in activities of daily living, improved orientation and mobility, better organization of personal belongings, stronger sensory discrimination skills, and greater competence in foundational functional tasks. Because many of these skills can be practised repeatedly within the home environment, the combination of educator guidance and caregiver involvement likely contributed to the consistent improvements observed across participants.

Summary of Findings

Across the six-month intervention, children participating in the Arunodaya Digital-First School Readiness Programme demonstrated substantial improvements in overall functioning, digital literacy, social-emotional well-being and family support, and daily living, mobility, sensory, and foundational skills. Improvement was observed across all age groups, both genders, and every participating state. The largest gains occurred during the first three months of participation, while continued engagement supported further skill development over time. Collectively, these findings suggest that combining accessible technology, individualized instruction, and caregiver engagement can provide an effective pathway toward school readiness and greater independence for blind children living in underserved communities.

Discussion

This study provides practice-based evidence that a digital-first, community-based model can support meaningful improvements in school readiness and functional independence among blind children living in rural and underserved communities. Across 229 children who completed assessments at all three time points, significant improvements were observed in overall functioning as well as in digital literacy, social-emotional well-being and family support, and daily living, mobility, sensory, and foundational skills. Consistent improvements across age groups and gender suggest that the programme can benefit children with diverse backgrounds and developmental profiles.

The most notable finding was the magnitude of improvement in Digital Literacy. Many children entered the programme with little or no prior experience using accessible smartphones or assistive technology. Within six months, participants demonstrated substantial improvements in TalkBack navigation, digital reading, educational applications, voice assistants, and wireless keyboard use. These findings reinforce the growing recognition that accessible smartphones can serve as powerful educational tools for blind children, particularly in settings where Braille materials, specialist teachers, and rehabilitation services remain limited.

Importantly, digital literacy was not taught as an isolated skill. Instead, the programme integrated technology into everyday learning, communication, mobility, and daily living

activities, enabling children to use digital tools to support broader educational participation and independence. This integrated approach may explain why improvements were observed across all assessment domains rather than in digital skills alone.

Substantial gains were also observed in Daily Living, Mobility, Sensory, and Foundational Skills. These competencies are essential for successful participation in school and community life and are often difficult to develop without individualized instruction. Delivering training within children's home environments allowed educators and caregivers to reinforce these skills through everyday routines, creating repeated opportunities for practice beyond scheduled teaching sessions.

Similarly, improvements in Social-Emotional Well-being and Family Support suggest that educational interventions for blind children should extend beyond academic instruction. Active caregiver involvement, increased opportunities for participation, and individualized educator support may have contributed to improvements in confidence, social engagement, and family participation. These findings reinforce the importance of adopting holistic approaches that address both educational and psychosocial aspects of inclusion.

The programme was specifically designed to prepare children with complete blindness who had been excluded from formal education for successful school enrolment and participation. By combining school readiness instruction with digital literacy, caregiver engagement, and functional independence training, the intervention sought to address barriers that commonly prevent these children from entering or remaining in school. Continued programme support following school enrolment is intended to promote retention and sustained educational participation.

Programme outcomes were broadly consistent across age groups and gender, indicating that meaningful improvements can be achieved regardless of when children begin receiving structured support. This finding is particularly encouraging for programmes serving older children who may have experienced delayed access to education or rehabilitation services.

Variation in outcomes across states highlights the importance of implementation fidelity in digital-first programmes. The comparatively smaller gains observed in Chhattisgarh and West Bengal primarily reflected operational delays in the procurement and distribution of smartphones during the study period, which reduced participants' exposure to the digital components of the intervention. These findings emphasize that timely access to assistive technology is a critical component of successful programme implementation. The subsequent outcomes of children who received devices during the next phase of implementation will be presented in a follow-up manuscript.

Although the availability of digital learning resources varies across schools, the Arunodaya programme equips each child with an accessible smartphone and wireless keyboard that remain with the child after programme completion. This enables learners to

continue using the same assistive technology following school enrolment, while reducing dependence on school-provided digital resources. Continued teacher orientation and inclusive classroom practices nevertheless remain important for supporting effective use of these technologies in educational settings.

Finally, although Digital Literacy demonstrated the largest overall gains, a small proportion of participants showed limited improvement. This finding suggests that providing devices alone is insufficient. Sustained progress depends on regular opportunities to practise digital skills, ongoing educator support, active caregiver involvement, and reliable access to assistive technology. Future programme development should therefore focus not only on technology provision but also on strengthening the ecosystem that enables children to use digital tools confidently and independently.

Limitations

Several limitations should be considered when interpreting these findings.

First, this study was conducted as a real-world programme evaluation rather than a controlled research trial. As no comparison group was included, improvements observed during the study cannot be attributed exclusively to programme participation. The findings should therefore be interpreted as practice-based evidence of programme-associated change rather than definitive evidence of causal effectiveness. The programme was implemented with the objective of providing timely educational support to all eligible children identified in underserved communities. Deliberately withholding access to educators, assistive technology, and educational support from a group of children for research purposes was considered inconsistent with the programme's service delivery objectives. Future studies may explore alternative evaluation designs that maintain equitable access to services while strengthening causal inference.

Second, analyses were based on children who completed assessments at baseline, midline, and endline. Although follow-up completion was high (88.1%), some participants had not completed all assessment points because of family-level circumstances or because they had entered the programme more recently. Consequently, outcomes reported in this paper reflect complete-case longitudinal analyses rather than the experiences of all enrolled participants.

Third, the assessment instrument was developed for programme monitoring and evaluation. Although it incorporated direct observation, caregiver input, educator verification, and video-based evidence for performance-based tasks, further psychometric validation would strengthen its application in future research.

Fourth, the evaluation covered only the initial six months of programme implementation. The study therefore does not examine whether improvements were sustained over longer periods or whether they translated into educational outcomes such as school enrolment, attendance, academic achievement, grade progression, or long-term independence.

Finally, sample sizes differed across participating states, with some states contributing relatively small numbers of participants. State-level findings should therefore be interpreted primarily as implementation observations rather than estimates of programme effectiveness within individual states. In addition, the programme did not systematically collect information on household characteristics such as parental education, household income, sibling composition, nutrition, or living conditions. These contextual factors may influence children's educational progress and should be examined in future studies.

Implications for Practice

The findings offer several practical lessons for educators, programme implementers, and policymakers working to improve educational opportunities for blind children.

First, accessible smartphones can function as powerful educational tools when combined with structured instruction and ongoing educator support. Digital literacy should be viewed not as a separate intervention but as a foundation that enables children to access information, participate in learning, communicate independently, and develop confidence across multiple areas of daily life.

Second, community-based delivery models can substantially expand access to educational services for children who remain unreached by specialized schools or rehabilitation centres. Training local educators and actively engaging caregivers enables learning to occur within children's everyday environments while reducing dependence on institution-based services.

Third, successful school readiness programmes should adopt a holistic approach that integrates digital literacy, orientation and mobility, daily living skills, sensory development, social-emotional well-being, and family engagement. Improvements observed across all assessment domains suggest that these competencies reinforce one another and collectively contribute to educational participation and independence.

Fourth, timely access to assistive technology is essential for successful implementation of digital-first programmes. The experience of Chhattisgarh and West Bengal demonstrates that delays in procuring and distributing smartphones can reduce children's exposure to digital learning opportunities during programme implementation. Technology deployment should therefore be planned alongside educator training and caregiver engagement to maximise programme impact.

Finally, the findings support continued investment in accessible technology, educator capacity building, caregiver training, and community-based service delivery. Together, these components provide a practical and scalable framework for promoting inclusive education among blind children living in rural and underserved communities.

Conclusion

This study presents practice-based evidence from the implementation of the Arunodaya Digital-First School Readiness Programme across seven Indian states. Over a six-month

period, blind children demonstrated substantial improvements in overall functioning, digital literacy, social-emotional well-being and family support, and daily living, mobility, sensory, and foundational skills. Improvements were observed across all age groups and both genders, indicating that the programme can effectively support diverse groups of learners.

The findings highlight the potential of combining accessible smartphone technology with individualized instruction, caregiver engagement, and community-based service delivery to address longstanding barriers to educational participation. Rather than viewing assistive technology as an additional resource, the Arunodaya model positions digital access as a central component of school readiness and independent learning for blind children.

Although this study does not establish causal effectiveness, it demonstrates that a digital-first, community-based approach can be implemented successfully at scale and can support meaningful improvements in skills that are fundamental to inclusive education. These findings contribute to the growing evidence that accessible technology can play a transformative role in expanding educational opportunities for blind children in low-resource settings.

Future research should examine longer-term educational outcomes, including school enrolment, attendance, retention, academic achievement, grade progression, and continued participation in digital learning following transition into school.

References

Government of India. (2016). *The Rights of Persons with Disabilities Act, 2016* (Act No. 49 of 2016). Ministry of Law and Justice. https://legislative.gov.in/sites/default/files/A2016-49_1.pdf

United Nations. (2006). *Convention on the Rights of Persons with Disabilities.* United Nations Department of Economic and Social Affairs. https://social.desa.un.org/issues/disability/crpd

World Bank. (2025). *Inclusive education.* https://www.worldbank.org/en/topic/education/brief/inclusive-education

World Health Organization. (2024). *Assistive technology.* World Health Organization. https://www.who.int/news-room/fact-sheets/detail/assistive-technology

World Health Organization, & UNICEF. (2022). *Global report on assistive technology.* World Health Organization. https://www.who.int/publications/i/item/global-report-on-assistive-technology

World Health Organization, & World Bank. (2011). *World report on disability.* World Health Organization. https://www.who.int/publications/i/item/9789241564182

Tables and Figures

Practice-Based Evidence from a Digital-First School Readiness Program for Children with Blindness in Rural India

Table 1. Overall complete-case Total Score results

N	Baseline	Midline	Endline	Baseline-Midline Gain	Midline-Endline Gain	Baseline-Endline Gain	Improved Baseline-Endline	Time p-value
229	10.72	22.01	25.36	11.29	3.34	14.63	229 / 229 (100.0%)	<0.001

Caption: This table summarizes overall outcomes for the 229 participants who completed baseline, midline, and endline assessments. The mean total score increased from 10.72 at baseline to 22.01 at midline and 25.36 at endline, representing an average improvement of 14.63 points over six months. All 229 participants demonstrated improvement between baseline and endline. The change over time was statistically significant ($p < .001$).

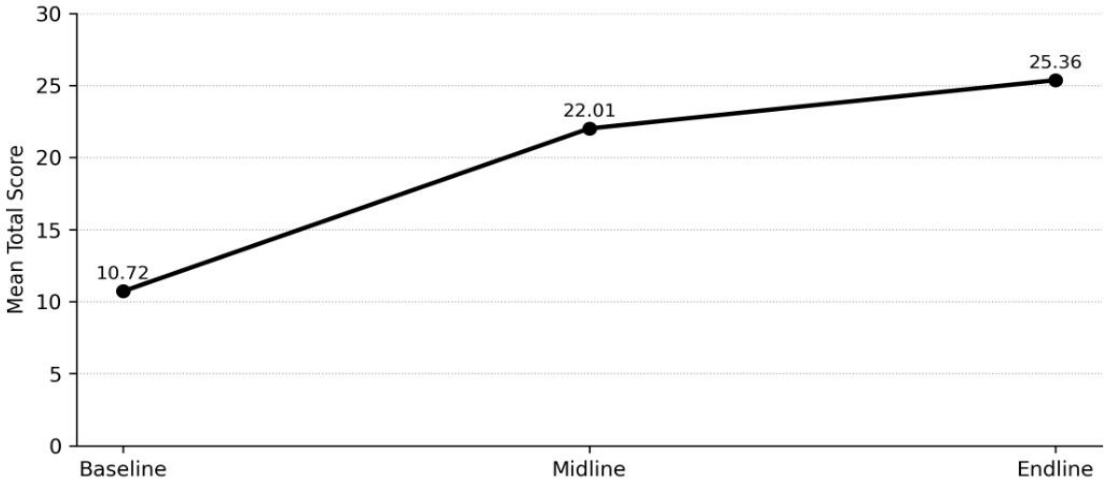


Figure 1. Mean Total Score trajectory for the 229 complete cases

Table 2. Complete-case Total Score results by age group

Age Group	N	Baseline	Midline	Endline	Baseline-Midline Gain	Midline-Endline Gain	Baseline-Endline Gain	mproved Baseline-Endline
4 to under 9	54	9.04	19.15	22.65	10.11	3.50	13.61	54 / 54 (100.0%)
9 to under 14	97	10.80	22.24	25.76	11.43	3.53	14.96	97 / 97 (100.0%)
14-17	78	11.79	23.72	26.73	11.92	3.01	14.94	78 / 78 (100.0%)

Caption: This table compares programme outcomes across three age groups: 4 to under 9 years (n = 54), 9 to under 14 years (n = 97), and 14 to 17 years (n = 78). All age groups

demonstrated substantial improvements, with average baseline-to-endline gains ranging from 13.61 to 14.96 points. Every participant improved regardless of age.

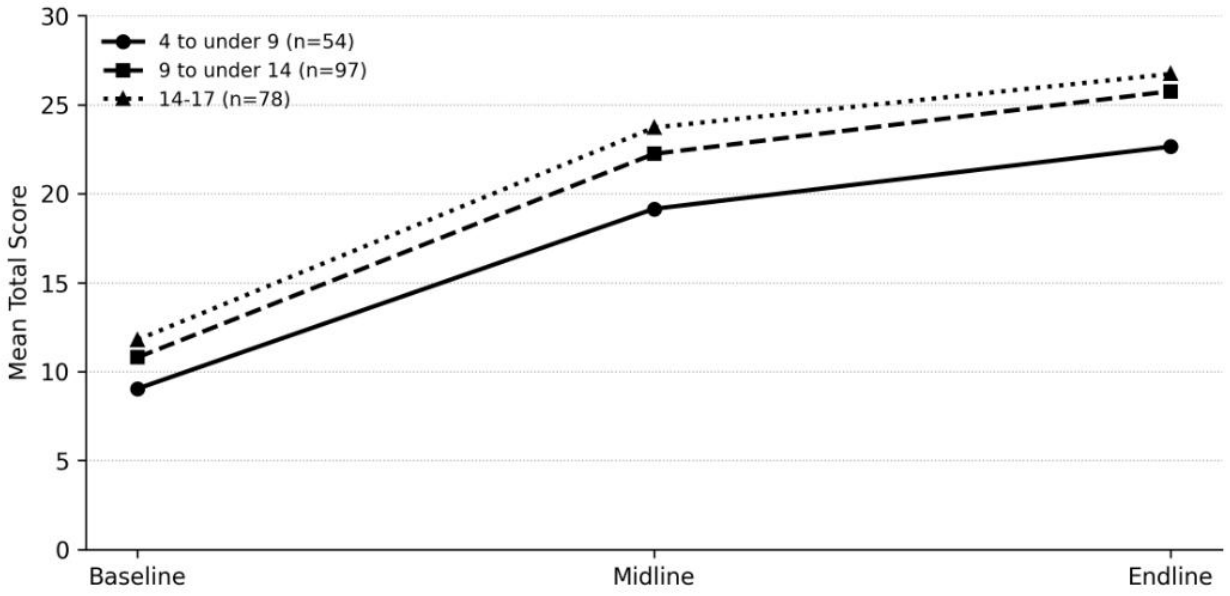


Figure 2. Mean Total Score trajectory by age group

Table 3. Complete-case Total Score results by gender

Gender	N	Baseline	Midline	Endline	Baseline-Midline Gain	Midline-Endline Gain	Baseline-Endline Gain	Improved Baseline-Endline
Female	105	10.56	21.30	24.71	10.73	3.42	14.15	105 / 105 (100.0%)
Male	124	10.86	22.62	25.90	11.76	3.28	15.04	124 / 124 (100.0%)

Caption: This table compares outcomes for girls (n = 105) and boys (n = 124). Mean total scores increased from 10.56 to 24.71 among girls and from 10.86 to 25.90 among boys. Baseline-to-endline improvements were similar for both groups, and every participant demonstrated improvement.

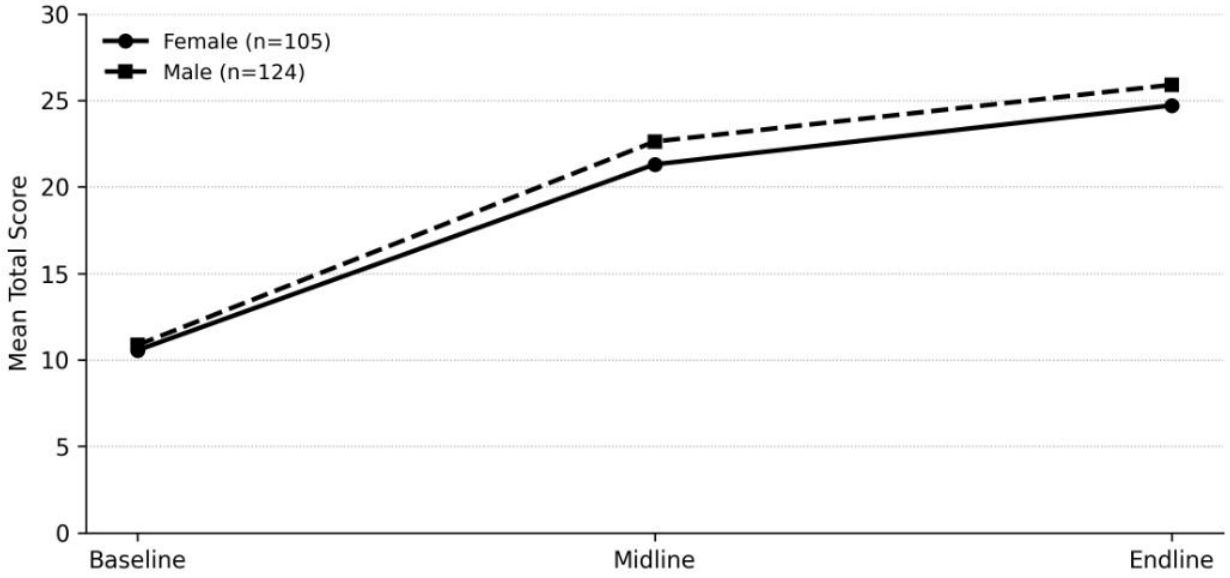


Figure 3. Mean Total Score trajectory by gender

Table 4. Complete-case Total Score results by state

State	N	Baseline	Midline	Endline	Baseline-Midline Gain	Midline-Endline Gain	Baseline-Endline Gain	Improved Baseline-Endline
Rajasthan (RJ)	104	11.02	25.10	28.44	14.08	3.35	17.42	104 / 104 (100.0%)
Telangana (TL)	5	6.00	12.80	22.60	6.80	9.80	16.60	5 / 5 (100.0%)
Maharashtra (MH)	11	7.18	20.27	21.73	13.09	1.45	14.55	11 / 11 (100.0%)
Andhra Pradesh (AP)	18	3.11	12.94	17.00	9.83	4.06	13.89	18 / 18 (100.0%)
Uttar Pradesh (UP)	51	12.41	21.76	26.02	9.35	4.25	13.61	51 / 51 (100.0%)
Chhattisgarh (CG)	22	13.77	22.59	24.91	8.82	2.32	11.14	22 / 22 (100.0%)
West Bengal (WB)	18	11.61	16.89	17.56	5.28	0.67	5.94	18 / 18 (100.0%)

Caption: This table presents programme outcomes across seven participating states. All states demonstrated improvement between baseline and endline. Average gains ranged from 5.94 points in West Bengal to 17.42 points in Rajasthan. Average gains ranged from 5.94 points in West Bengal to 17.42 points in Rajasthan. Reasons for state-level differences are discussed in the manuscript.

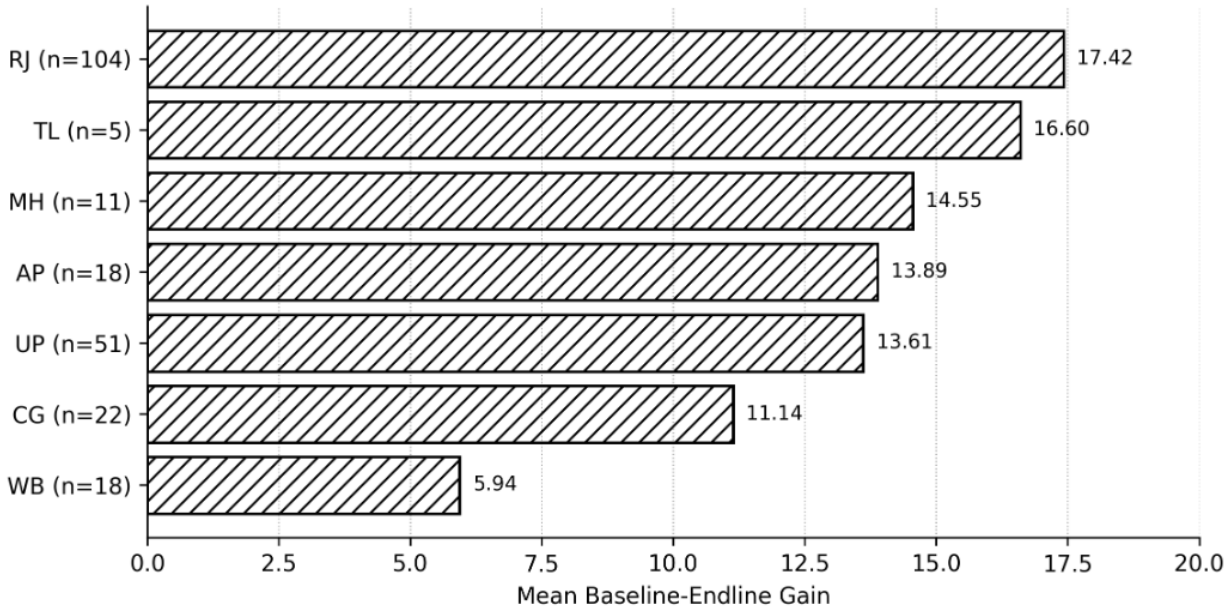


Figure 4. Mean Baseline-to-Endline Total Score gain by state

Table 5. Complete-case domain-level results

Domain	N	Baseline	Midline	Endline	Baseline-Midline Gain	Midline-Endline Gain	Baseline-Endline Gain	Improved Baseline-Endline	Time p-value
Digital Literacy	229	0.24	4.53	6.84	4.30	2.31	6.60	196 / 229 (85.6%)	<0.001
Social-Emotional Well-being and Family Support	229	6.23	9.40	9.76	3.17	0.36	3.53	226 / 229 (98.7%)	<0.001
Daily Living, Mobility, Sensory, and Foundational Skills	229	4.26	8.08	8.76	3.82	0.68	4.50	228 / 229 (99.6%)	<0.001

Caption: This table summarizes outcomes across the three assessment domains. Digital Literacy demonstrated the largest average improvement (6.60 points), followed by Daily Living, Mobility, Sensory, and Foundational Skills (4.50 points), and Social-Emotional Well-being and Family Support (3.53 points). Improvements in all domains were statistically significant ($p < .001$).

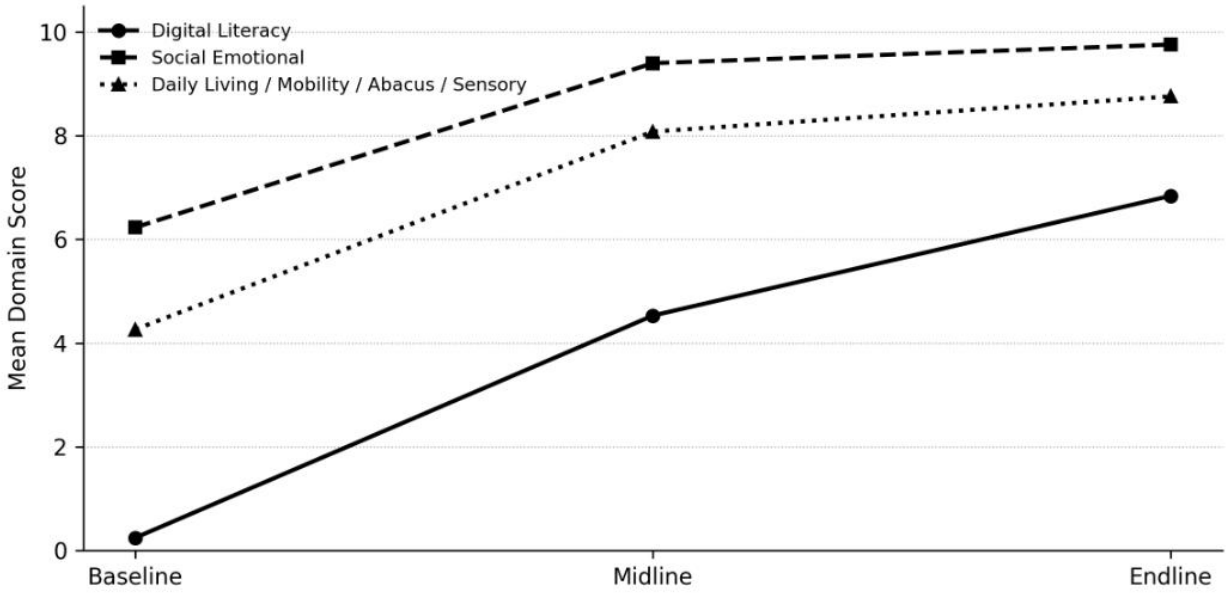


Figure 5. Mean domain-score trajectories for the 229 complete cases

Table 6. Repeated-measures ANOVA and time-by-group interaction tests

Analysis	df1	df2	F	p-value	Result
Overall time effect	2	456	1406.56	<0.001	Significant
Time x Age interaction	4	452	1.71	0.147	Not significant
Time x Gender interaction	2	454	1.85	0.159	Not significant
Time x State interaction	12	444	22.35	<0.001	Significant
Digital Literacy time effect	2	456	597.12	<0.001	Significant
Social Emotional time effect	2	456	552.08	<0.001	Significant
Daily Living / Mobility / Abacus / Sensory time effect	2	456	699.16	<0.001	Significant

Caption: This table summarizes the statistical analyses. Significant improvements over time were observed for overall programme outcomes and for each assessment domain (all $p < .001$). No significant differences in improvement were found across age groups or gender, while the interaction between time and state was statistically significant, indicating variation in outcomes across states.

Less Waiting, More Reading: AI and Accessible Books for Learners with Visual Impairments — Prashant Verma

Accessibility Specialist, DAISY Consortium

Around the world, millions of books, research papers, textbooks, government documents, and reports still remain inaccessible to people with print disabilities. Although digital publishing has grown rapidly, creating truly accessible books continues to be a slow, expensive, and highly specialized process.

A major part of the challenge begins with PDF files. PDFs were originally designed for printing and visual presentation, not for accessibility or machine-readable structure. As a result, extracting clean and usable text from PDFs is still surprisingly difficult, especially when documents contain images, tables, multiple columns, mathematical expressions, scanned pages, or complex layouts.

For decades, organizations producing accessible books have relied on Optical Character Recognition (OCR) technology to convert scanned pages into editable text. But OCR is far from perfect. Even today, OCR systems often struggle with poor-quality scans, old documents, unusual fonts, handwriting, and multilingual content. Many languages still do not receive the same level of OCR accuracy as English, which creates additional barriers for publishers and organizations in developing countries.

The result is that accessible book production often requires enormous human effort. After OCR conversion, teams must spend a lot of time proofreading text and correcting recognition errors manually. This becomes even more time-consuming for long textbooks and academic publications.

However, text conversion is only one part of the accessibility challenge.

Creating accessible publications also requires proper document structure. Headings must be identified so that screen reader users can navigate easily. Lists, tables, and page numbers must be marked correctly. Different languages appearing inside the same document should be tagged properly so assistive technologies pronounce them correctly and they are converted to the correct braille representation. Metadata such as title, author, keywords, language, and summary should also be added to improve discoverability and usability.

In reality, many accessible books still fall short in these areas. Navigation is often poor, headings are inconsistent, metadata is missing, and language markup is rarely included. Image accessibility remains one of the biggest gaps. Writing meaningful image descriptions requires both subject knowledge and accessibility expertise, making it a difficult and costly task. As a result, image descriptions are frequently omitted entirely or reduced to vague text that provides little value to blind, low vision or dyslexic readers.

All of this increases the cost and time required to create accessible publications, limiting the number of books that organizations can produce.

Now, Artificial Intelligence is beginning to change that landscape.

The DAISY Consortium is an international not-for-profit organisation with thirty years of expertise in accessible publishing standards and tools. Since May 2025, now more than a year ago, DAISY has been working with organisations that produce accessible textbooks and educational materials for learners with visual impairment, conducting active research into how modern AI technologies can simplify and accelerate the production of accessible publications for people with print disabilities, with a continuous feedback loop driving ongoing improvement.

To explore these possibilities, DAISY developed Fido, a software application designed to prototype different approaches to AI-assisted accessible publishing. Fido enables partner organisations to evaluate a range of leading AI services, including OpenAI, Google Gemini, Claude, Mistral, and others, without requiring deep technical expertise. Crucially, rather than asking users to adopt unfamiliar workflows, Fido integrates directly with the software they already use, keeping the experience simple and accessible.

What sets Fido apart from generic AI tools is the depth of accessibility knowledge embedded within it. DAISY has invested considerable effort in prompt engineering and workflow design specifically for accessible publishing tasks, drawing on decades of expertise. This means Fido can produce significantly higher quality outputs than off-the-shelf AI tools used without that specialist knowledge, and the year-long active research programme has allowed those prompts and workflows to be continuously refined through real-world feedback from partner organisations.

Fido can convert scanned or image-based PDFs into structured Word documents while preserving headings, lists, tables, images, and even mathematical content. It can automatically generate image descriptions, analyze heading structure, detect multiple languages, create metadata, and prepare documents for accessible formats such as EPUB and DAISY books.

Importantly, the goal is not to replace human expertise, but to reduce repetitive manual work dramatically.

Tasks that once took several days can now often be completed in a few hours. This is not a theoretical claim, but a consistent finding from more than a year of active research with partner organizations. Human review remains essential, because AI systems can and do make mistakes, but the reduction in repetitive manual effort has been substantial and measurable.

Fido is already being used by DAISY Consortium members and partner organizations working in multiple languages, including English, French, Spanish, Hindi, and Arabic. Feedback has been especially strong from organizations producing accessible educational materials for learners with blindness, low vision, and other print disabilities.

Yasmine Youssef, an accessibility specialist and trainer based in Egypt, says Fido has helped streamline production across countries, languages, and multilingual publications:

“FIDO has proven to be a very helpful tool for speeding up the production workflow. We have successfully used it in different countries, including Jordan and the Dominican Republic, and with different languages such as Arabic and Spanish. We have also used it with multilingual documents, including bilingual Spanish-French publications. Overall, FIDO has helped streamline the production process and has demonstrated strong performance across different languages and publishing contexts.”

Similar results are being reported by organizations working in South Asia, where both speed and quality have improved significantly.

Another important consideration is the accessibility of the tool itself. Fido integrates directly with Microsoft Word and is designed to fit into existing accessible publishing workflows. It generates files in open, standard formats that work with tools organizations already rely on, including Duxbury Braille Translator, Sao Mai Braille, BrailleBlaster, DAISY Pipeline, and WordToEPUB. This has allowed organizations to introduce AI assistance into their workflows without abandoning familiar tools or retraining staff.

Fido is available free of charge from the DAISY Consortium. Organizations can use their own AI service API keys, and DAISY can also help eligible partners obtain access to AI services. Fido also supports managed AI gateways, which are sometimes deployed by educational institutions.

The global shortage of accessible books has long been described as a “book famine.” Producing high-quality accessible publications has traditionally required specialized staff, expensive workflows, and substantial time investment. AI alone will not solve every challenge, and careful human review will always remain important. But tools like Fido demonstrate that AI can become a powerful assistive technology for publishers, libraries, educational institutions, and disability organizations.

Asoka Bandula, Chairman of the DAISY Lanka Foundation, says Fido has transformed accessible book production in Sri Lanka:

“FIDO has reduced work that once took three days to just three hours. It is not only drastically reducing the time needed to create accessible books, but also enhancing the reading experience for learners by enabling us to provide richer navigation and image descriptions. FIDO is also helping us overcome technological gaps, as OCR for our languages is not yet up to the mark.”

In India, the impact has been equally significant. Sangeeta Kannan, who leads the Digital Library and Braille & Large Print Unit at the National Association for the Blind in New Delhi, says Fido has dramatically shortened the path from print to accessible EPUB:

“We have always struggled to provide accessible formats to students on time. The journey from a print book to an accessible EPUB takes two months or more, because proofreading and formatting have to be done manually. Now, with FIDO, we are able to

complete the work in one week, as it does most of the work with high accuracy and my team only needs to verify the results and make minor changes."

AI will not solve the global book famine on its own. But the evidence from more than a year of hands-on research is clear: tools like Fido are already accelerating the production of accessible educational resources, lowering costs, and increasing the supply of accessible books for people who need them. These benefits are not just theoretical. They are being felt now by teachers, students, and the organizations that support them.

FIDO AI is available for all free of cost. Anyone can download the installer from the DAISY Consortium website - https://daisy.org/activities/software/fido/.

To find out more about Fido and DAISY's accessible publishing research, visit daisy.org/fidoai or the DAISY Consortium website. We welcome enquiries through our contact form.

About the Author

Prashant Ranjan Verma is a certified accessibility specialist, innovator, and trainer with over two decades of experience dedicated to the empowerment of persons with disabilities. Based in New Delhi, he serves as an accessibility specialist with the DAISY Consortium, a global organization focused on international accessibility standards. In addition to his international work, he is the General Secretary of the National Association for the Blind (Delhi) and has been recognized with multiple national-level awards for his contributions to inclusive technology and accessibility.

Playful Learning of Fundamental Technology Skills — Mrs Phia Damsma

Co-Founder / Creative Director Sonokids Australia, Immediate Past President South Pacific Educators in Vision Impairment, Australia

Introduction

Digital Technology provides an opportunity for everyone to participate equally and inclusively, regardless of a disability. Through inclusive education everybody should get the opportunity to develop Digital Literacy, as this is essential for education, social life, and (future) employment. Early introduction is preferable since this can help to ensure that children will be effective users of technology by the time they need it to access the education curriculum, particularly for subjects such as Science, Technology, Engineering and Mathematics (STEM).

Sonokids has specifically designed a suite of educational ('Ballyland') game software and apps that provide an accessible learning pathway for young learners with blindness and low vision. Ballyland supports their development of early keyboarding skills, touch gesture skills to navigate a mobile touch device, digital "grid" language with concepts of

rows and columns, spatial orientation on the touch screen, space science knowledge, data sonification and coding/computational thinking skills. While they are having fun with Ballyland, learners develop not only these important skills for the STEM curriculum, but a wide range of fundamental life skills and conceptual understanding as well. With Sonokids Ballyland, young learners can feel empowered through shared experiences with sighted siblings and friends, and get a head start in the use of mainstream technology.

This paper aims to share practice and tips from Sonokids' decades-long professional expertise. It aims to demonstrate that learners with blindness and low vision, when given the chance, the right tools, suitable technology, and effective education in context, have the ability to learn to use technology and other STEM subjects just as well as their sighted peers.

Early Introduction to Technology – Role of the Educator

To include a learner with blindness and low vision in digital skills development, at home and in the classroom, firstly adaptable devices and/or access technology have to be available. Learners with blindness or severe low vision may require the use of a so-called screen reader: software that reads out what is shown on the computer screen and supports navigating (interactive) texts and online content in a non-visual way, without the use of a computer mouse.

Once installed on a laptop or desktop computer, screen reader software such as JAWS or the free NVDA enables a person who is blind to access any type of content, follow links, edit and create content, communicate with others online, and participate fully in education and our digital society, by way of (combinations of) the keys on the QWERTY keyboard.

Similar screen reading software is built into Android (TalkBack) and Apple (VoiceOver) mobile touch tablets and can be personalised in the device's settings. Other settings such as background colour, font size, clarity and more can be adjusted for optimal access with low vision or other print disabilities. This high level of accessibility settings in mainstream touch devices such as tablets and smart phones, with applications for wayfinding, information searching, and communication, is a major societal development that has opened up endless opportunities for children with blindness and low vision to achieve their goals and reach their full potential.

However, to learn effective finger gestures, key-combinations, accessibility terminology and concepts, every learner needs guidance and active teaching. The reason for this is that these skills are not intuitive and don't come naturally. Learners with blindness and low vision generally have few or no opportunities for incidental learning, and don't have a visual example to copy or imitate. Finally, when learning new technology skills, unexpected and unwanted things may happen on the device due to a wrong or incorrect execution of a gesture or short-key combination. This can be a scary experience for

inexperienced technology users, and the supportive presence of the educator can alleviate any unnecessary anxiety. Clearly, the aim is to build learners' self-confidence around the use of technology.

There is no "one size fits all" approach to successful teaching of digital skills. The learner's functional vision, (developmental) age, abilities, cognition, fine motor skills, personal interests, level of agency, and motivation will impact the learning process.

In all cases, educators can strive to:

- Customise/Personalise access options where possible, using adjustable Settings for individual users
- Motivate the learner. Make the learning content relevant, find things he or she is interested in, use new learning in relevant contexts, and make learning fun.
- Have high expectations of each learner's ability and provide encouragement
- Be patient, and allow the learner sufficient time to process, practice, repeat, and consolidate skills before transitioning to other skills
- Be confident in their own digital skills

Sonokids® Ballyland™: Engaging, Supportive, Safe, Accessible and Educational

Sonokids is passionate about developing fun and educational accessible games, digital tools and software for young learners with blindness and low vision. Building technology skills takes time, and every learner will do this at his or her own pace. Skills need to be slowly built and scaffolded, and repeated and practiced as often as possible. Clearly, the aim is to build self-confidence around the use of technology. To encourage learners in this process, access to fun, supportive, and safe educational materials is invaluable. The award winning Ballyland suite of educational game software and apps is used with proven success by educators around the world. Ballyland game apps are not only fully accessible for blind users of all ages, and offer a safe learning space for digital skills development, but they are also fun! All apps are tested by children, parents and teachers, including those with blindness and low vision. Ballyland apps are self-voicing, with original stories, songs and sounds.



Figure 1. Sunny Ballyland landscape with from left to right: CosmoBally, Ballicopter, Tinkleball, Squeaky, Babballoony and Wheelie

'Ballyland' is a fictional, happy world in which all characters are shaped like a ball, the toy that the majority of children will be familiar with or can easily be introduced to. These characters, called the Ballylanders, each have their own signature sound, and way of moving around. For example, Ballicopter is a little red helicopter with a rotor on his head, who flies in the sky over Ballyland, and Wheelie is a blue ball on wheels who likes to race around (and often crashes into things). Most learners quickly pick a favorite Ballylander and enjoy transitioning through the suite of educational games with these familiar sounds, songs, and stories. While having fun, they are developing essential STEM skills.

Preparation and Support for Technology Use: "Unplugged" and Tactile Learning

Effectively and efficiently interacting with a computer or a mobile device requires more than pure technical skills to control and navigate them. For example, teaching a basic finger gesture such as a "swipe from right to left" requires spatial orientation, fine motor skills, finger isolation and conceptual understanding of directional concepts. What is left and right, up and down, fast and slow, soft and loud? Skills such as these can be taught "unplugged": using tactile tools, musical instruments and activities such as tapping slowly or quickly, lightly or heavily on a table top, and using a tactile place mat for orientation.

Being able to explore the Ballylanders through touch contributes to children's engagement with the digital characters and ultimately benefits their learning.

On the Sonokids website blackline images (pdf files) for each Ballylander can be downloaded for free. These can be made into 2D raised line drawings, or tactile colouring pages, by printing the files with a Piaf, using swell paper. If you have access to a 3D printer, you can download free 3D print files of the Ballylanders. These are very popular as it really gives learners a good impression of the Ballylanders' physical features. The 3D printed Ballicopter is particularly useful as tactile learning tool with the Ballyland Rotor

app. Learners can practice turning Ballicopter's rotor on the model and then replicate this motor skill onto the touch screen to turn the virtual rotor.

Finally, it is highly recommended to support digital learning in the Ballyland Code Challenges with a tactile game grid, targets and obstacles. The 3D printed Ballyland tactile grid and mini moveable Ballyland characters and 'obstacles' have been specifically designed for use with the Ballyland Code apps and can be purchased from the Sonokids website. Educators can also create tactile support materials, like tactile grids, obstacles and 'characters' with everyday objects such as a toy car, little ball, wikki stix or pipe cleaners, cut-out shapes from cardboard, plastic lids from bottles, etc. Be creative!

Overview of the Ballyland Suite of Educational Game Software and Applications

Please refer to the Sonokids website sonokids.org for more information, instructions, and video tutorials about the Ballyland software and apps.

Most of the Ballyland software and apps are suitable for use by learners from 4 or 5 years of age. Due to circumstances and abilities, some children may access them at a much later age and will still find great benefit and engagement. For this reason, no specific age recommendations are provided with the apps. The pdf file '2026 Overview Skills Development through Ballyland Apps' was published to assist educators in selecting the apps best suited for their learners. This can be downloaded from https://www.sonokids.org/ballyland-early-learning/

Note: Ballyland educational game apps for Android and iOS tablets are compatible with smart phones. However, Sonokids recommends where possible to use tablets as the larger screen makes for an easier and better learning experience for young learners. Aiming to removing access barriers for learners through technology, Sonokids has also chosen to make sure that the software, apps and learning tools are affordable for all, even offering two of the apps for free. A list of all apps can be found on the Sonokids website.

Ballyland Early Keyboarding Software for PC

For MS Windows. Designed for use with a standard English language QWERTY keyboard. Find tips, instructions, and video tutorials on the sonokids.org website.

Ballyland Early Keyboarding is unique software, specifically designed to enable young learners to independently explore and play on a computer keyboard, developing foundation keyboarding skills and keyboard 'mapping' skills in the process. These skills will greatly benefit children's future use of computer technology. In the 'Any Key Goes' level, the keys of the keyboard don't do their normal thing: instead, they produce engaging sounds, songs and stories. Freely exploring this 'landscape' of sounds on the keyboard, learners start to understand basic computer interaction: that different keys do different things, but pressing the same key twice will twice have the same outcome. They develop fine motor skills and memorise the position of certain keys and have

demonstrated to quickly learn where to find specific keys without being able to see the keyboard.

The sounds are not based on an alphabetic structure, which makes Ballyland very special. It was designed for young learners, with no literacy skills. However, the sounds are not randomly chosen. They are all familiar, everyday sounds. Also, to help learners to create a ‘mental map’ of the computer keyboard without sight, categories of sounds/images correspond with categories of keys.

Another special design feature that supports learning by children with blindness and low vision is that the signature sounds of the Ballylanders are assigned to five keys that have been identified to be important for future navigation with screen reader software such as JAWS or NVDA. These are the Escape key (Babballoony), Spacebar (Ballicopter), Enter key (Tinkleball), left Arrowkey (Squeaky), and right Arrowkey (Wheelie). The so-called Key Games in the program introduce learners in a playful way to how these particular keys function in a formal computer environment. For example, in Ballicopter’s Key Game (where you need to find a duck!), you press Spacebar to make the helicopter land and press the same key again to make Ballicopter take off again. This simulates how in a formal setting, Spacebar can toggle a setting on and off.

Due to its clever and user-friendly design, Ballyland Keyboarding software benefits and engages children with a wide range of disabilities and learning difficulties, as well as learners from a non-English background. The meaning of each sound is spoken out loud and they can anticipate or repeat the words to develop English language literacy. It is suitable for use from around 3 years of age.

On the Sonokids website you can register for a free trial version that includes the Any Key Goes level (where every key produces a sound, song, or story) and Ballicopter's Key Game (spacebar). It can be opened and played three times. Full Individual and Group User Licenses are for purchase on the website.

I’m using Ballyland with a little boy who is blind in preschool. He LOVES the stories and songs on the numbers (lots of dancing involved) and it is really helping him to get both hands on the computer to explore, rather than just one. Interestingly he uses a Large Print keyboard in preschool but a regular QWERTY at home. He is able to move between the two, finding the keys he is interested in.

Access Technology Consultant, Australia

Ballyland applications for Android and iOS (Apple) mobile touch devices

Get the Ballyland apps from the Google Play Store or Apple App Store. For more information, visit the Sonokids website at sonokids.org

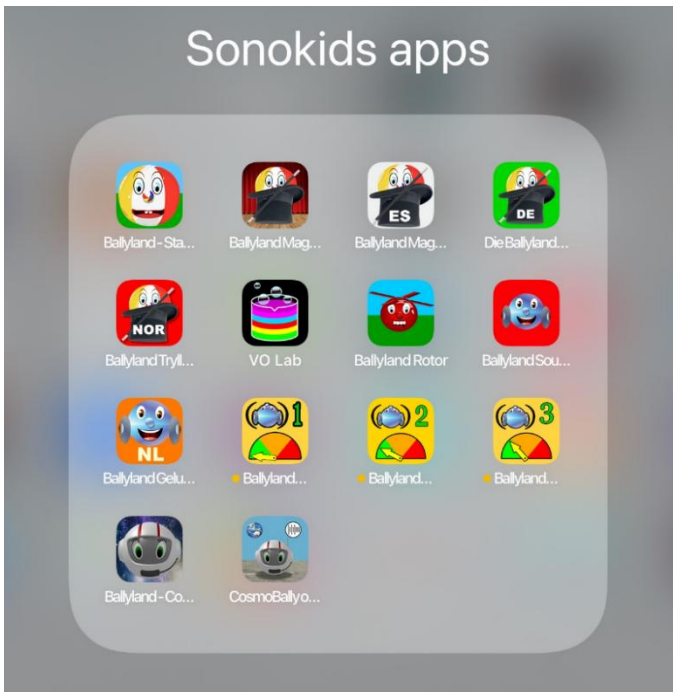


Figure 2: Overview of Sonokids Ballyland apps

Ballyland Stay Still, Squeaky!

Currently only available for iOS/iPad.

‘Ballyland Stay Still, Squeaky!’ is the perfect first introduction to touch screen devices for all, while being specifically designed for young learners with blindness and low vision. The interactive story teaches basic iPad skills through cause and effect, while the Bonus Game builds spatial awareness on the screen. Learners with little or no previous technology experience can use two simple, ‘informal’ gestures, 'touch' (with any number of fingers) and 'swipe' to independently move through the fun adventure of Squeaky, the bouncy ball from Ballyland. Squeaky tries really hard to stay clean for a visit to his grandmother. But as learners are encouraged to interact and touch the screen, Squeaky keeps getting dirtier and dirtier... The story offers great sound effects, and bright, simple images and animations.



Figure 3: Young girl enjoying playing and learning with Ballyland Stay Still Squeaky!

The Bonus Game uses ‘touch and hold’ to direct Squeaky on five routes to collect now familiar types of dirt in a specific order. This is a great way to playfully develop finger drag skills and spatial awareness on the screen.

‘Stay Still, Squeaky!’ is a wonderful resource for learning the basics of using a touch screen device and a variety of early learning skills, promoting independence and empowerment for users with visual impairments.

H.K. on Wonderbaby dot org

Ballyland Magic Plus

Designed for iPads (iOS) and Android tablets.
This popular app teaches fundamental skills for the inbuilt screen readers on Android tablets (TalkBack) and iOS iPads (VoiceOver). Also available in Norwegian, Spanish, and German versions.

Ballyland Magic Plus is a fun game that gives learners a head start to using an iPad or Android mobile touch screen device by way of the built-in screen reader. The four multi-level scenes of Ballyland Magic Plus follow the Ballylanders in their preparations for a performance in a Magic Show. While they play and interact with the Ballylanders, children practice their own 'magic' touch gestures, and accessibility concepts for access technology on touch screen devices: finger drag, split tap, double tap, single finger flick left/right, and three finger flick left/right. When they have mastered all the required touch gestures, they are put in charge of the Ballyland Magic Show!

The app offers a fun and supportive learning experience. Although it has been demonstrated that the app can be used independently, active guidance and support may be required to help the learner perform the touch gestures correctly and achieve the best learning outcomes. To assist with this process, dynamically updated score-data and clear, short instructions are provided throughout the app.

Tapping along in sync with the rhythm of the original ‘Tap Tap’ song is a fun way for learners to develop the correct timing and speed for the important ‘double tap’ gesture on the touch screen.

VO Lab

Currently only available for iOS/iPad.
VO Lab is an iPad game designed for teenagers and older students to learn and practice basic navigational touch gestures for VoiceOver, Apple’s built-in screen reader on iOS devices. It is a ‘more mature’ alternative for Ballyland Magic Plus, but teaches the same skills.

In the four multi-level stages of the VO Lab app, you follow the directions of the strange professor in his unusual chemistry lab, where he undertakes a not quite scientific experiment, with fictional chemicals. You practice touch gestures while you move through the app. When you have mastered all of the required touch gestures, you will be put in charge of the final experiment!

Ballyland Sound Match

Designed for iPads (iOS) and Android tablets. Also available in Dutch version.
Ballyland Sound Match is a sound-matching audio game that challenges listening and memory skills. The game is engaging and fun for all and designed to particularly support learning by children with blindness and low vision. This makes it the perfect game to enjoy together with siblings, friends, and parents, especially with the “Black Curtain Challenge”!

While busy navigating the touch screen to locate, memorise and pair the matching sounds, children will discover the structure of the (adjustable) digital game grid as the self-voicing app announces rows and columns.

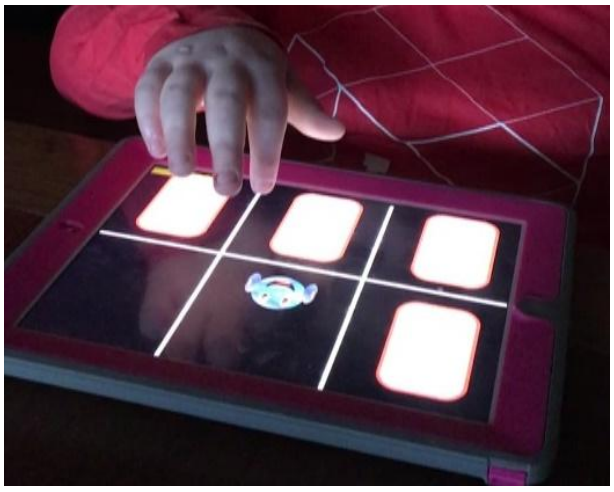


Figure 4 Boy playing Ballyland Sound Match in 3x2 game grid

“As a teacher, working with children around the world, I have witnessed how Ballyland apps allow children with and without a visual impairment to play and learn together. Ballyland Sound Match is not only a fun game, but it also helps children to acquire important skills preparing them for use of technology and mathematics."

Prof. Bogusław ‘Bob’ Marek, Ph.D. OBE, Founder of Hungry Fingers, Poland.

Ballyland Rotor

Only available for iOS/iPad

The ‘rotor’ is a handy but often overlooked finger gesture, a quick shortcut to change the settings in VoiceOver, the built-in screen reader on iPads. In the Ballyland Rotor game, the ‘rotor’ is aptly used to control the flight plan of Ballicopter, the little red helicopter from Ballyland. Every turn and finger flick, each step and decision along the way, decides how his adventure will unfold. This is also a fundamental coding concept, to be further explored with the three Ballyland Code apps. So, buckle up, and take control, using two fingers to expertly turn the rotor.

Ballyland Code Apps

‘Ballyland Code 1: Say Hello’, ‘Ballyland Code 2: Give Rotor’ and ‘Ballyland Code 3: Pick Up’. Designed for iPads (iOS) and Android tablets.
The audio-based Ballyland Code apps introduce learners to fundamental computational thinking and coding concepts and skills that will be applicable to any programming language. Too often learners with blindness and low vision are excluded from actively participating in coding lessons in the classroom. The Ballyland Code apps offer an inclusive activity. Not only are the interface and the coding panel accessible, but the coding output is too. Audio description and great audio effects are at the core of these innovative apps. Mini audio-plays explain the context of the three-level Coding Challenges, where correctly selected and sequenced coding commands are required to move a character to a target in the digital game grid. These apps are perfectly suited for inclusion in the Coding curriculum, Computational Thinking lessons, and Hour of Code activities.

“My student is in a fourth grade general education classroom that goes to computer class once a week and often participates in coding lessons. Without your Ballyland Code apps 1, 2, and 3 I would have nothing comparable to sites like code.org for her to participate in.”

Victoria, Teacher of Students with Visual Impairments

Ballyland™ CosmoBally™ in Space

Designed for iPads (iOS) and Android tablets. Free.
Ballyland CosmoBally in Space is a fun educational game that offers a simple introduction to the solar system, through the accounts of CosmoBally. She is an

astronaut, and the first Ballylander to fly in space. Responding to touch with audio feedback, the story is presented both visually as well as through real human voices, audio effects, and songs.

Using an informal ‘touch’ gesture, learners with little or no technology experience can independently move through the interactive story and listen to CosmoBally who is sharing her experiences in space with the resident Ballylanders in Ballyland. They have great questions for her, such as: ‘Can you breathe in fresh air out there in space?’ and ‘Which planet is the hottest?’ Explaining how some planets remind her of her friends in Ballyland, CosmoBally presents snippets of factual information about the Sun, the Moon and the planets in our Solar system. In the Bonus Game learners can use ‘finger drag’ and ‘touch and hold’ to find planets in a specific order along five routes to score points and establish radio connection with CosmoBally.

“The story itself, though based on the solar system, gives scope for teachers and learners to expand beyond this: PSHE theme of friendship, feelings (they miss CosmoBally), Science (air to breathe, telecommunication), Art and Design (organize a cosmic fashion show, build a transport that can be raced against Wheelie and use different terrains from the planet), the importance of turn taking and not being grumpy for being last, and the list goes on…”

Specialist Teacher, involved with testing ‘Ballyland CosmoBally in Space’.

CosmoBally™ on Sonoplanet™

Designed for iPads (iOS) and Android tablets. Free. Supported by South Pacific Educators in Vision Impairment (SPEVI Inc).

Cutting edge: Sonokids' second 'space' themed app is the first accessible educational game app introducing young learners with blindness and low vision to ‘sonification’. Lift off to Sonoplanet, where sonification has turned all information and data, including images, into non-speech sound**!** The four non-visual games in this app provide a treasure trove of learning opportunities within the STEAM education curriculum. The added A in STEAM stands for Arts, as this app can be used for creative activities, such as drawing pictures in sound. Students can actively develop an understanding of data sonification and in the process develop skills such as Listening, Orientation, Spatial awareness, Analytical thinking, Pattern recognition, Fine motor skills and more. Results from a survey under educators suggest surprising benefits of playing and learning with this app (Damsma, 2024). Sonification is used by professional scientists with blindness to access and work with original scientific data. Some young learners who may be struggling with alternative modes of accessing visual information have shown special affinity with this technology. We hope that you will try this with your learner too!

Sonokids Nonvisual eSafety Project

In the pipeline, for Android and iOS.

In 2025 Sonokids undertook research to see what, if any, extra challenges children with blindness and low vision face navigating the online world and staying safe online. We invited educators, parents and youth with blindness and low vision to share stories, bespoke resources tips, and concerns, with the aim to use the experience they have gathered in the education space, both professionally and personally, to identify the challenges these learners face and ultimately, consider creating a new app or tool to support eSafety. As a result of this research, we are currently working on the development of a Ballyland educational game app around eSafety. Please contact us if you are interested in participating or partnering in this project.

Ballyland Song Book

Sonokids Song Book 1, by The Ballylanders (free) - Streaming

Featuring 19 original Sonokids children's songs, familiar from Ballyland educational game apps, or brand new from the Ballyland Universe. Listen where you usually stream your music - search for "Sonokids".

Tip: After playing and learning with Ballyland CosmoBally in Space, stream the 'Planets Song' from this album to reinforce the order of the planets in their distance to the Sun.

Conclusion

With so many apps to choose from, it is hoped that this paper encourages educators to introduce young learners to technology. When given the right tools, technology and education, within a motivating and engaging context, learners with blindness and low vision can be just as capable of using computer technology as their sighted peers. With Sonokids' 'Ballyland' suite of educational game software and apps the process of learning essential digital skills for access to Science, Technology, Engineering, and Mathematics education, can easily become fun. Ballyland facilitates early introduction to technology and supports young learners to take fundamental first steps on their pathway to achieving their goals and dreams.

Reference

Damsma, P. (2024). Hearing a circle: An exploratory study of accessible sonification for young children with blindness and low vision. *British Journal of Visual Impairment*, 43(3). https://doi.org/10.1177/02646196241253534).

Blind and Visually Impaired Students and the Need for Digital Literacy in Higher Education — Kassahun Yibeltal Sahilu, PhD

Background

The rapid expansion of digital technology has transformed higher education, making digital literacy an essential competency for academic success. However, discussions about digital literacy often focus on mainstream users and overlook the unique experiences of blind and visually impaired students. This article examines digital literacy from the perspective of blind students in higher education and highlights the critical role of assistive technology in enabling their participation and success. Drawing on relevant literature and insights from blind students and university personnel at George Mason University, the article argues that blind students face a dual challenge: mastering assistive technology while simultaneously developing the advanced digital competencies required in higher education. The article concludes with recommendations for universities, technology developers, educators, and policymakers to promote inclusive digital transformation.

Introduction

Discussions about the digital age and its implications are often centered on mainstream technology and typical users. Such discussions rarely consider the diverse needs of specific social groups affected by technological advancement. In reality, the impact of digital technology varies significantly across populations, creating differences in access, opportunities, challenges, and benefits.

Blind and visually impaired individuals are both positively and negatively affected by technological developments. Yet public discourse tends to emphasize the experiences of sighted users. For example, when people think about smartphones, they typically focus on visual interaction—how users see and navigate screens—rather than non-visual interaction through screen readers and audio output. This reflects a broader tendency to overlook blind and visually impaired users in discussions of digital innovation.

The situation is similar in higher education. While digital literacy has become indispensable to academic success, little attention has been given to how blind students acquire and use these skills. This article shifts the perspective by examining digital literacy through the experiences of blind and visually impaired students in higher education.

The purpose of this article is to demonstrate the importance of digital literacy for the success of blind students in colleges and universities. To illustrate the discussion, the article incorporates insights from two blind students, an associate professor, and a program coordinator at George Mason University. Although the sample is not large enough for broad generalization, these experiences provide valuable perspectives on the

opportunities and challenges faced by blind students in today's digital learning environments.

Digital Literacy and Its Role in Higher Education

Educational technology has become central to teaching and learning, particularly in higher education. Effective participation in contemporary colleges and universities increasingly depends on the ability to navigate digital environments (Rahman, 2020). Currently, higher education is trying to align itself with the requirements of the digital age. Digital competence and digital literacy are understood to promote an effective teaching and learning environment (Ličen & Prosen, 2024). Consequently, digital literacy has emerged as a fundamental competency.

What Is Digital Literacy?

Digital literacy has been defined as:

"The ability to use digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, create, and communicate information in order to function in a knowledge society" (New Zealand Government, 2005).

This definition encompasses both basic technological skills and higher-order cognitive abilities such as evaluating, synthesizing, and analyzing information. These advanced competencies are especially important in higher education, where students are expected to engage in inquiry, critical thinking, and knowledge production.

According to Ng (2012), digital literacy comprises technical, cognitive, and social-emotional skills that enable individuals to use digital technologies effectively, think critically about digital information, communicate appropriately in online environments, and address technology-related problems. Ng's characterization of digital literacy can be broken down into three distinct elements:

Technical skills: The operational ability to use digital technology effectively.

Cognitive skills: The ability to develop critical thinking, as well as evaluating, creating, and understanding digital information.

Social-emotional skills: The ability to communicate appropriately, responsibly, and safely in digital environments.

Similarly, Tejedor et al. (2020) conceptualize digital literacy as a multidimensional construct comprising interconnected competencies needed to participate effectively in contemporary digital environments. Jones and Hafner (2012) further emphasize that digital literacy extends beyond technical proficiency to include the ability to engage creatively in social practices, construct digital identities, and maintain meaningful relationships through digital media.

Thus, digital literacy extends beyond operating computers, smartphones, or tablets. It involves using digital technologies strategically and critically to support academic learning, research, communication, and professional development.

Importantly, higher education requires students to move beyond everyday technology use. Students may be proficient in social communication and information sharing but still struggle to employ technology effectively for academic purposes. Even so-called "digital natives" require explicit instruction in the educational uses of technology (Ng, 2012). Digital literacy has therefore become foundational to effective participation in academic, professional, and civic life in the twenty-first century.

United Nations action on Digital Technology

The United Nations has undertaken several initiatives to promote and protect the rights of persons with disabilities. One of its most significant policy measures is the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), which was adopted in 2006.

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) is highly relevant to the discussion of digital technology and inclusive higher education for two main reasons. First, the Convention contains explicit provisions relating to access to information and communication technologies. These provisions are reflected in the Preamble, paragraph (v), Article 3(f), Article 4(1)(f), (g), and (h), Article 9(g), and other related articles that promote accessibility and the elimination of barriers to information and communication. Second, the Convention recognizes education as a fundamental right of persons with disabilities under Artcle 24, which encompasses all levels of education, including higher education. Article 24(5) specifically provides for equal access to tertiary education, vocational training, adult education, and lifelong learning, while emphasizing the provision of reasonable accommodation to ensure meaningful participation.

Therefore, the Convention serves as an important framework for promoting inclusive higher education and developing digital technology policies that support accessibility. The inclusion of blind and visually impaired students in higher education can be achieved more effectively through the implementation of inclusive digital technology policies grounded in the principles and obligations of the UNCRPD.

Digital Literacy: How Can Blind and Visually Impaired Students Achieve It?

Given that effective learning in modern higher education is essentially intertwined with digital spaces, blind students must achieve full mastery of assistive and mainstream educational technologies. One key strategy for helping them achieve reliable digital literacy skills is to intentionally incorporate modern digital technology throughout the education of blind students (El Koshiry et al., 2024). This skill enhancement process should start early in their educational journey and continue into higher education. For

blind and visually impaired students, digital literacy must always be understood in close relation to assistive technology.

Assistive technology refers to tools and systems designed to enhance the functional capabilities of individuals with disabilities. The U.S. Technology-Related Assistance Act (1988) defines assistive technology as:

"Any item, piece of equipment, or product system, whether acquired off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities" (Cook et al., 2020).

Similarly, the World Health Organization (2001) defines assistive technology as:

"Any product, instrument, equipment or technology adapted or specially designed for improving the functioning of a disabled person" (p. 180).

Examples include screen readers such as JAWS and NVDA, screen magnification software, refreshable Braille displays, optical character recognition (OCR) tools, and accessible mobile applications.

For blind students, mastering assistive technology is often a prerequisite for participating in the digital environments of higher education. Unlike their sighted peers, blind students frequently face a dual challenge:

- They must acquire deep operational proficiency in assistive technologies themselves.
- They must seamlessly use these technologies to develop the advanced cognitive and digital competencies required for academic research, communication, collaboration, and critical inquiry.

Learning assistive technology is not a simple process; it requires time, dedicated training, continuous practice, and persistence. Economic barriers and unequal access to updated technology can further complicate this acquisition process. Nevertheless, assistive technology serves as an indispensable bridge between blind users and the digital world, enabling access to educational resources, communication, employment opportunities, and social participation.

Accessibility Challenges in Higher Education

Despite significant technological progress, numerous systemic barriers continue to limit the educational experiences of blind students. Common accessibility challenges include:

- Websites that fail to comply with international accessibility standards (such as WCAG).
- Learning Management Systems (LMS) that are not fully compatible with modern screen readers.
- Poorly formatted source documents, including scanned PDFs lacking underlying text or OCR functionality.

- Specialized academic applications and software lacking robust accessibility features.
- Digital course content designed without consideration for assistive technology users.

These barriers are often not caused by technological limitations, but rather by inadequate design practices and limited awareness of digital accessibility principles among academic staff. Accessibility should therefore be viewed not as an optional enhancement or an afterthought, but as an essential, non-negotiable component of inclusive education.

Experiences of Blind Students in Higher Education

The experiences shared by blind students at George Mason University illustrate both the profound opportunities and persistent challenges associated with digital technology.

The students reported that technology significantly enhanced their independence and academic performance. Through assistive technologies, they were able to:

- Access course materials synchronously with their peers.
- Conduct academic research independently.
- Complete and submit assignments.
- Participate fully in online and face-to-face classes.
- Take examinations securely.
- Communicate effectively with instructors and peers.
- Use generative artificial intelligence tools when appropriate.

One participant emphasized:

"Digital technology is absolutely essential in higher education. It allows us to access materials and achieve our academic goals."

At the same time, participants noted persistent challenges related to inaccessible applications, inconsistently designed university websites, and specialized research databases that do not adequately support screen readers. These experiences suggest that technology can promote true educational equity, but only when institutional accessibility is systematically prioritized.

Artificial Intelligence and Assistive Technology

The introduction of artificial intelligence (AI) has been a remarkable innovation impacting all spectrums of human life, and education is no exception. The technology has significantly altered contemporary teaching and learning methodologies (Mourtajji & Arts-Chiss, 2024). AI is also increasingly shaping accessibility and educational participation. Blind and visually impaired students have already begun enjoying the benefits of generative AI. So impressed with its utility, one research participant in a recent study described ChatGPT as “the king of knowledge” (Adnin & Das, 2024).

Opportunities

AI offers several promising possibilities for visually impaired academics:

- Converting complex visual information into highly descriptive text.
- Improving real-time OCR and document remediation workflows.
- Interpreting mathematical images, diagrams, graphs, and charts.
- Reducing structural barriers traditionally associated with visual-heavy course content.
- Enhancing independent learning, self-tutoring, and research productivity.

Challenges

However, AI also presents critical limitations that must be addressed:

- AI-generated visual descriptions may contain hallucinated details or critical inaccuracies.
- Core accessibility considerations are not consistently integrated into the user interfaces of emerging AI systems.
- Errors in AI interpretation can negatively affect independent learning outcomes if left unverified.
- Unequal economic access to advanced, premium emerging AI models may widen existing educational disparities.

Overall, AI represents both an unprecedented opportunity and a distinct challenge. Its ongoing development and deployment within higher education must intentionally prioritize inclusivity and universal design.

Conclusion and Recommendations

Digital and assistive technologies have fundamentally transformed the educational experiences of blind and visually impaired students in higher education. They have expanded access, strengthened individual student independence, and enhanced opportunities for long-term academic success.

However, meaningful participation in the digital age requires more than simply handing a student a device. Blind students often face the demanding dual task of mastering complex assistive technologies while simultaneously developing the advanced digital literacy skills demanded by modern university curricula. Creating genuinely inclusive learning environments requires a collective, active commitment from universities, educators, policymakers, and technology developers alike.

Recommendations

1. **Universities** should adopt, monitor, and strictly enforce digital accessibility standards across all internal platforms, procurement pathways, and instructional materials.
2. **Technology Developers** should natively integrate universal accessibility principles into the design of digital learning products and software from the absolute outset.
3. **Faculty and Staff** should receive ongoing institutional training in inclusive teaching methodologies and accessible document creation.
4. **Blind and Visually Impaired Students** should be provided with timely, well-funded access to specialized assistive technology training and dedicated technical support services upon enrollment.
5. **Artificial Intelligence Systems** should incorporate alt-text generation and screen-reader compatibility as core design principles rather than secondary features.
6. **Policymakers and Advocacy Organizations** should collaborate to promote equitable financial access to cutting-edge digital technologies and personal assistive devices.

Ensuring digital accessibility is not merely a technical box to check; it is a profound matter of educational equity, civil rights, and social justice. Inclusive digital transformation must ensure that no student is left behind.

References

Adnin, R., & Das, M. (2024). “I look at it as the king of knowledge”: How blind people use and understand generative AI tools. In *Proceedings of the 26th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '24)* (October 27–30, 2024, St. John's, NL, Canada). Association for Computing Machinery. https://doi.org/10.1145/3663548.3675631

Cook, A. M., Polgar, J. M., & Encarnação, P. (2020). *Assistive technologies: Principles and practice* (5th ed.). Elsevier.

El Koshiry, A., Eliwa, E., Abd El-Hafeez, T., & Tony, M. A. A. (2024). Effectiveness of a cloud learning management system in developing the digital transformation skills of blind graduate students. *Societies, 14*(12), Article 255. https://doi.org/10.3390/soc14120255

Jones, R. H., & Hafner, C. A. (2012). *Understanding digital literacy: A practical introduction*. Routledge.

Ličen, S., & Prosen, M. (2024). Strengthening sustainable higher education with digital technologies: Development and validation of a digital competence scale for university teachers (DCS-UT). *Sustainability, 16*, Article 9937. https://doi.org/10.3390/su16229937

Mourtajji, L., & Arts-Chiss, N. (2024). Unleashing ChatGPT: Redefining technology acceptance and digital transformation in higher education. *Administrative Sciences, 14*(12), Article 325. https://doi.org/10.3390/admsci14120325

New Zealand Government. (2005). *The Digital Strategy: Creating Our Digital Future*. Ministry of Economic Development. https://www.mcguinnessinstitute.org/wp-content/uploads/2021/04/108.-Digital_Strategy_Creating_Our_Digital_Future_2005.pdf

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education, 59*(3), 1065–1078. https://doi.org/10.1016/j.compedu.2012.04.016

Rahman, M. M. (2020). Impact of digital technology in higher education: Perspective from Bangladesh. *International Journal of Research in Business and Social Science, 9*(5), 318–325. https://doi.org/10.20255/ijrbs.v9i5.815

Spante, M., Sofkova Hashemi, S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education, 5*(1), Article 1519143. https://doi.org/10.1080/2331186X.2018.1519143

Tejedor, S., Cervi, L., Pérez-Escoda, A., & Tusa Jumbo, F. (2020). Digital literacy and higher education during COVID-19 lockdown: Spain, Italy, and Ecuador. *Publications, 8*(4), Article 48. https://doi.org/10.3390/publications8040048

United Nations. (2006). *Convention on the Rights of Persons with Disabilities*. https://www.un.org/disabilities/documents/convention/convention_accessible_pdf.pdf

World Health Organization. (2001). *International classification of functioning, disability and health (ICF).* World Health Organization.

The Role of Emerging Digital Tools for Students with Visual Impairment at the University of Dar es Salaam (UDSM) — Mashukura Habibu Kabwogi

Transcriber and Assistive Technology Instructor, University of Dar es Salaam, The United Republic of Tanzania

Abstract

This article examines the role of emerging digital tools for students with visual impairment at the University of Dar es Salaam (UDSM). Specifically, the article seeks to identify emerging digital tools used by UDSM students with visual impairment; demonstrate the contribution of emerging digital tools to the learning experiences of UDSM students with visual impairment; analyse challenges affecting the utilization of emerging digital tools among UDSM students with visual impairment; and highlights measures undertaken by UDSM to empower students with visual impairment to effectively use emerging digital tools for their learning success. To obtain the desired information, the researcher selected

the UDSM to be a case example institution. The article identifies that emerging digital tools such as computers, digital Braille note takers, screen readers, Optical Character recognition software, screen magnification software, smartphones, and digital voice recorders were among the most commonly used technologies at UDSM. It is further indicated that with the advent of these digital tools, many students with visual impairment are inspired to use them in performing their learning activities. The article further establishes that emerging digital tools significantly enhance academic independence, access to educational resources, communication, and participation in learning activities. The article concludes that emerging digital tools play a critical role in enhancing educational inclusion for students with visual impairment at UDSM. Increased investment in digital tools, reliable internet connectivity, institutional support, and digital literacy training are essential to maximizing the effective use of these technologies by students with visual impairment at UDSM.

Keywords: Accessibility, emerging digital tools, UDSM, students with visual impairment

Introduction

In this modern era, university education has been digitized, where many courses are delivered through digital learning platforms, online resources, electronic libraries, and virtual communication tools. While these innovations have improved educational access for many university learners, they cause an obstacle for students with visual impairment as they face significant difficulty in accessing visual presentations, diagrams, and other conventional educational resources. For instance, students with visual impairment may experience barriers in accessing digital learning platforms, electronic library resources, online assessments, multimedia content, PowerPoint presentations, PDF documents, scanned handouts, and other visually presented information. These barriers may limit their participation in learning activities unless accessible digital tools are provided. This study therefore examines the role of emerging digital tools for students with visual impairment at UDSM.

Background to the study

Historically, students with visual impairment relied heavily on Braille materials and human readers only to access educational materials. While these approaches provided valuable support, they often limited students' independence and their ability to access current information efficiently. However, the emergence of digital tools powered by accessibility features has significantly reduced this dependence by enabling students with visual impairment to access information independently (Elshaer, AlNajdi, & Salem, 2025; Kisanga, 2025).

In this article, emerging digital tools refer to newly developed or continuously evolving digital technologies equipped with accessibility features that support students with disabilities particularly those with visual impairment. Emerging digital tools may include computers, smartphones, tablets, digital Braille devices, audio-based learning tools,

screen readers, magnifiers, video conferencing tools, cloud-based applications, electronic communication platforms, OCR applications, online learning platforms, as well as artificial intelligence applications (Elshaer, AlNajdi, & Salem, 2025; Kisanga, 2025; Tuttle & Carter, 2022).

In recent years, the emergence of digital tools has revolutionized how students with visual impairment learn by offering them greater independence in accessing educational resources. According to Goyal (2025), emerging digital technologies expand educational opportunities by enabling learners with visual impairment to access online information and engage effectively with complex academic subjects like science, mathematical calculations, and computations. Thus, for students with visual impairment, the use of emerging digital tools is no longer optional; it is a necessity for their educational success.

The use of emerging digital tools in supporting students with disabilities particularly those with visual impairment is anchored in various international and national policy frameworks that uphold the right to inclusive, equitable, and sustainable education for all. At the international level, the World Intellectual Property Organization (WIPO), World Wide Web Consortium (W3C, 2.2), publications from United Nations Educational, Scientific and Cultural Organization (UNESCO), as well as guidance from World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) collectively emphasize the responsibility of educational institutions to ensure access to information, participation, and interactive learning environments for students with disabilities, particularly those with visual impairment (UNESCO, 2021; WHO & UNICEF, 2022; WIPO, 2013; W3C, 2023) .

In Tanzania, these commitments to equitable access are articulated in the national Digital Education Guidelines for Universities, the national Digital Education Strategy, the UDSM Policy on Disability, and the 2050 Tanzania Development Vision. All of these underscore the role of digital solutions in advancing educational accessibility (Tanzania Ministry of Education, Science and Technology, 2025a; 2025b; Tanzania National Planning Commission, 2025; University of Dar es Salaam, 2022).

Collectively, the international agreements, standards, and policy frameworks have provided the foundation of educational inclusion globally. For instance, they have contributed to the rapid invention of various digital devices, software, and emerging artificial intelligence powered accessibility solutions which have enhanced more equitable learning for students with disabilities, including those with visual impairment (Elshaer, AlNajdi, & Salem 2025; Kisanga, 2025).

The implementation of these international agreements, standards, and policy frameworks varies across countries. For example, Canada through the Canadian National Institute for the Blind (CNIB) introduced accessible technology programs to facilitate access to tactile graphics, refreshable Braille displays, and AI-powered reading technologies for students with visual impairment (Ostrowski, 2016). Similarly, the University of Toronto provides accessible course materials in formats compatible with screen readers, ensuring online

learning platforms comply with web accessibility standards and offering alternative formats for documents that are not accessible.

The United Kingdom has strengthened access to digital technologies through its national health and social care systems, ensuring that students with visual impairment can obtain appropriate devices and support services. Many United Kingdom universities implement Universal Design for Learning (UDL) principles, offer institutional licenses for screen readers, and provide training and technical support for students with visual impairment in using immerging digital tools such as real time captioning, object recognition apps, smart audio navigation, and smart tactile graphics systems. Furthermore, the Allowance for the UK students with disabilities provide government funded access to high-tech digital tools, including refreshable Braille displays, magnification devices, OCR software, and note taking technologies, thereby reducing economic barriers that many students face (Montenegro-Rueda, Fernández-Batanero, & Fernández-Cerero, 2023).

In South Africa, the University of Cape Town and the University of Johannesburg have established comprehensive Accessible technology centres and disability resource units that provide training, repair services, and individualized support for students with visual impairment. These Disability Units are equipped with Braille embossers, computers installed with screen reading software, magnification stations, DAISY readers, and specialized support personnel for students with visual impairment (Mohlaloga, Pillay, & Pretorius, 2025).

In Tanzania, UDSM through its Centre for Disability Services (CDS) has adopted the use of emerging digital tools such as the Orbit Reader 20, Braille Note Touch+, Braille Sense, computers installed with the NVDA screen reader, and reading magnifying devices for students with visual impairment. These digital tools help students with visual impairment in accessing electronic educational resources and participating in academic activities conducted digitally. To progress this agenda, UDSM initiated the university's disability policy in 2022. The policy recognizes that the accessibility of electronic information and communication technologies is essential for inclusive education (University of Dar es Salaam, 2022). Kisanga (2025) theorizes that UDSM policy on disability emphasize the need to improve access to digital resources for students with disabilities, particularly those with visual impairment.

The Purpose of the Study

The purpose of this study was to examine the role of emerging digital tools for students with visual impairment at UDSM.

Specific Objectives

1. To identify emerging digital tools used by UDSM students with visual impairment;
2. To demonstrate the contribution of emerging digital tools to the learning experiences of UDSM students with visual impairment;

3. To analyse challenges affecting utilization of emerging digital tools among UDSM students with visual impairment; and
4. To highlight measures undertaken by the UDSM to empower students with visual impairment to utilize emerging digital tools for their learning success.

Research Methodology

Research approach

This study employed a qualitative research approach, which enabled the researcher to obtain in-depth understanding dynamics of using emerging digital tools among students with visual impairment at UDSM.

Research design

The study adopted a single case study design to explore one group of students, referred to as students with visual impairment, who were affected by the emergence of digital tools when accessing their learning within a specific institutional context. UDSM was selected because of its long-standing commitment in supporting students with disabilities including those with visual impairment.

Study context

The journey of UDSM in serving students with disabilities has a long history since the establishment of the Special Needs Education Unit during the 1978/79 academic year. This Unit later became the Centre for Disability Services in 2022. At first, the university served two students with visual impairment who registered there. From then onwards, the UDSM continued to serve various students with visual impairment and those with other disabilities.

Sample size and sampling techniques

The study involved 35 students with visual impairment, 10 human readers, and 5 CDS staff. These groups were purposively selected because they possessed diverse perspectives regarding the use of emerging digital tools from both users' and service providers' experiences.

Specifically, students with visual impairment provided first-hand information on the digital tools they used in their studies, the benefits they derived from these technologies, the challenges they encountered, opportunities associated with integrating emerging digital tools in their learning, and their suggestions for improving digital accessibility and inclusion within the university.

Human readers contributed insights into how emerging digital tools have influenced the academic support they provided. They described the changing nature of their roles, the extent to which digital technologies have reduced students' dependence on human assistance, and the challenges that still require human assistance.

CDS staff provided institutional perspectives on the provision of services to students with visual impairment, digital literacy trainings, technical support, as well as disability inclusion initiatives and strategies implemented by the university to enhance the use of emerging digital tools among students with visual impairment.

Data collection methods

Data were collected in June 2026 through semi-structured interviews and documentary analysis. The semi-structured interviews were conducted to obtain detailed information about experiences of students with visual impairment who used emerging digital tools, including the types of technologies used, their contribution to learning, challenges encountered, and institutional support available.

Documentary analysis was also conducted to examine relevant institutional documents, policies, and reports related to disability inclusion, digital accessibility, and support services at UDSM. Documents reviewed included the UDSM Policy on Disability and other relevant materials related to disability support and digital learning.

Findings

The following presentation of findings is guided by the four objectives of the study:

1. Emerging digital tools used by UDSM students with visual impairment

The findings indicate that UDSM students with visual impairment use various emerging digital tools to support their learning. Among these tools is screen reading software as justified by participants 9 and 4.

> *"I use NVDA on my laptop to navigate Microsoft Word, browse the internet, and participate in online classes." (Participant 9)*

"Screen readers are the most important tools in my studies. Without NVDA on my laptop and Talkback on my smartphone, I would not be able to access lecture notes, browse the university learning platforms, or prepare my assignments independently." (Participant 4)

These quotations reveal that screen reading software remains the foundation of digital accessibility for university students with visual impairment.

Participants also reported using Optical Character Recognition (OCR) software to access printed learning materials.

> *"Whenever lecturers distribute printed handouts, I scan them using my smartphone camera, convert them with Invision-AI or InstaReader Apps, and read them with my screen reader." (Participant 6)*

These findings verify that by combining OCR applications with scanners or smartphone cameras, students are able to convert textbooks, journal articles, lecture handouts, and other printed documents into accessible digital formats.

Participants further explained that they used emerging AI-powered accessibility tools in describing images, recognizing objects, identifying currency, and navigating unfamiliar environments.

"I depend on Seeing AI and CashReader to detect currency and identify objects around me." (Participant 2)

"I always use ChatGPT and Be My Eyes AI to understand diagrams and images." (Participant 8)

These findings demonstrate the value of AI-powered accessibility tools to the learning of students with visual impairment at UDSM.

The participants also identified digital Braille note takers as important learning tools because they combine Braille input, speech synthesis, and electronic storage. Participants explained that these devices reduce their reliance on traditional Braille writing machines while allowing them to store large volumes of lecture notes electronically.

"Instead of carrying many Braille books, My BrailleSense enables me to take notes during lectures, save them, edit them later, and access them whenever I need to revise." (Participant 10)

"Reading through the Braille note touch + helps me understand technical materials more accurately because it contains Braille and speech at once." (Participant 5)

These findings suggest that the advent of digital Braille note taking technologies has transformed the learning experiences of students with visual impairment by reducing their dependence on traditional Braille devices or Braille books.

Digital voice Recorders are another tool reported to be used by students with visual impairment at UDSM in capturing lectures, discussions, seminars, and other important academic information for later review. Participants explained that recorded lectures allowed them to review difficult concepts and clarify missed information more effectively.

"Using a digital voice recorder during lectures helps me capture important explanations from lecturers. I can listen to the recordings later when studying, especially when I need to remember points that I could not write down during the lecture." (Participant 15)

"I always use a digital voice recorder during seminars and group discussions where large amounts of information were presented at a time. Storing audio information digitally enables me to listen later in a quiet environment, concentrate better, and understand the content more deeply." (Participant 20)

These findings validate the role of digital voice recorders in simplifying the work of notetaking to students with visual impairment.

Participant with low vision also indicated that screen magnification software made printed and electronic learning materials more accessible.

"The magnification features on my computer and smartphone allows me to enlarge text , making it easier to read lecture notes without experiencing eye strain." (Participant 8)

This participant remark confirms how magnification technologies enabled learners with low vision to access mainstream digital devices more efficiently.

2. The contribution of emerging digital tools to the learning experiences of UDSM students with visual impairment

The findings revealed that emerging digital tools have significantly enhanced the independence of students with visual impairment in accessing learning materials and participating in academic activities.

Participants reported that technologies such as screen readers, digital Braille note takers, and screen magnification software enabled them to read lecture notes, access online learning platforms, conduct research, and complete assignments without relying heavily on sighted assistance.

“Before installing NVDA on my laptop, I depended on my human reader to operate it for me. Now I can search for information, read lecture notes, and complete assignments independently.” (Participant 6)

“Emerging digital tools have made research possible because I can read journal articles, analyse information, and write my thesis independently.” (Participant 13)

These findings confirm that emerging digital tools have made learning easier for students with visual impairment

The findings also showed that OCR applications and AI-powered accessibility tools have expanded access to educational resources by converting printed materials into accessible digital formats.

“When I receive a printed article or a book chapter, I can convert it using OCR software into accessible format that my screen reader can read.” (Participant 9)

“My reading role is changing because my student is becoming more independent with technology. Instead of reading everything for him, I mainly assist when he encounters technical difficulties in converting inaccessible materials.” Human reader 2

These findings illustrate that OCR technology address barriers related to inaccessible printed materials.

The findings further reveal that emerging digital tools have improved communication and collaboration between students with visual impairment, lecturers and their peers during the learning process.

Participants reported that digital communication platforms such as WhatsApp groups, email, Zoom, Microsoft Teams, and other virtual-based learning platforms enabled them to exchange academic information, participate in group discussions, receive class announcements, and collaborate on group assignments.

“Through WhatsApp class groups, I receive notes, assignment instructions, and announcements at the same time as my classmates.” (Participant 14)

“Technology has made our communication faster. When a student encounters inaccessible learning material, he can simply send me a copy by email and explain the specific problem he is experiencing. This makes it easier for me to provide appropriate assistance on time, rather than waiting until we meet physically.” (human reader 2)

These findings demonstrate that emerging digital tools strengthened communication and collaboration, thereby promoting equitable learning at UDSM.

3. Challenges Affecting Utilization of emerging digital tools among students with visual impairment

The findings revealed that although emerging digital tools have substantially improved learning opportunities for students with visual impairment at UDSM, several challenges continue to limit their effective use. The first important challenge explained by participants is the lack of knowledge and skills on using digital tools.

Participants explained that many students with visual impairment join the university with little or no prior experience in using computers, screen readers, digital Braille note takers or other digital tools, making it difficult for them to cope with the digital learning environment during their first days at university.

"When I joined the university, I had never used a computer with a screen reader. Everything was new to me, and I depended heavily on my classmates until I received training from the Centre for Disability Services." (Participant 1)

"Most of us come from schools where computers are either unavailable or inaccessible. We begin learning digital skills only after arriving at the university." (Participant 9)

These findings indicate that many students with visual impairment in Tanzania go to secondary schools and higher education with limited exposure to digital literacy.

Another major challenge identified by participants was the high cost of assistive technologies. Students explained that many digital devices and software applications remain unaffordable.

"Some digital devices are too expensive for students to purchase. We often rely on the university's equipment because buying our own is beyond our financial capacity." (Participant 6)

This quotation suggests that the high cost of digital devices limits access for many students with visual impairment, as many are unable to afford their own digital devices, particularly after completing their university studies.

The study further revealed that inaccessible learning materials continue to hinder effective participation in academic activities. Participants reported receiving lecture notes in inaccessible PDF formats, encountering images without alternative text, and using online resources that were incompatible with screen reading software.

"Sometimes lecturers provide scanned handouts that their screen readers cannot read. Our work is to type them in accessible format." (human reader 1)

"Some diagrams and images are uploaded without descriptions, making it impossible for me to understand important concepts independently." (Participant 11)

These findings affirm that inaccessible educational resources remain a significant barrier to students with visual impairment.

Participants identified the high cost of internet bundles and poor internet connectivity as barriers to accessing online learning resources and participating in virtual learning activities.

"When the internet connection is poor or I cannot afford data bundles, it becomes difficult to participate in online classes or download learning materials." (Participant 3)

This quotation highlights the importance of internet connectivity to ensure the effective attendance of students with visual impairment in digital classes.

4. Measures undertaken by the UDSM to empower students with visual impairment to utilize emerging digital tools for their learning success.

The findings revealed that UDSM, through the Centre for Disability Services (CDS), has implemented various measures to promote the effective use of emerging digital tools among students with visual impairment. Participants acknowledged that these interventions have contributed significantly to improving their use of digital tools in learning.

Participants reported that digital literacy trainings provided each year to first year students serves as an important foundation for the effective use of emerging digital tools.

“Upon admission, students with visual impairment receive orientation and training on the use of computers, screen readers, smartphones, digital Braille devices, and other digital tools used in learning.” (Transcriber 2)

"The digital literacy training I received during my first year helped me learn how to use NVDA, access electronic documents, and navigate university learning systems independently." (Participant 2)

"Without the digital literacy trainings offered by CDS, adapting to use digital Braille note takers from Perkins Brail would have been very difficult." (Participant 7)

These findings indicate that digital literacy trainings play a critical role in preparing students with visual impairment to use emerging digital tools in their learning.

The study further revealed that UDSM provides continuous technical support pertaining to the use of emerging digital tools throughout academic journey of students with visual impairments. Participants explained that CDS staff offer ongoing assistance, troubleshooting services, and individualized guidance whenever students encounter challenges related to digital technologies.

"Whenever I experience difficulties with my screen reader or computer, I can seek support from assistive technology instructor from CDS, who helps me resolve the problem and continue with my studies." (Participant 5)

This quotation demonstrates the importance of dedicated technical support services in ensuring the sustainable use of emerging digital tools by students with visual impairment.

Participants also reported that UDSM has invested in buying digital technology resources to facilitate learning.

“Computers equipped with screen readers, digital Braille note takers, digital voice recorders, video magnifiers and other digital devices are made available through CDS to support learning of students with disabilities, especially those with visual impairment.” (CDS staff 3)

"Many students cannot afford to buy digital devices on their own, so the equipment provided by the university enables them to accomplish their learning effectively." (CDS staff 5)

These findings demonstrate that UDSM has made substantial efforts to promote the use of emerging digital tools among students with disabilities particularly those with visual impairment.

The findings further reveal that the CDS resource room serves as an important learning environment for students with disabilities including those with visual impairment.

We have the resource room equipped with computers, video magnifiers, internet connectivity, and other digital tools that support their learning.” (CDS staff 1)

"The resource room provides a supportive environment where students with disabilities including those with visual impairment can receive assistance in doing their assignments, tests, and examinations." (CDS staff 4)

These findings reflect the university's long-standing commitment to create equitable learning opportunities for all.

Participants also highlighted disability awareness trainings provided to lecturers as an important strategy for improving accessibility.

“CDS always provide trainings on disability awareness to UDSM staff including lecturers which help them to understand the educational needs of students with disabilities. These trainings encourage them to prepare course materials in accessible digital formats for students with visual impairment.” (CDS staff 1)

"Previously, some lecturers did not understand the needs of students with visual impairment. They assume we can access learning materials in the same way as sighted students with the help of our human readers. They are more likely to provide inaccessible materials. But nowadays, CDS has provided awareness to them about accessibility requirements." (Participant 8)

These findings suggest that disability awareness initiatives contribute to a more inclusive learning environment at UDSM.

The study further found that improvements in internet infrastructure have enhanced access to digital learning resources. Participants reported that campus wide WIFI services and improved internet connectivity enable them to access online learning platforms, digital libraries, and communication tools more efficiently.

"Reliable internet access allows me to download academic articles, participate in online discussions, and conduct research without unnecessary interruptions." (Participant 11)

These findings indicate that internet connectivity is a critical component of digital inclusion because many emerging digital tools support internet use.

Discussion of Findings

The findings show that students with visual impairment require a variety of learning support mechanisms to cater for their learning needs. Among these, emerging digital tools are the learning support mechanism which has proven to be most helpful for UDSM students with visual impairment (Kisanga & Kisanga, 2020; Ngonyani & Mnyanyi, 2021).

As stated by Kisanga (2025), emerging digital tools have made a paradigm shift in the entire learning process of UDSM students with visual impairment. For instance, when compared to a typewriter, a computer is better. When opposed to a brailed book, surfing an E-book is easier for acquiring more latest Information.

The findings have demonstrated that digital Braille note takers are generally more advantageous than traditional Braille machines due to their multifunctional capabilities. Tuttle and Carter (2022) clarify that while traditional Braille machines are mainly designed for writing Braille on paper, digital Braille note takers allow users to create, store, edit, and retrieve electronic documents.

The findings reveal that UDSM has expanded beyond the use of traditional assistive devices to include emerging digital tools that support accessible learning environments for students with visual impairment. As documented by Kisanga and Kisanga (2022), popular digital tools used by UDSM students with visual impairment include Non-Visual Desktop Access (NVDA), Optical Character Recognition (OCR) applications, artificial intelligence-powered accessibility tools, video magnifiers, digital Braille note-taking devices, and Talkback for Android devices. Therefore, the increasing availability of digital tools at UDSM represents a shift from traditional disability support approaches, which often depended heavily on human assistance and specialized materials, towards more flexible and independent learning approaches.

The findings suggest that digital transformation at UDSM has the potential to reduce educational barriers experienced by students with visual impairment. The findings are exemplified by Rao, Torres, and Smith (2021) who postulate that through keyboard commands and voice feedback provided by screen reading software integrated into computers, tablets, and smartphones, students can read documents, browse websites, compose assignments, and participate in virtual learning environments independently. Similarly, OCR technologies have transformed access to printed materials by allowing students to convert textbooks, articles, and lecture notes into accessible digital formats (Elshaer, AlNajdi, & Salem, 2025).

The study signifies that emerging digital tools contribute significantly to inclusive learning by enabling students with visual impairment to participate in academic activities alongside their sighted peers. Ngonyani and Mnyanyi (2021) supplement that technology should not be viewed merely as a tool for compensating for disability, but as an instrument for building the broader understanding of digital inclusion in higher education.

The findings specify that ensuring adequate digital literacy training among newly enrolled UDSM students with visual impairment is essential to enable them to effectively utilize digital tools. This statement is supported by Montenegro-Rueda, Fernández-Batanero, and Fernández-Cerero (2023) that the availability of digital technologies alone without training is insufficient to achieve their meaningful use.

These suggestions agree with Kisanga (2025) who reported that availability of digital tools requires more than providing devices; it requires continuous development of the skills, confidence, and knowledge necessary to use technologies effectively.

The findings also demonstrate the importance of continuous digital literacy training throughout students' academic journey of students with visual impairments . Tuttle and Carter (2022) stipulate that although introductory training provides students with basic skills, emerging technologies continue to change rapidly, requiring ongoing professional support. Similar observations were reported by Kisanga (2025), who noted that continuous digital literacy and assistive technology training are essential for enabling students with visual impairment to benefit fully from high-tech assistive devices and accessibility features added on new digital applications.

The study illustrates the importance of institutional support in promoting the effective use of digital tools among students with visual impairment. Kisanga and Kisanga (2020), Ngonyani and Mnyanyi (2021) comment that the experience of UDSM in providing digital literacy training, coordinating accessibility initiatives, and offering technical assistance demonstrates that the successful use of emerging digital tools among students with visual impairment requires a comprehensive institutional approach.

Furthermore, the findings indicate that lecturer awareness and accessible content development are essential components of digital inclusion. Even when students possess appropriate assistive technologies, inaccessible learning materials can continue to create barriers. Therefore, universities should ensure that academic staff understand digital accessibility principles and prepare teaching materials in formats compatible with screen readers, magnification software, and other assistive technologies.

The findings establish that the expansion of internet connectivity at UDSM has created opportunities for students with visual impairment to access online libraries, digital learning platforms, and electronic academic resources. According to Elshaer, AlNajdi, and Salem (2025), the use of emerging digital tools requires investment not only in technologies but also in broader digital infrastructure that supports digital participation.

Conclusion

The UDSM has empowered students with visual impairment through the use of emerging digital tools, enabling them to complete assignments, tests, and examinations more independently. These tools have also simplified their participation in research presentations and enhanced their ability to attend classes and other university events through online platforms.

As a result of these initiatives, the University of Dar es Salaam has succeeded its commitment to provide a suitable learning environment to all including students with visual impairment. This made UDSM to become an exemplary institution and a role model for other universities in Tanzania and beyond in promoting inclusive and accessible higher education. Therefore, I am delighted to welcome various tertiary institutions to use UDSM as their role model in providing an accessible learning environment for students with visual impairment.

References

Elshaer, I. A., AlNajdi, S. M., & Salem, M. A. (2025). Sustainable AI solutions for empowering visually impaired students: The role of assistive technologies in academic success. *Sustainability, 17*(12), 5609.

Goyal, Y. (2025). Empowering Students with Disabilities in Science Labs: Leveraging Assistive Technologies for Inclusive Learning. *Institutions, 2*(1).

Kisanga, S. E. (2025). Enhancing high-tech assistive technology use for learning among students with visual impairment in Tanzania's higher education. *University of Dar es Salaam Library Journal, 20*(1), 226-239.

Kisanga, S. E., & Kisanga, D. H. (2022). The role of assistive technology devices in fostering the participation and learning of students with visual impairment in higher education institutions in Tanzania. *Disability and Rehabilitation: Assistive Technology, 17*(7), 791-800.

Mohlaloga, G., Pillay, R., & Pretorius, A. (2025). *Transformation and inclusivity in higher education: Exploring the experiences of students with visual impairments in a South African University during the COVID 19 pandemic.* In South African Higher Education Transformation Journey: Thirty Years after Democracy (pp. 31-52). Cham: Springer Nature Switzerland.

Montenegro-Rueda, M., Fernández-Batanero, J. M., & Fernández-Cerero, J. (2023). Impact of ICT on university students with visual impairment. *British Journal of Special Education, 50*(1), 28-48.

Ngonyani, J. C., & Mnyanyi, C. B. (2021). Assessing the relevance of assistive technologies for persons with disabilities in higher learning institutions: a case of University of Dar Es Salaam in Tanzania. *European Journal of Special Education Research, 7*(2).

Ostrowski, C. (2016). *A narrative inquiry into the experiences of university students with visual impairments: The effects of people, institutions, and technology in supporting learning* (Doctoral dissertation, University of Calgary).

Rao, K., Torres, C., & Smith, S. J. (2021). Digital tools and UDL-based instructional strategies to support students with disabilities online. *Journal of Special Education Technology, 36*(2), 105-112.

Tanzania Ministry of Education, Science and Technology. (2025a). *National Digital Education Guidelines for Universities*.

Tanzania Ministry of Education, Science and Technology. (2025b). *National Digital Education Strategy 2025–2030.*

Tanzania National Planning Commission. (2025). *The Tanzania Development Vision 2050.*

Tuttle, M., & Carter, E. W. (2022). Examining high-tech assistive technology use of students with visual impairments. *Journal of Visual Impairment & Blindness, 116*(4), 473-484.

United Nations Educational, Scientific and Cultural Organization. (2021). *Reimagining our futures together: A new social contract for education.* UNESCO Publishing.

University of Dar es Salaam. (2022). *Policy on disability and special educational needs.* https://www.udsm.ac.tz/index.php/udsm-policies-and-guidelinesinstruments udsm.ac.tz+1

World Health Organization, & United Nations Children's Fund. (2022). *Global report on assistive technology*. World Health Organization.

World Intellectual Property Organization. (2013). Marrakesh Treaty to *Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired or Otherwise Print Disabled*. WIPO.

World Wide Web Consortium. (2018). *Web Content Accessibility Guidelines* (WCAG)

Technology for Access and Participation: Matching Educational Supports to Learner Requirements — Frances Gentle AO, PhD, DLitt (Hons)

Lecturer, NextSense & Macquarie University (Australia)
Past President, International Council for Education of People with Visual Impairment

Introduction

We are living in an exciting era in which technology is transforming educational opportunities for children and young people with blindness, low vision, and deafblindness. From braille displays and screen readers to artificial intelligence and accessible digital resources, innovative technologies are opening new pathways to learning, participation, and independence. To realise this potential, however, technology must be carefully matched to each learner's preferences and requirements and embedded within high-quality teaching, comprehensive assessment, curriculum planning, and specialist instruction.

Over the past two decades, mainstream technologies have become increasingly accessible. Screen readers, magnification, speech recognition, text-to-speech and accessibility settings are now built into smartphones, tablets and computers, while advances in artificial intelligence are expanding access through image description, object recognition, navigation support and rapid conversion of printed materials into accessible formats.

Yet technology itself is not the goal. The goal is equitable access to learning, meaningful participation alongside peers, and the development of independence throughout life. For educators and families, the challenge is not simply keeping pace with emerging technologies but ensuring that technology is selected and used in ways that align with each learner’s educational requirements and long-term aspirations.

AI has enormous potential to support access to information and reduce barriers to participation. However, AI represents only one part of a much broader accessibility ecosystem. Advances in braille technology, refreshable braille displays, digital publishing,

accessible educational materials, mainstream accessibility features, and cloud-based learning platforms are also transforming educational opportunities for learners with visual impairment.

As AI tools become increasingly available, educators also have an important responsibility to evaluate the accuracy, accessibility, privacy implications, and educational appropriateness of AI-generated information. Professional judgement remains essential to ensure that AI supports learning in ways that are safe, inclusive, reliable, and aligned with each learner's educational goals. The challenge is no longer simply obtaining technology but making informed decisions about which technologies are most appropriate for particular learners, educational contexts, and learning goals.

Technology as a Tool for Access and Participation

For many learners with visual impairment, technology provides access to literacy, numeracy, communication, information, social interaction, and participation in everyday classroom activities. Increasingly, technology also provides access to further education, employment, recreation, and lifelong learning.

Technology can support independence by reducing reliance on adult assistance. Historically, many learners with blindness or low vision depended on teachers, teaching assistants, family members, or peers to provide access to information. Today, a learner may be able to independently access printed text using optical character recognition (OCR), listen to audio descriptions of images, navigate digital resources with a screen reader, or use a refreshable braille display to access information in real time.

Providing a device alone is not sufficient. Accessibility must be explicitly taught. Similarly, educators often require professional learning to effectively support technology use. The increasing availability of built-in accessibility features on iPads, Chromebooks, Windows devices, and MacOS systems means that mainstream classroom teachers are now more likely than ever to encounter accessibility tools within everyday teaching environments. Specialist educators and technology professionals therefore play an important role in supporting both learners and teachers to make effective use of available technologies.

A key educational principle is that technology is most effective when it supports participation alongside peers, promotes independence, reduces barriers without isolating the learner, and becomes an integrated part of everyday classroom practice. Technology should not create a separate educational experience. Rather, it should provide access to the same learning opportunities available to classmates while recognising that different learners may require different pathways to achieve this access.

Understanding Different Access Profiles

The following learner profiles and accompanying case studies provide a practical approach to considering how technology, curriculum planning, assessment, and educational supports can be matched with learner preferences and requirements. The

learner profiles reflect common educational access needs encountered in practice. The accompanying case studies are fictional, composite examples developed from common themes and experiences in educational settings. They are intended to illustrate how different approaches can support learners with diverse access requirements and do not represent individual children.

Learner Profile 1: Reduced acuity and central vision

This profile includes learners with conditions such as optic nerve hypoplasia, optic atrophy, albinism, Stargardt disease, juvenile macular dystrophies, central retinal disorders, retinopathy of prematurity, and other conditions that reduce visual acuity and detailed central vision.

These learners often expend considerably more effort than their peers to access detailed visual information. Reading may be slower and more fatiguing, particularly when curriculum materials contain dense text, diagrams, graphs, maps, tables, or technical content. As curriculum demands increase through the upper primary and secondary years, the amount of sustained visual effort required frequently increases as well.

A common challenge for educational teams is determining when enlarged print remains an efficient literacy medium and when additional access methods should be introduced. Some learners continue to rely on vision long after it has become educationally inefficient. The role of the Learning Media Assessment (Holbrook et al., 2019) is therefore not simply to identify what a learner can see, but to determine how the learner can access learning most efficiently, independently, and sustainably over time.

Curriculum planning should focus on maintaining access to age-equivalent learning outcomes while reducing unnecessary visual workload. This may involve providing accessible materials before lessons, reducing copying demands, allowing flexible methods for demonstrating understanding, and explicitly teaching organisational, digital access, and study skills as part of the Expanded Core Curriculum (Allman & Lewis, 2014).

Learning Media Assessments should examine not only visual capability but also visual efficiency. Important considerations include the impact of fatigue on learning, the balance between visual and auditory access, the long-term sustainability of enlarged print, and whether tactile access, including braille, may become beneficial as curriculum demands increase. Introducing additional access methods should be viewed as expanding learning options rather than replacing vision.

Technology supports may include built-in magnification, electronic magnifiers, screen magnification software, OCR applications, accessible digital texts, text-to-speech systems, and AI-enhanced reading tools (Siu & Presley, 2020). These technologies can reduce visual fatigue while increasing independence, flexibility, and efficient access to information.

The goal is to maximise educational efficiency rather than simply maximise visual use.

Case Study: Ella – Balancing visual and auditory access

Ella is a 12-year-old learner with Stargardt disease, a progressive macular condition affecting central vision. She attends a mainstream secondary school and is highly motivated academically. Although she can read enlarged print, she becomes increasingly fatigued when required to read lengthy passages or access detailed visual information throughout the school day. Teachers initially responded by continually enlarging materials. While this improved visibility, it did not address the increasing effort required to read large volumes of text. A Learning Media Assessment revealed that visual access remained effective for short reading tasks but was becoming educationally inefficient for extended academic work.

The educational team therefore shifted its focus from maximising visual use to maximising educational efficiency. Digital textbooks were introduced, allowing Ella to adjust font size, contrast, and display settings to suit different learning tasks. Built-in magnification tools were combined with text-to-speech features so that she could alternate between visual and auditory access according to the task and her level of visual fatigue. Teachers began providing learning materials before lessons, reducing copying demands and allowing Ella to preview content. She was also explicitly taught organisational and digital file-management skills to support independent learning across multiple subjects.

These adjustments did not alter curriculum expectations. Instead, they enabled Ella to access the same curriculum as her peers while reducing fatigue, increasing independence, and improving learning efficiency. The case illustrates an important principle: educational planning should focus not simply on what a learner can see, but on how learning can occur most efficiently and sustainably over time.

Learner Profile 2: Visual processing and complexity challenges

This profile includes learners with cerebral visual impairment (CVI), optic nerve conditions associated with visual processing difficulties, and some genetic or neurological conditions that affect visual attention, visual recognition, and information processing (Lueck & Dutton, 2015).

For these learners, the primary challenge is accessing, processing, and using information efficiently for learning. They may experience difficulty locating important information on a page or screen, interpreting diagrams and visual layouts, recognising objects or symbols, managing visually busy environments, or processing visual and auditory information simultaneously. Such difficulties can significantly affect classroom participation. Learners may appear inattentive, overwhelmed, or unable to complete tasks when, in reality, they are experiencing cognitive overload associated with complex visual information.

Curriculum differentiation should therefore focus on reducing visual complexity without reducing educational expectations. Learners often benefit from highly structured learning experiences, predictable routines, explicit teaching of concepts and vocabulary, carefully

sequenced instruction, and classroom environments that minimise unnecessary visual distractions. Organisational and self-management skills taught through the Expanded Core Curriculum can further support independence.

Reducing visual complexity should not be confused with lowering educational expectations. The objective is to improve access to information while maintaining engagement with age-appropriate curriculum content. When visual information is presented in ways that reduce cognitive load, learners are often able to demonstrate knowledge and skills that may otherwise remain hidden.

Technology can support access when it reduces cognitive demands rather than simply enlarging information. Simplified tablet interfaces, visual scheduling applications, uncluttered digital presentations, screen masking tools, and text-to-speech features can help learners focus on key information. AI tools may further assist by simplifying text, summarising content, and presenting information in alternative formats (CAST, 2024).

For many learners in this profile, the most effective intervention is not additional technology but thoughtful curriculum design and classroom organisation that reduce unnecessary visual complexity while maintaining access to meaningful learning.

Case Study: Noah – Reducing cognitive load

Noah is a 9-year-old learner with cerebral visual impairment. His visual acuity is relatively functional, yet he experiences significant difficulty locating information, managing visually busy environments, and interpreting complex visual layouts. Teachers initially described Noah as easily distracted and inconsistent in his classroom performance. However, closer observation revealed that many of these difficulties occurred when information was presented in cluttered or visually complex formats.

Noah’s Learning Media Assessment, together with classroom observations, highlighted that Noah's primary challenge was processing efficiency rather than visual acuity. Worksheets were redesigned using simplified layouts with fewer visual distractions. Information was presented in smaller, clearly sequenced steps, and key concepts were introduced before new learning activities commenced. Technology was used selectively to complement these curriculum adjustments rather than replace them. Noah used a visual scheduling application to anticipate transitions and daily routines. Screen masking tools reduced visual clutter when reading digital materials, while text-to-speech features reduced the need to process large amounts of visual information simultaneously. Importantly, curriculum expectations remained unchanged.

As visual complexity was reduced, Noah demonstrated a much stronger understanding of curriculum concepts, participated more confidently in classroom activities, and completed learning tasks with greater independence. His case illustrates the important distinction between visual acuity and visual processing efficiency, and the value of educational planning that focuses on reducing cognitive load while maintaining high expectations.

The goal for Noah was not to simplify learning, but to simplify access to learning.

Learner Profile 3: Light sensitivity and variable visual efficiency

This profile includes learners with conditions such as achromatopsia, aniridia, albinism, congenital cataracts, nystagmus, amblyopia, strabismus, and other conditions associated with photophobia, glare sensitivity, or fluctuating visual efficiency.

Educational performance for these learners often varies according to environmental conditions and task demands. Lighting, glare, fatigue, visual complexity, viewing distance, and the duration of visual tasks can all influence how efficiently a learner accesses information. A learner may appear to access information successfully in one environment yet experience substantial difficulties in another. Importantly, these changes do not necessarily reflect changes in vision itself but rather changes in the visual demands placed on the learner. As a result, educational performance may fluctuate throughout the day, creating challenges for both learners and educators.

Curriculum planning should recognise that visual access is not always stable. Flexible scheduling of visually demanding tasks, alternative learning locations, regular visual breaks, and careful management of environmental conditions may be just as important as technology. Learning Media Assessments should examine how lighting, viewing distance, fatigue, visual complexity, and environmental factors influence educational efficiency. In some cases, learners may continue to rely heavily on vision while doing so inefficiently and at considerable personal cost. Explicit teaching of self-advocacy skills can help learners recognise when adjustments are needed and communicate these needs confidently.

Technology can provide flexible access as visual efficiency changes throughout the day. Helpful tools include adjustable display settings, dark mode, electronic magnification with contrast controls, audiobooks, reading guides, matte screen protectors, and portable lighting solutions. AI-supported reading tools may further assist learners in alternating efficiently between visual and auditory access according to the demands of different learning tasks.

Educational teams should recognise that fatigue management is an important educational adjustment rather than a sign of reduced capability.

Case Study: Mele – Managing light sensitivity and visual efficiency

Mele is a 13-year-old learner with albinism who attends a mainstream secondary school. Although she uses vision as her primary learning medium, her visual efficiency varies considerably throughout the day depending on lighting conditions, glare, fatigue, and the complexity of visual tasks. She frequently experiences headaches and eye strain following extended periods of reading or working under bright classroom lighting.

Initially, teachers assumed that enlarged print and preferential seating near the front of the classroom were sufficient adjustments. However, Mele continued to experience fluctuating academic performance and increasing visual fatigue, particularly during longer lessons and assessment tasks. A Learning Media Assessment demonstrated that

although Mele could access printed and digital materials effectively, the effort required to do so was often unsustainable across a full school day. Educational planning therefore shifted from simply improving visibility to reducing visual effort and supporting sustained learning.

A combination of environmental and technological adjustments was introduced. Mele began using adjustable display settings, dark mode, and electronic magnification with contrast controls on her laptop. Audiobooks and text-to-speech enabled her to alternate between visual and auditory access during extended reading tasks, while a reading guide and matte screen protector reduced glare.

Teachers provided digital learning materials before lessons, allowing her to prepare for visually demanding activities and manage her workload more effectively. Flexible scheduling and regular visual breaks were incorporated throughout the school day to minimise fatigue. These adjustments enabled Mele to participate more consistently in classroom learning without reducing curriculum expectations. She also became more confident in recognising when visual fatigue was increasing and selecting strategies that maintained her learning efficiency.

Mele's experience demonstrates that, for some learners, successful educational planning depends not on increasing visual demands but on recognising that visual efficiency fluctuates and providing flexible strategies that support sustained access to learning.

Learner Profile 4: Non-Visual learning and braille literacy

This profile includes learners who are blind, some learners with deafblindness, and others for whom vision is not an efficient, functional, or reliable primary learning channel. Examples include learners with Leber congenital amaurosis, advanced retinal dystrophies, severe retinopathy of prematurity, microphthalmia, anophthalmia, optic nerve aplasia, and other conditions resulting in profound vision loss.

For non-visual learners, educational access is achieved primarily through tactile and auditory pathways. Braille should be recognised as a literacy medium and a fundamental tool for independent learning and lifelong participation. Effective educational programming includes braille literacy instruction, orientation and mobility, concept development, assistive technology, communication skills, and many of the experiences that sighted learners acquire incidentally through observation.

Curriculum access depends on maintaining high educational expectations while providing alternative pathways to learning. Educational planning should therefore include tactile and experiential learning opportunities, pre-teaching of unfamiliar concepts, explicit concept development, and the integration of Expanded Core Curriculum skills, particularly compensatory access skills, into everyday learning. For learners with deafblindness, educational planning may also include tactile communication systems, communication partners and educator training, access to interveners, hearing assistive

technologies where appropriate, and deliberate opportunities for social interaction, communication, and concept development.

For learners who use braille, literacy instruction remains a central educational priority. Braille provides direct access to spelling, punctuation, grammar, mathematics, and the structure of written language in ways that audio alone cannot. As curriculum demands increase, braille literacy supports independent reading, note-taking, assessment participation, and access to increasingly complex information.

Learning Media Assessments should examine readiness for braille instruction, tactile discrimination skills, auditory processing strengths, concept development, communication preferences, and future literacy and post-school participation requirements.

Technology should be selected to complement, not replace, the learner's primary literacy and communication systems. Useful technologies may include screen readers, refreshable braille displays, braille notetakers, braille embossers, tactile graphics, accessible STEM resources, augmentative and alternative communication systems, hearing assistive technologies, and communication devices where appropriate. Emerging AI applications may also benefit learners with deafblindness through enhanced environmental descriptions, object recognition, communication supports, and multimodal access to information.

For non-visual learners, technology is most powerful when it complements strong braille literacy, tactile instruction, concept development, communication, and opportunities to build independence.

Case Study: Amina – Braille, technology and independence

Amina is a 15-year-old learner who is blind and uses braille as her primary literacy medium. She attends a mainstream secondary school and is preparing for tertiary education. As curriculum demands increased, Amina required efficient access to large volumes of information across multiple subject areas. Traditional embossed braille materials remained essential, but the volume and timeliness of resources required in secondary school made additional access methods necessary.

Working collaboratively with her specialist vision teacher, classroom teachers, and family, Amina learned to use a refreshable braille display linked to her laptop. This enabled her to access digital textbooks, take notes during lessons, complete assignments electronically, participate in online learning platforms, and access teacher-prepared resources in real time.

Screen reader software supported navigation across digital environments, while cloud-based storage enabled efficient organisation of school materials. More recently, Amina began exploring AI-powered image description tools to assist with accessing photographs, diagrams, and other visual content encountered online. Her specialist vision teacher also taught her to critically evaluate AI-generated information, recognising

that descriptions may occasionally be incomplete, inaccurate, or lack important educational detail.

Importantly, technology did not replace braille. Rather, braille and technology worked together to support literacy, academic achievement, and independence. Braille remained the foundation of Amina's literacy, while technology expanded the range, timeliness, and independence of the information she could access.

Amina’s experience illustrates how braille and technology should be viewed as complementary rather than competing educational tools.

Looking Beyond the Learner Profiles

The learner profiles and case studies presented above provide a practical guide for understanding the diverse ways in which children and young people who are blind, have low vision, or are deafblind access learning. However, educational planning should never be based on diagnosis alone. Every learner has unique strengths, preferences, aspirations, and learning needs that require individual assessment.

The Learning Media Assessment provides a framework for determining how each learner can access learning most efficiently, independently, and sustainably. Effective educational planning considers educational efficiency, literacy, communication, participation, technology, and future learning requirements. When technology, curriculum planning, and Expanded Core Curriculum instruction are integrated in response to individual learner requirements, children and young people who are blind, have low vision, or are deafblind are better equipped to participate fully, achieve academically, and prepare for lifelong learning.

Principles for Effective Educational Practice

The learner profiles and case studies reflect different educational preferences and requirements. Several common principles emerge.

First, effective technology decisions are grounded in educational assessment. Learning Media Assessments, Functional Vision Assessments, and Expanded Core Curriculum considerations provide the foundation for selecting appropriate technologies and teaching strategies.

Second, technology should support educational goals rather than drive them. The most appropriate technology is not necessarily the newest or most sophisticated option, but the one that best promotes participation, learning, communication, and independence.

Third, technology is most effective when combined with explicit instruction, thoughtful curriculum planning, and collaboration among learners, families, educators, and support personnel.

Ultimately, technology should expand opportunities for participation rather than create separate learning experiences. Whether through braille, AI-powered image description,

text-to-speech, tactile communication systems, or simplified interfaces, the goal remains meaningful participation in learning and in life. This perspective is particularly relevant to the ICEVI-WBU Global Braille Literacy Campaign, which emphasises that braille literacy remains a fundamental educational right. Emerging technologies should strengthen braille access rather than diminish its importance.

Technology in Diverse Global Contexts

The global education landscape is characterised by enormous variation in access to technology and educational resources.

In some countries, learners may have access to refreshable braille displays, AI-powered image recognition systems, cloud-based learning platforms, high-speed internet, and a wide range of accessible digital resources. In other settings, access may be limited to a shared smartphone, a Perkins brailler, slate and stylus or other braille device, or locally produced tactile materials.

For many learners in low- and middle-income countries, access to accessible educational materials remains one of the greatest barriers to educational participation. Even when technology is available, challenges may include unreliable electricity, limited internet connectivity, inadequate teacher preparation, and a shortage of accessible textbooks and learning materials.

At the same time, technological innovation is creating new opportunities to address some of these barriers. Smartphones have become powerful educational tools that can provide text-to-speech, magnification, OCR, navigation assistance, communication platforms, and access to digital books at relatively low cost. Digital publishing initiatives and accessible online libraries are making it increasingly possible to provide learners with timely access to educational materials (Ganner et al., 2023).

The Visionary Learning through Technology initiative, developed through collaboration among ICEVI, the DAISY Consortium, and other partners, reflects this changing landscape. The initiative recognises that successful technology implementation depends not only on devices but also on kit, confidence, content, connectivity, and culture. Importantly, educational planning should not begin with technology. It should begin with learners.

The challenge for educators is not to pursue the newest technology, but to identify the technology that most effectively supports learning within local contexts and available resources. In some settings, a smartphone with text-to-speech may be transformative. In others, braille materials, tactile graphics, or communication systems may provide the most effective pathway to learning.

Educational equity requires flexibility, creativity, and a willingness to focus on outcomes rather than equipment.

Looking Forward: From Technology to Educational Opportunity

Technology and artificial intelligence are creating unprecedented opportunities for learners with blindness, low vision, and deafblindness to access information, participate in learning, and develop greater independence. However, successful educational outcomes depend not on technology alone, but on how thoughtfully it is integrated into teaching and learning.

Throughout this article, the learner profiles have demonstrated that technology decisions should emerge from educational assessment rather than diagnosis alone. Braille remains fundamental to literacy for learners who are blind, while AI can expand access to information, communication, and participation. Together, they strengthen educational opportunity and independence.

Educational technology must also be considered within diverse global contexts. Around the world, learners experience very different levels of access to devices, connectivity, accessible materials, and specialist support. Regardless of available resources, the educational objective remains the same: providing every learner with equitable opportunities to participate, learn, and achieve.

For governments, ministries of education, teacher preparation programs, and organisations working in the field of blindness and low vision, investment in technology must be accompanied by investment in teacher preparation, accessible educational materials, braille literacy, communication systems, and ongoing professional learning. Technology cannot compensate for the absence of strong educational foundations.

The future of education for learners with blindness, low vision, and deafblindness will depend not on the sophistication of technology, but on informed educational practice that places learners at the centre of every decision.

Technology can open doors, but it is informed educational practice that enables learners to walk through them.

References

Allman, C.B. & Lewis, E. (Eds.). (2014). ECC essentials: Teaching the expanded core curriculum to students with visual impairments. New York: ABF Press.

CAST (2024). CAST Universal Design for Learning Guidelines version 3.0. https://udlguidelines.cast.org.

Ganner, J., Mrva-Montoya, A., Park, M., & Duncan, K. (2023). Books without borders: A practical guide to inclusive publishing. Institute of Professional Editors & the Australian Publishers Association, https://www.iped-editors.org/wp-content/uploads/2023/04/Bookswithoutbarriers_Screen.pdf.

Holbrook, M. C., Kamei-Hannan, C., & McCarthy, T. (eds.). (2019). Foundations of Education: Instructional Strategies for Teaching Children and Youths with Visual Impairments, Volume II (3rd ed.). New York: AFB Press.

Lueck, A. H., & Dutton, G. N. (Eds.). (2015). Vision and the Brain: Understanding Cerebral Visual Impairment in Children. New York: AFB Press.

Siu. Y-T., & Presley, I. (2020). Access technology for blind and low vision accessibility (2nd ed.). American Printing House for the Blind.

The Transformative Power of Artificial Intelligence in Assistive Technologies for Blind and Visually Impaired People — Boureima Bouda Ismaila

Head, Adapted IT Unit for Blind and Visually Impaired People, Soli Abdourahamane School for Young Blind People in Niamey; and General Secretary of the National Union of the Blind of Niger (UNAN), Niger.

Introduction

Rapid advances in artificial intelligence are opening a new era of possibilities for people with visual impairments. This article explores how AI-powered assistive technologies are fundamentally transforming inclusive education, accessibility, literacy, autonomy, and social participation for blind and visually impaired people. Drawing on recent innovations and future trends, this submission aims to highlight the crucial role of AI in promoting independence and equity.

Artificial Intelligence in Inclusive Education

AI is revolutionizing learning environments. Screen readers and voice assistants, now more sophisticated than ever, offer seamless access to digital content, allowing students to interact more effectively with educational materials and their peers. These tools adapt content in real-time based on individual learner needs, thereby creating truly personalized learning experiences.

The landscape of assistive technologies is evolving rapidly. Smart glasses, such as those developed by Lumen and Envision, use AI to describe the environment in real-time, recognize faces, read text, and identify objects, offering a new level of environmental awareness and navigation. These devices allow users to move more autonomously and safely. Mobility aids like Guidance integrate AI for autonomous navigation, offering unprecedented independence to visually impaired people. Beyond mobility, mobile applications like Be My Eyes provide versatile features, from document recognition to image description.

AI contributes to the creation of truly accessible digital platforms. From the automatic generation of alternative texts for images to the intelligent adaptation of content, AI ensures that online educational resources are intrinsically inclusive. This approach reduces the need for manual remediation and promotes a more equitable learning

experience. AI-powered adaptive learning systems can also identify gaps in students' understanding and offer additional resources tailored to their specific needs.

AI applications offer essential features for literacy and autonomy. AI-enhanced Optical Character Recognition (OCR) allows visually impaired people to read printed and digital documents with ease. Intelligent voice assistants help with daily task management, from checking transport schedules to managing personal finances. These tools significantly strengthen literacy skills and independent living capacities, allowing individuals to navigate their daily lives with more confidence and autonomy.

Challenges, Ethics, and Equity in AI Adoption

While the potential of AI is immense, its implementation presents significant challenges. Ethical considerations regarding data privacy, algorithmic biases, and equitable access to these advanced technologies are paramount. It is crucial to ensure that AI benefits everyone without exacerbating existing inequalities. Inclusive design and policy frameworks must be at the heart of the development of these technologies. Furthermore, the issue of economic accessibility remains central.

How can we ensure that people in developing countries and low-income communities have access to these innovations?

The successful integration of AI-powered assistive technologies requires a collaborative approach involving users, families, educators, and the wider community. Understanding their perspectives and needs is crucial for developing solutions that are truly impactful and user-centered. Feedback from blind and visually impaired people themselves, as well as from their relatives and education professionals, is essential for refining and improving these technologies.

Braille Literacy and Technology Development in Slovakia — Michal Tkáčik

Head Coordinator, the Braille Authority of Slovakia; and
Vice President, Slovak Blind and Partially Sighted Union, Slovakia

In the context of the ongoing international discussion on the future of braille literacy, Slovakia continues to contribute to research, braille rules development and professional dialogue in this field. Activities of the Braille Authority of Slovakia (SABP), operating within the Matej Hrebenda Slovak Library for the Blind in Levoča, increasingly focus not only on the promotion of braille literacy but also on the development and application of modern technologies that support the production, distribution and everyday use of braille.

A recent scholarly article by Tkáčik and Ježíková (2025) examines the evolution of braille education in Slovakia. The paper analyses the relationship between traditional pedagogical approaches and contemporary methods that increasingly rely on digital

technologies, assistive software and modern didactic tools. Particular attention is paid to the ways in which technological developments have transformed both the teaching process and the accessibility of braille materials for blind learners.

The description of modern approaches in the article also highlights the rapid development of Braille technologies worldwide, particularly in the area of refreshable braille displays and tactile graphics displays. However, keeping pace with these technological developments remains challenging for smaller countries such as Slovakia and several other countries in Central and Eastern Europe. The relatively small market for assistive technologies, combined with lower average income levels, often makes it difficult for blind users to purchase braille displays independently, while public funding schemes for such technologies are frequently limited. At the same time, the widespread adoption of personal computers and screen readers in the 1990s and early 2000s enabled many users in these countries to access digital information through speech output alone, which represented a significantly more affordable solution. As a result, computer use without braille displays became the dominant model of digital accessibility. Over time, this has also influenced expectations within educational systems and among users themselves, where braille displays are not always perceived as a standard component of computer equipment for blind people. Consequently, a self-reinforcing cycle can emerge in which limited demand, constrained funding and reduced institutional emphasis on braille technology continue to affect the availability and everyday use of refreshable braille displays.

Despite the situation described above in Slovakia and in some other Central and Eastern European countries, we recognise that refreshable braille displays remain an important tool in educational contexts. They enable blind students to read text in braille while teachers simultaneously view the same content in standard print on the screen, facilitating direct interaction and feedback in classroom communication. This form of parallel access is particularly valuable in subjects that require precise reading and writing, such as natural sciences, mathematics and foreign languages, where the tactile representation of symbols, spelling and structure plays a crucial role in learning.

At present, no clear pathway out of this self-reinforcing cycle has been identified; nevertheless, ensuring broader access to Braille technologies and advocating for their systematic support should become a key priority in the near future.

International Braille Conference 2025 in Slovakia

The publication by Tkáčik and Ježíková (2025) is closely connected with the international conference “The Current Status of braille in Society and Its Future Use”, held in October 2025 at the Slovak Library for the Blind in Levoča. The conference brought together experts, educators, technology developers and braille users to discuss the role of braille in education, culture, assistive technology and information access.

Several contributions addressed technological developments shaping the contemporary braille ecosystem. These included presentations on the historical evolution and current technological workflows of braille embossing, highlighting the transition from traditional mechanical production to fully digital pre-press processes supported by specialised software and automated printing technologies. Particular attention was devoted to the modernisation of production environments in braille printing houses, the use of high-capacity braille embossers, and the integration of artificial intelligence into pre-press preparation and data processing workflows as a very possible future of these processes.

Technological innovation was also reflected in discussions on the digital preparation of braille documents, the role of assistive technologies such as refreshable braille displays, and the growing importance of interoperable digital standards for braille representation. These developments are closely linked to broader international initiatives aimed at improving the accessibility of digital information for blind users and ensuring compatibility between screen readers, braille translation software and tactile output devices.

An additional perspective on the technological development of braille was presented through the example of the Corvus application, a software environment for the Android operating system. It is a specialised assistive platform developed in Slovakia that represents a unique approach to accessible user interface design for blind users, integrating braille support across multiple interaction layers.

One of the key components of the Corvus application is a braille on-screen keyboard, which allows users not only to enter text quickly using the braille input method but also to perform efficient text editing. Within this environment, users can select blocks of text, copy, move or delete content, and navigate through text using braille commands. The keyboard also offers a read-only mode, which prevents accidental modification of the text when navigating through it, thereby increasing safety and usability during reading.

The Corvus application also implements a braille-based navigation layer. By placing fingers on the touchscreen in Braille dot configurations and entering braille characters directly on the phone display, users can navigate through interface elements such as headings, tables, buttons and other structural components in a way similar to navigating structured content on the web. This approach enables braille to function not only as an output medium but also as an active control interface for interacting with digital environments.

The system further demonstrates innovative uses of braille in the field of interactive learning and training. For example, the game “Beekeeper” was developed within the Corvus environment as a training tool designed to improve braille skills through gameplay. By combining braille input with interactive elements, the game supports the development of braille fluency and tactile interaction skills in an engaging way.

Overall, the development of Corvus illustrates the potential of locally developed assistive technologies to expand the functional scope of braille and to support innovative forms of

digital accessibility, showing how braille can remain a dynamic and evolving component of modern digital interaction.

The conference also provided valuable comparative perspectives on braille use in Central Europe. One of the keynote contributions presented research on the use of braille among adults with blindness or visual impairment in Hungary and Poland, delivered by Judit Gombás and Marta Kanarek. The presentation offered insights into patterns of braille literacy, educational background and everyday use of braille among adult users, contributing to a broader understanding of the current position of braille in contemporary European societies.

Taken together, the scholarly article by Tkáčik and Ježíková (2025) and the 2025 international conference held in Slovakia represent complementary components of a broader set of activities undertaken by the Braille Authority of Slovakia in 2025. These activities aim to strengthen braille literacy, stimulate international cooperation and support the integration of emerging technologies into the braille ecosystem. In doing so, they reaffirm the continuing relevance of braille as a fundamental tool for education, information access and full participation of blind people in contemporary digital society.

About the Braille Authority of Slovakia

The Braille Authority of Slovakia (SABP) plays an important role as a national expert body coordinating professional activities related to braille standardisation, research and advocacy for braille literacy. SABP contributes to the development of national rules for writing and using braille, provides consultations on braille technologies and tactile graphics, and supports the production of accessible educational materials. In addition, it actively participates in international expert networks and standardisation activities, including cooperation within the Braille Working Group of the European Blind Union and related initiatives focusing on tactile information and accessible environments.

References

International Braille Conference 2025 in Slovakia: Current Status of Braille in Society and Its Future Use. https://www.skn.sk/konferencia-sabp-2025/en.html

Tkáčik, M. & Ježíková, M. (2025). Traditional versus modern ways of teaching reading and writing braille in Slovakia. Štúdie zo špeciálnej pedagogiky 2025, roč. 14, č. 1 (Marec 2025). https://www.unipo.sk/public/media/26527/Štúdie%20zo%20špeciálnej%20pedagogiky%202025,%20roč.%2014,%20č.%201.pdf

Quiet AI: How Artificial Intelligence Is Subtly Reshaping Life for the Visually Impaired — Zaheer Ally

Independent executive and global south–based thought leader on governance, power, and disability.

The idea for this article came to me during a recent editorial meeting while we discussed possible themes for this issue.

Whilst I fumbled with my iPhone during the meeting, I realised I had a fleeting thought during my morning walk and, as I often do, had grabbed my phone to record a voice memo before the idea evaporated. Later, scrolling through my notes, I noticed the little waveform icon next to the recording. Out of curiosity, I tapped it.

Within seconds, the rambling, two-minute audio file had been transformed into a clean, readable transcript. Every "um," every half-finished sentence, was rendered perfectly into text.

It was a small thing. A "nice to have" feature. But it stopped me in my tracks.

My mind shot back to my university days. I'd sit in lectures, a clunky Dictaphone balanced on my desk, desperately trying to keep up. Then came the real work: the long, laborious hours in my room after class, headphones on, finger poised over the play and pause buttons, transcribing the professor's words into notes. It was a necessary evil, a time-sink that cost me countless weekends.

That simple transcription feature on my iPhone wasn't just a convenience; it was a solved problem I hadn't even thought to complain about anymore. It was a ghost from my past, exorcised by a piece of code I'd taken for granted.

It got me thinking. Those of us who are visually impaired often focus on the headline-grabbing innovations: the self-driving cars, the facial-recognition apps that describe the scene around you, the smart glasses that promise to narrate the world. But what about the quiet revolution? What are the subtle, almost invisible ways that Artificial Intelligence has woven itself into the fabric of our daily lives, smoothing the path in ways we no longer even notice?

We are living through a period of Quiet AI, a technology that doesn't announce itself with a bang, but works in the background. It's not about grand, dedicated "accessibility modes." It's about mainstream features that have inadvertently become adaptive layers of enhancements for those of us who navigate the world differently.

Here are a few of the subtle, silent game changers I've realised I now take for granted.

1. The Death of the JPG Menu (and the Small Print)

For years, one of the most irritating barriers in daily life was the "unreadable document." A takeaway menu pinned to a noticeboard. A leaflet for a local event. A letter from the

bank. The small print on a medicine bottle. These were islands of information completely cut off from my digital, screen-reader-friendly world.

Then Optical Character Recognition (OCR) got a massive, AI-powered upgrade. It's no longer the clunky software of the 90s. It's now baked into my phone's camera and scanning apps. I can point my iPhone at a random leaflet, take a photo, and within a second, my phone reads the text aloud. My finger slides across the screen, and VoiceOver speaks: "Tonight's special: Sheep's Head." … uh, no thanks, next item please.

But the real magic is when the AI goes beyond raw reading. Apps like Seeing AI don't just transcribe a bill, they find the "total amount due" and read it first. They identify barcodes so one can mail a package alone. They recognise currency, saving you from handing over a R20 note instead of a R10.

It's not an "accessibility app" I had to seek out. It's just the camera, doing something quietly miraculous. And cumulatively, these small wins represent a massive transfer of independence. It's the difference between asking for help and just handling it yourself.

2. Seeing with Sound

We all know about audio descriptions for movies and TV, the narrator describing the action during pauses in dialogue. That's a dedicated accessibility feature. But what's far more subtle is the descriptive power now hidden in the most mundane places.

When I scroll through Instagram or Facebook, the AI doesn't just see a photo; it generates alt-text. My screen reader doesn't just say "image." It says, "Image may contain: pizza, table, indoor, three people smiling." It's not perfect, but it provides context that simply didn't exist for us a decade ago. It turns a wall of silence into a social conversation.

Even more profound is the way AI is used in apps like GoodMaps Explore. They don't just give turn-by-turn directions like a GPS for cars. They use AI to create a 3D audio landscape, placing digital "beacons" at landmarks. As I walk, I hear a soft chime and a whisper in my ear: "You are approaching the main library entrance." It's a subtle, non-intrusive layer of information that builds a mental map of the world without demanding my full attention.

3. The Assistant that Anticipates

Some of Quiet AI's most powerful forms don't wait for you to point a camera or ask a question. They just nudge you at the right moment.

My phone now suggests a route home when I leave work, even if I haven't opened Maps. It learns my routine. For someone with low vision who doesn't drive, this is a small but genuine reassurance, the phone quietly offering, "Traffic is light on the bus route today."

Then there's predictive text and smart replies. When I'm typing an email, the AI finishes my sentences with eerie accuracy. "See you at..." becomes "See you at 3pm in room

204." I type less, which means fewer proofreading headaches. Gmail now offers one-tap summaries of long threads: "Here's what you need to know." For an educator drowning in parent emails, that’s not just convenience, it’s survival.

And perhaps the most subtle of all: my phone alerts me if I've left my AirPods behind, or flags an unfamiliar sound (a smoke alarm, a door knock) and vibrates a pattern. I didn't ask for these features. The AI is just watching out.

For visually impaired learners and teachers, this anticipatory layer is still young, but it's already quietly saving spoons. No fanfare. No "accessibility mode." Just a device that seems to know what you need before you say it.

The Unseen Operating System

The point isn't that these technologies are perfect. They aren't. The transcription still occasionally produces hilarious nonsense. The image recognition can mistake a fire hydrant for a child. But the true revolution is their ubiquity.

For educators, this shift is already visible in the classroom. A student can photograph a handout and have it read aloud instantly, no waiting for a braillist or a volunteer. A low-vision learner can follow a live-transcribed lecture on their phone in real time. Quiet AI doesn't replace good teaching; it removes the friction that used to come between a student and the lesson.

We tend to look for innovation in the big, shiny objects. But for many in the disabled community, the most profound innovations are the ones that disappear. They are the quiet, intelligent helpers that dissolve a barrier here, save an hour of frustration there, and slowly, silently, make the world a more navigable place. And sometimes, it takes an old memory of a Dictaphone and a late-night transcribing to realise that some of the most revolutionary accessibility tools are the ones we barely notice anymore.

Digital Catalysts for Inclusion: The Saksharta Model, Artificial Intelligence, and the Transformation of Education for the Visually Impaired — Dr. Homiyar Mobedji

Director Programmes, Benetech [Asia & Africa], Ahmedabad Gujarat India

The global educational landscape is currently navigating a period of profound transition, characterized by the intersection of rapid digital innovation and a renewed commitment to universal human rights. For the estimated 270 million individuals living with visual impairment in India—including 9.2 million who are blind—the historical barriers to literacy and participation have been rooted in a persistent "book famine" and a lack of accessible infrastructure. As digital innovation accelerates, the emergence of the Saksharta model, developed through the pioneering work of Benetech in India and other developing countries, represents a systemic shift toward inclusive education. This model leverages

technology and artificial intelligence (AI) to redefine independence and literacy for learners who are blind, deafblind, or have low vision.

The Saksharta Model: A Framework for Self-Reliant Learning

The Saksharta program is fundamentally a literacy and digital access initiative designed to empower India's blind and visually impaired community through digital accessibility tools and specialized training. By supporting over 80 schools and colleges, the program promotes learning, career readiness, and social inclusion. The core philosophy of the Saksharta model is the "blended method," which combines traditional assistive tools like tactile learning with cutting-edge digital resources, such as e-books, online materials, and digital documents. This strategy expands access to a vast trove of educational materials while fostering self-reliant learning, reducing the student's dependency on human scribes or other external aids.

Implementation of the Saksharta model follows a structured three-year timeline designed to ensure sustainability and institutional growth. The program specifically targets regions with a high prevalence of poverty, recognizing that the intersection of visual impairment and economic disadvantage often reinforces systemic barriers to employment and health.

Saksharta Program Implementation Phases

Phase	Timeline	Primary Objectives and Deliverables
Year 1	July 2024 – June 2025	Deployment of digital literacy infrastructure in 30 schools and colleges; initial teacher training sessions.
Year 2	July 2025 – June 2026	Refresher training for Year 1 institutions; onboarding and infrastructure support for 30 additional schools.
Year 3	July 2026 – June 2027	Onboarding of more schools; large-scale conversion of 15,000 pages per month into accessible formats; comprehensive evaluation.

The program aims to support a minimum of 5,000 students and 500-800 educators across 13 Indian states, including Gujarat, Maharashtra, Karnataka, Tamil Nadu, and West Bengal. By establishing "10 model schools" to mentor new institutions, the Saksharta model creates a sustainable framework for inclusive education that extends beyond the initial intervention period.

Technological Equalization through Affordable, Accessible and Locally Available Assistive Solutions

One of the most significant contributions of the Saksharta model is its focus on affordable and readily available technology. Traditional assistive devices, such as refreshable Braille displays, can be cost-prohibitive for schools in developing countries. Benetech addresses this challenge by championing the use of standard Android devices coupled with physical USB keyboards or use of refurbished laptops. This combination serves as a cost-effective reading and writing solution that promotes inclusion by empowering students with greater autonomy in a mainstream digital environment.

The cornerstone of this digital ecosystem is Bookshare, the world's largest online library for individuals with print disabilities. Bookshare offers more than 1.3 million titles in over 50 languages, including 13 Indian languages such as Hindi, Bengali, and Tamil. By utilizing smartphones, laptops and tablets, students can access textbooks, career resources, and bestsellers, effectively bridging the digital divide. The platform provides features such as high-quality audio, karaoke-style highlighting, and text enlargement, ensuring that the reading experience is optimized for the specific needs of each learner.

Impact of Bookshare and Digital Tools in India

Metric	Details and Impact
Membership	Over 25,000 active members in India accessing localized content.
Linguistic Diversity	Interfaces available in 13 Indian languages to support diverse regional curricula.
Educational Parity	Students write exams independently using screen readers on laptops, replacing traditional scribes.
Content Volume	Over 1.3 million accessible titles, including 10,000 freely available public domain books.

Artificial Intelligence: Expanding the Horizons of Accessibility

As artificial intelligence continues to evolve, its integration into the daily lives of persons with visual impairment has moved from the theoretical to the practical. AI-driven tools are now reshaping how students navigate their environments, interact with complex data, and participate in social activities. The International Council for Education of People with Visual Impairment (ICEVI) emphasized in its 2025 statement that the primary goal of AI in education should be the preservation of human agency and the enhancement of social and emotional learning.

Advances in Scene Interpretation and Navigation

AI-powered applications are increasingly utilizing computer vision and large-language models (LLMs) to provide real-time feedback on a user's surroundings. Jyoti AI, Seeing AI and Lookout are smartphone application developed, which identifies objects based on spoken prompts and guides users through audio and vibrational feedback. These tools allow users to "feel" where objects are located in real-time, significantly reducing the time spent searching for items in unfamiliar environments.

Furthermore, the integration of AI into wearable technology is creating hands-free interpretation solutions. Ray-Ban Meta smart glasses and Envision Glasses utilize AI to recognize faces, objects, and text, allowing users to ask questions about their environment and receive instant auditory responses. These innovations are particularly impactful for students navigating large university campuses or complex urban environments.

Breakthroughs in STEM and Creative Tools

Historically, Science, Technology, Engineering, and Mathematics (STEM) subjects have presented significant barriers for visually impaired students due to their heavy reliance on visual diagrams and notation. The A11yShape tool is an AI-assisted program that enables visually impaired programmers to create and verify 3D models. By taking digital pictures of models generated in the OpenSCAD code editor, the tool uses GPT-4o to provide detailed descriptions of the shapes from multiple angles. This allows blind developers to modify complex models—such as rockets or robots—without assistance from sighted individuals.

For mathematical literacy, Benetech has introduced modules focused on "Reading and Writing Math," bringing in international expertise to ensure that visually impaired students can engage with higher-grade mathematics independently. This is supported by the development of best practices for authoring MathML (Mathematical Markup Language) in EPUB files, ensuring that equations are perceivable by screen readers.

Empowering the Deafblind Community: Haptics and Tactile AI

For learners who are deafblind, traditional auditory or visual aids are insufficient. The latest innovations in assistive technology for this community focus on tactile and haptic feedback systems that translate environmental and digital information into physical signals.

Gesture Recognition and Haptic Interfaces

Recent research has introduced cloud-based, AI-assisted gesture recognition systems for individuals with Usher syndrome. These systems relocate tactile input and output from the hands to an arm-mounted sleeve, preserving manual dexterity while enabling continuous, bidirectional interaction. By using surface electromyography (sEMG) to

capture muscle activations, personalized convolutional neural networks (CNNs) can classify gestures in real-time, providing a scalable solution for long-term communication.

Real-Time Captioning and Two-Way Translation

NuCaption is a real-time captioning tool designed specifically for the deafblind community, transforming spoken conversations into immediate text that can be read via Braille displays or felt through tactile feedback. Additionally, new AI-powered devices are being developed to translate sign language into text or speech, and vice versa. A prototype inspired by the Perkins Braille Machine uses a microphone to capture speech, processes the audio using AI, and converts it into specific vibration patterns that the user can interpret as Braille characters.

Case Study: Gender Equity and Exam Independence in Anantapur

The impact of the Saksharta model is most vividly demonstrated in the success stories emerging from rural India. In Anantapur, Andhra Pradesh, a historic milestone was achieved when six visually impaired girl students successfully wrote their 10th-grade exams independently using laptops equipped with screen-reading software. Supported by the Rural Development Trust (RDT) and the Benetech India team, these students moved away from traditional Braille scripts and human scribes, which had long been the only options for board examinations.

This initiative addressed the specific educational disparities faced by women with disabilities in India. While the general literacy rate for Indian women is approximately 62.3%, the rate for women with disabilities drops significantly to 45%. By providing these students with Lenovo tablets and laptops, Benetech and its partners transformed the learning environment, allowing the girls to access over 800,000 titles on Bookshare and participate in subjects like Mathematics and Science on an equal footing with their peers.

The Anantapur Examination Framework

Subject	Technological Approach	Results and Observations
English & Telugu	Screen-reading software on laptops for reading and typing answers.	Students completed exams faster than the allotted 4 hours, some in 2.5 hours.
Mathematics	Use of specialized math-reading software and tactile supplements.	First successful instance of using laptops for board math exams in the state.

Science & Social Science	Integration of digital question papers uploaded directly to laptops.	Printouts of typed answer sheets were sent for official evaluation.

Mahak P., one of the participants, noted that before the introduction of these tools, she felt "trapped" by the limitations of traditional materials. The transition to digital literacy not only improved her academic performance but also fuelled her ambition to become a clinical psychologist, illustrating how technology serves as a catalyst for expanded career aspirations.

Global Perspectives: Kenya and the Philippines

The Saksharta model's success in India has paved the way for its implementation in other developing countries, specifically Kenya and the Philippines. These programs focus on bridging the digital divide through localized solutions and strategic advocacy.

Strategic Interventions in the Philippines

In the Philippines, individuals with print disabilities face significant barriers due to the digital divide and a lack of accessible materials, particularly in rural areas. Benetech has responded by establishing "Reading Corners" in collaboration with local library authorities. These spaces are equipped with accessible technology and curated resources, serving as models for community-based inclusion. Furthermore, Benetech advocates for "born-accessible" publishing, encouraging local publishers to create digital books with built-in accessibility features from the start.

Capacity Building in East Africa

In Africa, Benetech partners with the Kenya Institute for the Blind and various government entities to develop inclusive education policies. The program leverages local expertise to ensure that interventions are culturally appropriate and sustainable. A major focus in the region is the promotion of modern pedagogy over rote memorization, utilizing Android devices and USB keyboards to foster independent reading and writing skills.

Challenges and Barriers to Inclusive Education

Despite the progress made by the Saksharta model and AI advancements, systemic challenges persist in implementing technology-based inclusive education in developing countries. A comparative systematic literature review reveals that the gap between policy intentions and classroom practices remains wide.

Structural and Infrastructural Barriers

In many developing contexts, the fundamental infrastructure required for inclusive education is missing. This includes accessible buildings, stable electricity, and consistent internet access. In rural areas, the digital divide is exacerbated by a lack of

communication infrastructure, making it difficult for students to access digital libraries like Bookshare.

Barrier Category	Specific Challenges Identified
Technology	Poor internet connectivity; high cost of specialized hardware; incompatibility of software platforms.
Human Resources	Shortage of trained special education teachers; lack of digital competence among regular educators.
Societal	Social stigma against individuals with special needs; bullying from peers; low parental awareness.
Policy	Weak enforcement of inclusive education mandates; insufficient funding for professional development.

Teacher Training: The Key to Sustainable Success

The Saksharta model recognizes that empowering educators is crucial for the success of any inclusive education program. Benetech provides comprehensive training modules for teachers, librarians, and parents, equipping them with the skills to guide visually impaired children toward academic success. These modules are designed to be self-paced and accessible, ensuring that educators can balance training with their existing responsibilities.

Benetech Accessibility Training Modules

Module Name	Audience	Duration	Key Learning Outcomes
DEI+A in the Classroom	General & Special Educators	1.5 Hours	Understanding disability, equity, inclusion, and basic accessibility standards.
International Inclusive Education	Educators & Parents	4 Hours	Overview of mathematical literacy; inclusive examinations; using Android for reading and writing.

Librarian Training	Librarians	Varies	Understanding disabilities that impact reading; assistive technology tools; reading systems.
Bookshare for Educators	School Administrators	30 Mins	Managing student and organization accounts; finding and assigning books; roster management.

The "train-the-trainer" model ensures that knowledge is sustained within schools and shared across regions, creating a ripple effect of empowerment. In India, partnerships with organizations like the National Federation for the Blind (NFB) have facilitated workshops that focus not only on technical skills but also on mobility, body language, and professional presentation.

Born-Accessible Publishing: Building an Inclusive Future

For digital inclusion to become the norm rather than the exception, the publishing industry must shift toward "born-accessible" standards. Benetech's Global Certified Accessible (GCA) program is the first independent third-party certification that ensures ebooks are accessible from the moment of their creation. By adjusting publisher workflows, the program helps ensure that content meets the needs of all readers, including those with print disabilities.

The EPUB 3 Standard

The EPUB 3 format is the industry gold standard for accessible publishing, offering a superior reading experience compared to traditional PDF files. Because it is based on HTML 5, EPUB 3 supports rich navigation, structural semantics, and personalized presentation features.

Feature	**PDF**	**EPUB 3**
Typography	Fixed fonts and sizes chosen by the designer.	Personalizable fonts, sizes, and spacing for the reader.
Layout	Fixed layout; difficult to navigate with screen readers.	Reflowable content; supports logical reading order and structural markup.
Navigation	Limited internal linking.	Complete table of contents; support for bookmarks and highlights.

Accessibility	Often lacks alt-text and semantic tagging.	Built-in support for image descriptions and accessibility metadata.

Certified publishers, such as Taylor & Francis, McGraw Hill, and Pearson Education, have committed to providing readers with accessible content by meeting EPUB Accessibility 1.1 and WCAG 2.2 AA guidelines. The European Accessibility Act further mandates that all digital goods and services available in the EU after June 2025 must be fully accessible, creating a legal imperative for publishers to adopt these standards.

Career Readiness and Socio-Economic Participation

The ultimate goal of the Saksharta model is to transition students from the classroom to the workforce, ensuring they can contribute meaningfully to society and achieve financial independence. Benetech and its partners provide career readiness programs that focus on digital skills, English communication, and work-readiness attitudes.

Employability Initiatives in India

Organizations like the Enable India, KVF – Chennai and Vision-Aid offer specialized training programs for visually impaired individuals. The TTI – Pune Customer Care Executive Course provides free residential training and placement support, equipping students with assistive technology skills and professional readiness to secure employment in the customer support industry. Similarly, the Enable Academy offers course packs that help persons with vision impairment build resumes, prepare for interviews, and understand workplace solutions used by role models in the field.

Assistive Technology Products for Independence

A thriving ecosystem of Indian startups is developing hardware that supports independent daily living and professional success.

Organization	**Key Products and Solutions**
Torch It	Saarthi Smart Cane for obstacle detection; Saksharta Inclusive Education Kit; Jyoti AI Pro smart glasses.
Thinkerbell Labs	Annie, the world’s first self-learning Braille device.
Vembi Technologies	Hexis, a refreshable Braille reader designed for inclusive schools.

Trestle Labs	Kibo, a device that digitizes and "audio'tizes" printed and handwritten content in over 60 languages.
Raised Line Foundation	Tactile diagrams and books in accessible formats for sensory exploration.

The Saksharta Advanced Empowerment Kit, developed by TorchIt in partnership with Benetech, is a comprehensive solution that includes AI glasses, a tactile keyboard, and a smartphone or a refurbished laptop preloaded with accessible apps. These tools are designed for use in classrooms, homes, and offices, redefining what it means for a visually impaired individual to be "equipped" for the modern world.

Institutional Frameworks and the Capability Approach

The work of Benetech and ICEVI is supported by theoretical frameworks that emphasize human dignity and the right to achieve one's full potential. The Capability Approach, pioneered by Amartya Sen, offers a normative framework for assessing growth as the achievement of certain "capabilities" or real freedoms. In the context of inclusive education, this means that providing a student with a device is not enough; the student must also have the skills (confidence), the content (accessible books), and the social connection (belonging) to transform that device into a tool for flourishing.

ICEVI's "Visionary Learning through Technology" initiative explicitly links these five elements—Kit, Confidence, Content, Connection, and Culture—to ensure that learners with visual impairment are not just participants in a classroom but active members of their communities. This holistic approach aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 4, which calls for inclusive and equitable quality education for all.

The Role of Global Advocacy: The Marrakesh Treaty

A critical enabler of the Saksharta model and the global accessibility movement is the Marrakesh Treaty, administered by the World Intellectual Property Organization (WIPO). The treaty facilitates the production and international exchange of specially adapted books for people with blindness or visual impairments by establishing copyright exceptions. India's ratification of the treaty in 2014 was a watershed moment, enabling Indian organizations to legally convert copyrighted works into accessible formats.

By allowing the cross-border exchange of these materials, the Marrakesh Treaty ensures that a visually impaired student in a remote village in India can access the same knowledge as their peers in other treaty-member nations.

Future Outlook: Preserving Human Agency in an Automated World

As we look toward 2030, the intersection of AI and disability inclusion holds immense promise, yet it requires careful stewardship. The ICEVI 2025 celebration calls for the active involvement of individuals with disabilities in the development and testing of AI tools to guarantee usability and inclusivity. The focus must remain on ensuring that AI complements human decision-making rather than diminishing the social and emotional dimensions of learning.

The Saksharta model serves as a beacon for future innovators, demonstrating that locally relevant, affordable, and accessible technology can dismantle the barriers to literacy and participation. By combining digital tools with specialized training and robust advocacy, we are paving the way for a world where visual impairment is no longer a barrier to education, employment, or a dignified life.

In conclusion, the transformation of education for persons with visual impairment is not merely a technological challenge but a social and ethical imperative. Through the collective efforts of organizations like Benetech, ICEVI, and their local partners, we are witnessing the emergence of a truly inclusive global society—where every learner has the opportunity to read, learn, and thrive, regardless of their visual status or socio-economic background. The success stories of students in Anantapur, the expansion of digital literacy to Kenya and the Philippines, and the pioneering work in tactile AI for the deafblind all point to a future defined by empowerment rather than dependency. As digital innovation continues to accelerate, the goal remains clear: to ensure that the light of knowledge is accessible to all.

Expanding Access through Round Table Guidelines — Sonali Marathe

Executive Member, Round Table on Information Access for People with Print Disabilities

For educators of students who are blind, have low vision, or other print disabilities, access to high-quality learning materials is fundamental to participation, achievement, and inclusion. Across Australia and Aotearoa New Zealand, the Round Table on Information Access for People with Print Disabilities (Round Table) has played a leading role in advancing accessible information through collaboration, knowledge sharing, and the development of practical guidelines that support the production of accessible formats.

What is Round Table?

Round Table is a collaborative member-led network of organisations and professionals committed to improving access to information for people with print disabilities. Its membership includes educators, accessible-format specialists, libraries, advocacy organisations, and technology experts who work together to promote best practice in accessible information.

Round Table has two subcommittees, which bring together expertise in particular areas of accessibility.

Australian Braille Authority (ABA)

The Australian Braille Authority (ABA) is an important Round Table subcommittee. ABA oversees the development and maintenance of braille codes and specifications used throughout Australia, ensuring consistency and quality in braille production and education.

ABA also acts as a braille accreditation body and promotes braille as the primary literacy medium for people who are blind, deafblind, or have severe vision impairment. In addition, ABA provides technical guidance, develops braille resources, and supports the adoption and implementation of Unified English Braille (UEB) and other specialist braille codes.

Australian and New Zealand Accessible Graphics Group (ANZAGG)

The Australian and New Zealand Accessible Graphics Group (ANZAGG) is a standing subcommittee of Round Table that serves as a forum for sharing information and expertise on strategies for providing access to graphics and visual information for people with a print disability.

ANZAGG promotes best practice in tactile graphics, image descriptions, accessible diagrams, maps, STEM graphics, and emerging technologies such as 3D printing. Through collaboration between educators, accessible-format producers, researchers, and users of tactile graphics, the group helps ensure that visual information can be effectively accessed and understood by learners with print disabilities.

Together, ANZAGG and ABA play a vital role in supporting accessible literacy and equitable access to information.

Guidelines that Support Accessible Learning

One of Round Table's most significant contributions is the development and maintenance of comprehensive guidelines for producing accessible formats.

These guidelines cover a broad range of formats, including audio, braille, large print, e-text, tactile graphics including 3D prints. Designed to support quality, consistency, and usability, they provide practical advice for anyone involved in creating accessible content, from teachers, transcribers, government and non-government organisations to publishers and disability support professionals.

All Round Table guidelines are available free of charge from the Round Table website and can be downloaded in a range of electronic formats. The guidelines are released under a Creative Commons Attribution-Non Commercial-No Derivative Works licence, allowing organisations and individuals to distribute the documents freely, provided they

are not modified, sold for profit, and Round Table is acknowledged as the copyright holder.

Key Round Table Guidelines

The current suite of guidelines includes:

Guidelines for Accessible Assessment

Supporting the creation of assessments that are equitable and accessible for learners with print disabilities, ensuring that assessments measure knowledge and skills rather than access barriers.

Guidelines for Producing Accessible 3D Prints

Providing guidance on designing and producing tactile 3D learning resources that support concept development, spatial understanding, and access to complex visual information.

Guidelines for Producing Accessible E-text

Promoting the creation of accessible digital content that works effectively with screen readers, refreshable braille displays, magnification software, and other assistive technologies.

Guidelines for Producing Accessible Graphics

Offering best-practice approaches for converting visual graphics and images into tactile and accessible formats that can be explored through touch and supported with clear descriptions.

Guidelines for Producing Clear Print

Supporting the creation of documents that meet the needs of people with low vision through appropriate use of font size, contrast, layout, and design.

Sound Advice Guidelines

Providing guidance on the production of high-quality accessible audio resources that are clear, consistent, and easy to navigate.

ABA Guidelines for Foreign Language Materials

Assisting braille producers and educators in the transcription of foreign language materials using Unified English Braille.

ABA Chinese (Mandarin) and UEB

Providing guidance on the representation and transcription of Mandarin Chinese alongside Unified English Braille, supporting access for multilingual learners and readers.

Why These Guidelines Matter

As educational resources become increasingly digital, interactive, and visually rich, ensuring accessibility from the outset is more important than ever. The Round Table guidelines provide educators, publishers, and accessibility professionals with trusted, practical resources that help create learning materials that are accessible, usable, and effective.

For content creators and teachers, these guidelines offer valuable support in planning inclusive reading and learning experiences. For accessible-format producers, they provide consistency and quality standards. Most importantly, they help ensure that people with print disabilities can access information in formats that meet their individual needs.

By making these guidelines freely available, Round Table continues to support inclusive information access, not only within Australia and New Zealand but also for people around the world.

To explore and download the complete suite of guidelines, visit Round Table Guidelines and ABA resources page**.**

From Cricket Fields to Classrooms: Harnessing Technology and AI to Build an Inclusive World for Persons with Visual Impairment — Dr. Mahantesh G. Kivadasannavar

Founder and Managing Trustee of Samarthanam Trust for the Disabled; Chairman of the Cricket Association for the Blind in India (CABI)

Introduction

The world stands at a remarkable inflection point where artificial intelligence (AI) and digital technology are no longer merely tools of convenience but instruments of liberation. For the nearly 285 million people worldwide living with visual impairment, this moment carries extraordinary promise. Technology has the power to dismantle barriers that have persisted for generations, transforming how persons who are blind or partially sighted learn, work, communicate, and participate in society.

Technology as a Bridge, not a Barrier

For too long, persons with visual impairment have been positioned as passive recipients of charity rather than active agents in society. Samarthanam Trust for the Disabled, founded in 1997 with the radical conviction that persons with disabilities are potential taxpayers rather than burdens, has demonstrated through its programmes across 10 Indian states what becomes possible when this perspective guides action.

Across its initiatives in education, livelihoods, skill development, and rehabilitation, Samarthanam has seen technology serve as a great equaliser. Screen readers such as JAWS (Job Access with Speech) and NVDA (Non-Visual Desktop Access) have enabled

thousands of blind students to access digital textbooks and online platforms. Optical Character Recognition (OCR) tools have converted print materials into accessible audio formats, bridging the gap between sighted and non-sighted learners. Refreshable Braille displays have brought independence to learners in remote and underserved communities. Each of these tools has meaningfully expanded the circle of opportunity for persons with visual impairment.

Artificial Intelligence: A New Frontier for Inclusive Education

The emergence of AI introduces capabilities that go far beyond traditional assistive technology. AI-powered tools can today describe images in real time, navigate complex visual environments, read handwritten text, and personalise learning pathways to an individual's pace and style. For persons with visual impairment, these advances represent a qualitative shift in what inclusive education can look like.

AI-based image recognition, for instance, allows a blind student to receive an instant, detailed description of a scientific diagram, a graph in a textbook, or a photograph, information that was once entirely inaccessible.

Natural Language Processing (NLP) tools have made conversational interfaces available to learners who face barriers with traditional keyboard-based interaction. Voice-enabled AI assistants extend independence well beyond the classroom, supporting daily living tasks from reading medicine labels to navigating public transport.

Intelligent tutoring systems powered by AI hold particular promise for inclusive education. By adapting content delivery, pacing, and assessment to individual learning profiles, these systems can cater to the diverse needs of learners with visual impairments, whether congenitally blind, low-vision, or Deafblind. The prospect of truly personalised, adaptive education at scale, in accessible formats, is closer than ever before.

Sport, Culture, and Technology: An Unexpected Intersection

Dr Mahantesh’ s leadership of the blind cricket movement in India illustrates how technology's transformative power extends well beyond the classroom. Under his stewardship as CABI Chairman, India's blind cricket team claimed multiple T20 World Cup, ODI (One Day International) World Cup, and Asia Cup titles. A landmark achievement was the organisation of the first-ever Women's Blind Cricket World Cup, a milestone in global inclusive sports.

In this arena, too, technology has played an enabling role. Audio commentary technologies allow blind spectators to experience live sport; digital platforms support team management and match coordination. More broadly, blind cricket stands as a powerful metaphor for what technology can do: it does not eliminate challenge, but it levels the field so that everyone can compete on their own terms.

A similar philosophy guides Samarthanam Institute of Music and Performing Arts (SIMPA), founded in 2024, which uses digital platforms and assistive technologies to help

persons with disabilities access, create, and share artistic expression through adaptive music software, audio-described theatre, and digital platforms for cultural participation.

Challenges That Remain

Many powerful AI tools remain available only in major world languages, leaving behind large portions of the global blind community. Connectivity barriers in rural and low-income settings mean cloud-dependent AI services remain inaccessible to those who may need them most. The cost of advanced assistive devices continues to place them out of reach for families in developing economies.

There is also the critical question of design. Too often, AI and technology products are built without meaningful involvement from persons with visual impairment. Accessibility is treated as a compliance checkbox rather than a foundational principle. The global disability rights movement has long championed the principle: "Nothing about us without us." This must be central to how AI tools are conceived, developed, tested, and deployed.

Teacher capacity is another dimension requiring urgent attention. Even where technology is available, educators may lack the training to integrate it effectively into inclusive classrooms. Investment in teacher education, particularly preparing educators to support learners with visual impairment using AI tools, is as important as the technology itself.

A Call to Action

Governments, technology companies, educators, and civil society are currently making consequential decisions about the future of AI. These decisions will determine whether the AI revolution becomes one of inclusion or exclusion. The international community of educators and advocates for persons with visual impairment must be at the table, not as observers, but as architects.

Dr Mahantesh advocates for three core imperatives. First, universal design must become the default: all digital platforms, educational tools, and AI applications should be accessible from inception, not retrofitted as an afterthought. Second, multilingual AI accessibility must be urgently prioritised, with investment in tools designed for the languages spoken by the world's underserved blind communities. Third, meaningful inclusion of persons with visual impairment in technology design must be required across all stages of product development.

Global bodies must continue to advocate for international standards that make these tools interoperable, affordable, and available across borders.

Conclusion

Dr. Mahantesh's autobiography, Eye Opener, stands as a testament to the belief that adversity can be the greatest teacher and that human potential knows no boundary when the right conditions are created. Technology and AI, wielded with intention and equity, are among the most powerful instruments for creating those conditions.

The question is not whether AI will transform education and daily life for persons with visual impairment. It already is. The question is whether the global community will ensure this transformation reaches every person regardless of geography, language, economic status, or degree of disability. That is the challenge and the calling of our time.

About the Author

Dr Mahantesh G. Kivadasannavar is the Founder-Managing Trustee of Samarthanam Trust for the Disabled and Chairman of the Cricket Association for the Blind in India (CABI). For nearly three decades, he has championed disability rights, inclusive education, livelihoods, rehabilitation, sport, and the arts. He holds an M.A. and M.Phil. in English Literature from Bangalore University and has received numerous honours, including India's National Award for Empowerment of Persons with Disabilities. Dr Kivadasannavar has represented India at international forums, including the World Blind Union and DAISY Consortium conferences, and has been awarded three honorary doctorates for his outstanding contributions to inclusion and empowerment.

Empowering Braille Users Across Europe: The Work of the EBU Braille Working Group and the “Expert Table Talks” Series — Reiner Delgado and Michal Tkáčik

Reiner Delgado, Group Leader of the EBU Braille Working Group; and Head of Social Affairs, German Federation of the Blind and Partially Sighted (DBSV), Germany

Michal Tkáčik, Member, Steering Committee, EBU Braille Working Group; Head Coordinator, Braille Authority of Slovakia; Vice President, Slovak Blind and Partially Sighted Union’; and Matej Hrebenda Slovak Library for the Blind, Levoca, Slovakia
European Blind Union: The voice of blind and partially sighted people in Europe

As technology continues to reshape how we access and interact with information, ensuring that no one is left behind is essential. For braille users, the digital landscape, spanning refreshable Braille displays, offers powerful tools for independence, learning, and work. Yet unlocking this potential requires guidance, innovation, and shared expertise. Across Europe, the EBU Braille Working Group is driving this progress, harnessing technology to strengthen Braille literacy and equip users with the skills needed to access the technology to thrive.

In recent years, the European Blind Union (EBU) has significantly strengthened its efforts to promote Braille literacy, accessibility, and innovation across Europe. At the heart of these activities is the EBU Braille Working Group – a network of experts, practitioners, and users committed to supporting the role of Braille in education, employment, and everyday life.

The Working Group operates as a collaborative platform bringing together professionals from different countries and backgrounds. Its activities range from developing

recommendations on Braille literacy and fluency, to contributing to international campaigns, and fostering exchange through the Livingbraille.eu platform, which serves as an open space for sharing knowledge, experiences, and resources related to Braille.

A Practical Focus: From Policy to Everyday Use

One of the key strengths of the EBU Braille Working Group lies in its ability to connect strategic thinking with practical, user-oriented solutions. While policy papers and research outputs remain important, there is a growing recognition that users also need concrete guidance on how to effectively use modern Braille technologies.

This is particularly relevant in the context of refreshable Braille displays, which play an increasingly central role in accessing digital information. Despite their potential, many users still face challenges related to connectivity, compatibility, learning curves, and efficient use.

To address these challenges, the Working Group launched in 2026 a new online initiative: the “Expert Table Talks on Braille Displays.”

The “Expert Table Talks” Series

The Expert Table Talks are a series of four interactive online sessions designed to support Braille users in mastering their devices and exchanging real-life experiences with experts.

Each session focuses on one of the four key dimensions of working with Braille displays:

- Connect – understanding how to connect Braille displays to computers, smartphones, and other devices;
- Consume – optimizing reading and accessing information through Braille in a digital environment;
- Control – learning how to operate devices efficiently using Braille display commands;
- Create – using Braille displays for writing and content creation.

This structured approach reflects the full lifecycle of Braille display use, from initial setup to advanced productivity.

International Exchange and Real-World Expertise

A defining feature of the Table Talks is their emphasis on peer learning and international exchange. Each session brings together experienced users, assistive technology specialists, developers, and trainers who share practical insights based on their daily work and personal experience.

The discussions are highly interactive and address real challenges faced by users, such as differences between USB and Bluetooth connectivity, the role of HID Braille protocols, compatibility across operating systems, and troubleshooting strategies.

Importantly, the experts participate in a personal capacity, contributing their knowledge voluntarily and creating an open and informal learning environment. This helps bridge the gap between manufacturers, professionals, and end users.

Reaching a Global Audience

Although initiated within the European context, the Table Talks have quickly attracted a global audience. The first session alone registered participants from more than 25 countries, highlighting the universal relevance of the topics discussed.

The online format allows for wide accessibility and encourages participation from users who might otherwise not have access to such expertise. Recordings of the sessions are also made available, ensuring that the knowledge shared can reach an even broader audience over time.

Anyone interested in these discussions on Braille displays is warmly invited to watch the sessions on the YouTube channel @livingbraille.

Looking Ahead

The Expert Table Talks demonstrate how international cooperation can effectively support Braille users in a rapidly evolving technological landscape. By combining expertise, lived experience, and open dialogue, the EBU Braille Working Group contributes not only to improving technical skills, but also to strengthening confidence and independence among Braille users.

As digital environments continue to develop, such initiatives will remain essential. They provide a model for how knowledge sharing, community engagement, and practical training can work together to ensure that Braille remains a vibrant and relevant tool for access to information worldwide.

Summaries and recordings of the sessions can be found on livingbraille.eu:

https://www.livingbraille.eu/topic/displays/.

AI, Braille, and Screen Readers: Rethinking Literacy for Learners with Visual Impairment in the Global South — Dr. Muhammad Shabbir

A learner who is blind can now hold a smartphone toward a page, a medicine label, or a crowded street, and hear it described in seconds. An application can read a scanned textbook aloud, summarise a dense research paper, draft a formal email, or narrate a photograph that no one thought to caption. For persons with visual impairment, the last three years of artificial intelligence have felt less like an incremental upgrade and more like a door swinging open.

I want to begin, however, not with celebration but with a distinction, because the difference between the two will shape the next decade of inclusive education. The arrival of powerful AI tools is widening *access* to information faster than at any point in history.

But access is not the same as inclusion, and inclusion is not the same as agency. A learner can be surrounded by information and still remain a passive recipient of it. The deeper purpose of education for any child is not merely to receive content but to acquire the capacity to read, understand, question, create, decide, and participate as an equal. That capacity is what I mean by agency, and it is the standard against which our new tools must be measured.

The scale of the opportunity — and the gap

The numbers explain why this matters so urgently. The World Health Organization estimates that at least 2.2 billion people live with a near or distance vision impairment, and that in around one billion of those cases the condition could have been prevented or has yet to be addressed (World Health Organization [WHO], 2026). The burden is not evenly distributed. Distance vision impairment is roughly four times more prevalent in low- and middle-income regions than in high-income ones (WHO, 2026), and an estimated nine in ten people with preventable or treatable vision loss live in lower- or middle-income countries (International Agency for the Prevention of Blindness [IAPB], 2023).

The technology gap is starker still. The 2022 WHO–UNICEF *Global Report on Assistive Technology* found that of the 2.5 billion people who need assistive products, nearly one billion are denied them, with access falling as low as 3 per cent in the poorest countries against roughly 90 per cent in the wealthiest (WHO & United Nations Children's Fund [UNICEF], 2022). For the regions often grouped, imperfectly, under the term "Global South," AI therefore arrives into a landscape where the most basic assistive tools — a white cane, a pair of spectacles, an accessible textbook — are still scarce. This is the equity question that frames everything else: a technology that depends on smartphones, data connectivity, and electricity does not automatically reach the learners who would gain the most.

A lesson we should already have learned

Before we decide what AI will mean for literacy, we should recall what happened the last time a transformative technology entered the lives of blind people.

When screen readers — software that converts on-screen text into synthetic speech — became widely available, a confident argument took hold in some quarters: Braille, it was said, was no longer truly necessary. A blind user could now listen to books, write documents, browse the internet, and communicate digitally without ever touching a dot. Why invest years in teaching a tactile code when a computer could simply read everything aloud?

They could not have been more wrong!

Screen readers were and are genuinely transformative, and I would not be writing this without them. But they did not replace literacy; they delivered information *around* it.

Listening to text is not the same as reading. Reading through a tactile system teaches a child how words are spelled, where punctuation falls, how grammar is structured, how a paragraph is shaped, how a mathematical equation or a line of computer code is laid out, and how an argument is built sentence by sentence. A learner who only ever listens may absorb content while never acquiring the architecture of written language itself.

The evidence on Braille bears this out. In the United States, where the data is best documented, more than half of blind students were Braille-literate in 1960; today the figure is commonly estimated at around ten per cent (National Federation of the Blind [NFB], 2009). Over the same period, the connection between Braille and economic independence has remained stubbornly clear: surveys repeatedly find that the large majority of *employed* blind adults are Braille readers (National Braille Press, n.d.). Correlation is not destiny, but the pattern is hard to ignore. The skill that was declared obsolete turned out to be closely tied to employment, dignity, and self-determination.

The same mistake, in a new accent

The reason this history matters is that the AI era invites us to repeat it, only faster and on a larger scale.

It is now tempting to treat an AI-generated summary as equivalent to reading the source, a voice assistant's answer as equivalent to research, and an automatic image description as equivalent to understanding what a picture actually contains. Each of these tools is useful. None of them is a substitute for the underlying competence. A summary reflects another system's judgment about what mattered; a generated description reflects a model's best guess, which can be confidently wrong; a spoken answer cannot, on its own, teach a child how to construct a spelled, punctuated, well-formed sentence of their own.

If we allow AI to become a comfortable replacement for literacy rather than a support for it, we risk producing a generation of learners with visual impairment who are *informed* but not *literate* — able to consume the written world but not to enter it as authors, scholars, and decision-makers. That is the difference between access and agency, and it is precisely the trap we fell into once before.

Toward a literacy ecosystem

The way out is not to romanticise old tools or fear new ones, but to stop treating them as rivals. Braille, screen readers, and AI are best understood as complementary parts of a single literacy ecosystem, each strongest where the others are weak.

Braille builds the foundational architecture of written language and remains essential for spelling, mathematics, music, and any field where exact notation matters; refreshable Braille displays now connect that tactile precision directly to digital devices. Screen readers provide speed, volume, and reach, opening vast libraries that could never be embossed. AI adds something new again: it can describe the visual world on demand,

make inaccessible material navigable, and lower the cost of producing accessible content in languages and scripts that publishers have long ignored.

A learner who commands all three is not dependent on any one of them. The child reads a passage in Braille to learn how it is constructed, uses a screen reader to move quickly through a long text, and turns to an AI tool to interpret an uncaptioned diagram — then writes their own answer, correctly spelled, in their own words. That is agency. The goal of inclusive education is to produce that learner, not to choose a single technology on their behalf.

Equity, ethics, and who builds the tools

For the Global South, three commitments will determine whether AI narrows the gap or widens it.

The first is equity of access. Tools that assume the latest smartphone, reliable bandwidth, and English-language fluency will deepen existing divides. The most valuable innovations will be those that work offline, on modest devices, and in local languages and scripts — and that treat affordable Braille production and teacher training as part of the same investment, not as competitors for the same budget.

The second is ethics. AI systems can describe the world inaccurately, reproduce the biases in their training data, and quietly collect information about some of the most marginalised users on earth. A learner who cannot independently verify what an AI tells them is uniquely vulnerable to its errors — which is itself an argument for literacy, not against it. Inclusive deployment requires honesty about these limits, attention to data privacy, and recognition that a confident wrong answer can be more harmful than no answer at all.

The third is participation. Persons with visual impairment in lower-income countries must be present not only as users of these technologies but as designers, researchers, educators, and decision-makers shaping them. The Convention on the Rights of Persons with Disabilities frames accessibility and education as rights, not charity, and rights are claimed by people who help build the systems that serve them. Knowledge about how blind learners read, work, and live is best produced with them, not merely about them.

Conclusion

Artificial intelligence is one of the most promising developments in the history of disability inclusion, and I welcome it without reservation as a tool. But a tool is judged by what it enables people to become. If AI expands access while quietly eroding literacy, it will leave learners with visual impairment better supplied and less free. If, instead, we build a literacy ecosystem in which Braille, screen readers, and AI reinforce one another, we can offer something far greater than access: the agency to read, to reason, to create, and to take one's place as a full participant in the world's knowledge — not as its audience, but as its authors.

References

International Agency for the Prevention of Blindness. (2023, August 29). *Bridging the equity gap in global vision*. https://www.iapb.org/blog/bridging-the-equity-gap-in-global-vision/

National Braille Press. (n.d.). *The need for Braille*. Retrieved June 3, 2026, from https://www.nbp.org/ic/nbp/about/aboutbraille/needforbraille.html

National Federation of the Blind. (2009). *The Braille literacy crisis in America*. https://nfb.org/braille-literacy-crisis-america

World Health Organization. (2026, February 10). *Blindness and vision impairment*. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

World Health Organization, & United Nations Children's Fund. (2022, May 16). *Almost one billion children and adults with disabilities and older persons in need of assistive technology denied access, according to new report* [Press release]. https://www.who.int/news/item/16-05-2022-almost-one-billion-children-and-adults-with-disabilities-and-older-persons-in-need-of-assistive-technology-denied-access--according-to-new-report

About the Author:

Dr. Muhammad Shabbir is a researcher, accessibility advocate, and Founder and CEO of Path Finder Solutions in Pakistan. He works on digital accessibility, inclusive technology, disability rights, and Internet governance and holds a Ph.D. in International Relations.

From classroom to career: Braille, AI, and the future of opportunity — Amina Boukhedimi

Communications and Marketing Advisor, HumanWare

For students who are blind, the conversation about technology is often framed as a choice between braille and newer digital tools. In practice, that choice is rarely so simple. Audio, OCR, image description, and artificial intelligence can expand access in important ways, but they do not automatically replace the literacy, precision, and independence that braille can provide. The World Blind Union and the International Council for Education of People with Visual Impairment (ICEVI) make this distinction clearly in their joint Global Braille Literacy Campaign: braille supports literacy and learning, including spelling, grammar, written expression, study, work, confidence, and autonomy, while digital tools remain important complements rather than substitutes for strong literacy foundations (World Blind Union & ICEVI, 2026).

Jane Constance’s journey illustrates this with unusual clarity. She is publicly known as a Mauritian singer and UNESCO Artist for Peace. UNESCO notes that she was born in

Mauritius in 2000, was blind at birth, began singing at age five, started learning piano at seven, studied music in London, won *The Voice Kids France* in 2015, and was named a UNESCO Artist for Peace in 2017 in recognition of her commitment to disability inclusion and empowerment (UNESCO, n.d.). Her educational story is equally significant.

Braille entered Jane's life early and remained central as she moved through school, university, and professional life. Over time, she used the BrailleNote mPower, later the Apex, and then the Touch Plus. For her, braille was never only a means of access. It was a means of authorship, precision, and control over language. She connects braille directly to spelling, grammar, vocabulary, writing, legal study, blogging, bilingual communication, and reading song lyrics accurately. In her experience, braille helped her develop strong language skills, not simply consume information.

That account aligns with current research. A scoping review by Croake, Gentle, and Duncan shows that braille literacy enables equal access to learning for students who are blind or have very low vision in mainstream inclusive classrooms, while also highlighting the need for strong pedagogy in braille instruction (Croake et al., 2025). Research on spelling similarly supports braille's role as a literacy medium rather than merely an access format. Clark and Stoner found that the spelling performance of braille readers in their study did not differ significantly from a normative sample, and subsequent work by Clark-Bischke and Stoner likewise reported spelling performance in written compositions comparable to that of sighted peers (Clark & Stoner, 2008; Clark-Bischke & Stoner, 2009).

Jane's classroom experience makes those findings tangible. With her BrailleNote, she could write in braille and connect the device to a screen so that her teacher could read her work, even without knowing braille. That detail matters pedagogically. It shows assistive technology not as a separate track, but as a bridge into shared classroom practice. This is a powerful example of how the right tools can support participation in mainstream learning without lowering expectations.

The progression of devices also mattered. Jane describes the mPower as relatively slow, the Apex as making internet access easier, and the Touch Plus as life-changing because it expanded what she could do online and academically. She links these changes directly to her educational trajectory, saying she would not have had the same academic path without those tools. Importantly, she does not describe them in narrowly technical terms. She connects them to real educational and social tasks: adapting to school, finding lyrics online, writing emails, communicating with others, and managing a fuller digital life.

Her university years in Preston develop the education-to-career argument further. Braille and braille technology were central to booking books online, reading, conducting research, emailing professors, organising work, and submitting dissertations on time. The issue is not simply that she had access to a tool. It is that braille supported a method of working: organised, independent, disciplined, and academically ambitious. This is where the discussion moves beyond accommodation alone. The question for educators is not

only whether a student can access material, but also whether that student is building habits of literacy, independence, and self-management that will matter in adult life.

Jane’s reflections on employment extend that argument still further. She now works in human resources, with responsibilities that include recruitment, interviews, background checks, selection criteria, and absence management. She also speaks directly about misconceptions in the labour market, calling it a myth that people who are blind cannot work independently. This remains true regardless of whether someone uses braille, audio, or another access method. In her experience, some recruiters still lack basic understanding of accessibility and assistive technology, and that gap causes them to overlook qualified candidates. Her account echoes a growing body of research showing that braille remains relevant not only in education but in professional life (McDonnall et al., 2024).

A second testimony, from Tanzania, reinforces the same pattern. Erick Maximillian Mlasani, a former student at Mvumi School and a beneficiary of the HumanWare BrailleNote trade-in programme, describes successive BrailleNote devices as gateways that helped him excel in secondary school, rank among the top advanced-level students nationally, succeed in law studies, earn a scholarship, secure early academic employment, and complete a master's degree with first-class results. Read alongside Jane’s account, Erick's testimony strengthens the case that early literacy, continuity of access, and sustained use of braille technology can shape not only classroom participation but long-term educational and professional outcomes.

Taken together, these accounts point to an important principle for educators: literacy develops over time, and the consistent use of appropriate tools matters most. A student who builds fluency, confidence, and independence with braille in school is better positioned to carry those habits into higher education and employment. In this sense, braille technology is not merely supportive; it can play a developmental role. At the same time, recent research suggests that braille-related practice among orientation and mobility specialists can be uneven, with 84% reporting that they rarely or never incorporate braille in their work with adults, highlighting the need for stronger training and confidence across the wider educational and rehabilitation ecosystem (Nemargut et al., 2026).

Neither Jane’s story nor the wider educational literature suggests that braille should be set against AI in a simplistic contest. Jane’s perspective is especially valuable here because she actively uses newer AI-enabled and smart assistive tools. She mentions using Meta smart glasses to capture video and sometimes read letters, using Be My Eyes for description, and seeing potential in newer tools for document presentation and summarisation. Yet she does not see these tools as replacements for braille. For her, braille still matters for spelling, vocabulary, writing, legal study, music lyrics, and direct control over what she writes. Her view is nuanced: there is no single valid answer for everyone, but braille remains essential knowledge and a source of independence.

That position is consistent with developments elsewhere in the field. APH's work on multiline braille presents braille as fundamental to reading, writing, and comprehension, while also showing how newer multiline displays can improve access to textbooks, classroom materials, layout, spacing, editing, and tactile information in modern learning environments (APH, n.d.). Braille is not static; it is developing alongside other technologies. The challenge, then, is not to choose between braille and AI, but to understand how students can use a range of tools without losing the deep literacy that braille can support.

From a product and technology perspective, this evolution is already visible in how braille tools are being developed and used in practice.

"AI is transforming accessibility, but it is not a complete solution on its own. While it can assist and speed up tasks, users still need to guide outputs and make informed decisions, such as recognising correct grammar or choosing between British and American spelling. In braille technology, AI shows real promise by improving workflows and reducing manual effort. Converting print into braille is complex and time-consuming, requiring careful attention to structure and layout. AI can streamline this process, generating accurate, well-formatted braille more efficiently and helping learners access materials sooner. It can also enhance tactile graphics by turning images into labelled tactile versions with added context, improving understanding. Ultimately, AI does not replace expertise. It supports it by handling repetitive tasks and allowing specialists to focus on quality while giving users faster, more accessible content in their preferred format," said Andrew Flatres, Product Manager, Braille Technologies.

From an educational and field perspective, these developments also point to a broader shift in how tactile access is delivered in classrooms. As Greg Stilson notes:

> "We are reaching a significant moment in the development of tactile access, where the possibility of on-demand tactile experiences is becoming increasingly real. Early developments, such as the integration of multiline braille displays with the APH Tactile Graphics Image Library, have already demonstrated this shift.
>
> Traditionally, these tactile graphics needed to be embossed and prepared in advance. With this integration, students can now search for graphics and receive results instantly, opening them in real time and allowing immediate tactile interaction rather than requiring custom production.
>
> As AI continues to improve, the ability to modify print images and content to meet the needs of braille and tactile learners is expanding rapidly. This creates new opportunities, but also raises important challenges related to accuracy, reliability, and the handling of copyrighted material, particularly in educational and assessment contexts.

These developments highlight a critical moment in accessibility, where technological progress must be matched with careful implementation to ensure quality and trust in educational environments."

Greg Stilson, Head of Technology Innovation, American Printing House for the Blind

For educators, the central issue may therefore be one of framing. Braille should not be treated as a legacy format awaiting replacement. It is a literacy medium. AI is a growing set of computational tools and supports. They do not solve the same problem, and they should not be expected to. The more productive question is how students can be given access to a range of tools while still developing the literacy, independence, confidence, and precision that braille makes possible.

Jane's closing message is as practical as it is hopeful. To parents and teachers unsure whether braille is worth the time and effort, she says: try it, because it can change a life. To students, she says: do not give up. To employers, she says: open the door to change and give talented people a chance. The future of inclusive education will not be determined by whether braille or AI prevails. It will be determined by whether students are given the literacy, access, expectations, and support they need to move from classroom learning to adult opportunity.

References

APH (n.d.). *The Monarch: Improving braille literacy for students*. American Printing House for the Blind. https://www.aph.org/blog/the-monarch-improving-braille-literacy-for-students/

Clark, C., & Stoner, J. B. (2008). An investigation of the spelling skills of braille readers. *Journal of Visual Impairment & Blindness*, *102*(9), 553–563.

Clark-Bischke, C., & Stoner, J. B. (2009). An investigation of spelling in the written compositions of students who read braille. *Journal of Visual Impairment & Blindness*, *103*(10), 668–679.

Croake, K., Gentle, F., & Duncan, J. (2025). Evidence-based pedagogy used to teach beginning readers braille in a mainstream setting: A scoping review. *British Journal of Visual Impairment*, *43*(2), 407–422.

McDonnall, M. C., Sessler-Trinkowsky, R., & Steverson, A. (2024). Use of braille in the workplace by people who are blind. *Journal on Technology and Persons with Disabilities*, *12*, 58–75.

Nemargut, J. P., Martiniello, N., & Mansour, M. (2026). Exploring braille practices and perceptions among orientation and mobility specialists working with different age groups. *British Journal of Visual Impairment*. https://doi.org/10.1177/02646196251409315

UNESCO (n.d.). *Young Mauritian singer Jane Constance named UNESCO Artist for Peace*. https://en.unesco.org/news/young-mauritian-singer-jane-constance-named-unesco-artist-peace

World Blind Union & International Council for Education of People with Visual Impairment (ICEVI) (2026). *More braille: More empowerment — Global braille literacy campaign*. https://wbu.ngo/about/global-braille-literacy-campaign

From Classroom to Career: How Artificial Intelligence Can Create Inclusive Pathways for Learners with Visual Impairments — Amandipp Singh

Founder and CEO, Enabled Talent, Ontario, Canada

Growing up with vision in only one eye, I often experienced the world a little differently from those around me.

Something as simple as reading a textbook, accessing classroom materials, finding the right classroom, or participating in activities often required additional effort. While determination helped, I learned early that access to the right support, tools, and people often made the difference between participation and exclusion.

Today, we are living through one of the most significant technological shifts of our lifetime. Artificial intelligence is changing how we learn, communicate, work, and access information. For learners with visual impairments, this moment presents an opportunity that goes far beyond technology itself. It presents an opportunity to create stronger pathways into education, employment, independence, and participation.

For many years, assistive technology focused primarily on access. Screen readers, magnification software, Braille displays, OCR applications, and navigation tools helped remove barriers that once prevented many students from participating fully in education. These technologies remain essential and continue to play a critical role in supporting learning.

What makes AI different is its potential to move beyond access and toward participation. Today, AI-powered tools can summarize large volumes of text, describe images, convert content into multiple accessible formats, assist with note-taking, provide real-time support, and personalize learning experiences based on individual needs.

For students, this means spending less time overcoming barriers and more time focusing on learning, creativity, critical thinking, and problem-solving.

For educators, AI creates opportunities to build more inclusive classrooms. Learning materials can be adapted faster, accessibility challenges can be identified earlier, and individualized support can be delivered more effectively than ever before.

Yet technology alone is not the answer. Across many communities, particularly rural and underserved regions, access to technology remains uneven. Connectivity challenges persist. Assistive technologies can still be expensive. Many educators have not received

sufficient training on integrating AI into inclusive learning environments. And too often, accessibility is still treated as an afterthought rather than a design principle.

Perhaps the greatest challenge appears after graduation. Around the world, many students with visual impairments successfully complete their education but continue to encounter barriers when seeking employment.

Accessible education does not automatically lead to accessible recruitment. It does not automatically lead to accessible onboarding. And it certainly does not guarantee long-term workplace inclusion. This is where I believe AI can play an important role.

AI-powered career exploration tools can help students better understand career pathways aligned with their skills and interests. Accessible job-matching platforms can connect candidates with inclusive employers. Virtual coaching tools can support interview preparation, workplace communication, accommodation planning, and professional development.

At Enabled Talent, this is the challenge we are working to address. Our team is building accessibility-first employment infrastructure designed to support persons with disabilities throughout their employment journey. Rather than focusing only on job placement, we are exploring how technology can support career discovery, workplace accommodations, onboarding, retention, and long-term workforce participation. One lesson has become very clear throughout this work.

The best solutions are not built for people with disabilities. They are built with people with disabilities.

Lived experience offers insights that research alone cannot provide. When blind and low-vision individuals participate as designers, researchers, educators, testers, entrepreneurs, and leaders, technology becomes more practical, more accessible, and ultimately more impactful.

As AI continues to evolve, inclusion and ethics must remain at the center of its development. Questions around privacy, affordability, accessibility, bias, and equitable access cannot be ignored. AI should support human decision-making, not replace it. Technology should strengthen independence while preserving dignity, choice, and self-determination.

Looking ahead, collaboration will be essential. Governments, educators, researchers, disability organizations, families, employers, and technology developers all have a role to play. No single organization can solve these challenges alone.

For learners with visual impairments, success should not be measured only by access to education. Success should mean having equitable opportunities to participate in society, pursue meaningful careers, contribute talents, build businesses, and live independently.

Artificial intelligence will not solve every challenge. But when accessibility is built into its foundation and people with disabilities are involved throughout its design, AI can become a powerful bridge between classroom learning and lifelong opportunity.

Because the future of accessibility is not simply about technology. It is about ensuring that every person has the opportunity to learn, contribute, participate, and thrive.

AI-Enabled Accessibility in Digital Learning: A Human-Centered and Evidence-Based Approach to Inclusive Education — Kumar B.S.M. and Vijayshree Vethantham

Kumar B.S.M.: Content & Product Development Advisor, Continual Engine, India.
Vijayshree Vethantham: SVP Growth & Strategies, Continual Engine, USA.

Abstract

As digital education expands globally, ensuring that learning materials are accessible to learners who are blind, have low vision, or are deafblind has become both an educational and operational priority. Recent advances in Artificial Intelligence (AI) are transforming accessibility from a reactive remediation activity into an integrated, scalable, and accessibility-by-design workflow. AI-enabled tools now support automated document structuring, contextual image descriptions, semantic document understanding, multimodal accessibility, and large-scale content remediation. When combined with human expertise, these technologies can improve operational efficiency, enable same-day access to learning materials, and strengthen educational participation and independence. This article examines current AI-enabled accessibility capabilities, recent developments in generative and multimodal AI, implementation strategies for educational institutions, and the continuing importance of human-centered oversight in inclusive digital learning.

Keywords: Artificial Intelligence (AI), Digital Accessibility, Inclusive Education, Visual Impairment, Assistive Technology, Accessibility-by-Design, Multimodal Accessibility, Digital Learning Materials, Human-Centered AI, Educational Technology, Screen Readers, Accessibility Remediation, Semantic Document Understanding, STEM Accessibility, Universal Design for Learning (UDL).

Introduction: From Accessibility Barriers to AI-Enabled Transformation

Digital learning ecosystems now include PDFs, presentations, videos, simulations, e-textbooks, and interactive online platforms. For learners with visual impairment, access to these materials depends not simply on availability but on whether content is compatible with screen readers, Braille technologies, magnification tools, and accessible multimedia formats (Burgstahler, 2015; UNESCO, 2021; United Nations, 2006).

Traditionally, digital accessibility has been approached as a compliance requirement or a post-production remediation task (Lazar et al., 2015). However, the rapid growth of digital content has changed institutional expectations. Educational institutions increasingly require accessibility solutions that support scalability, operational efficiency, and seamless integration into the content lifecycle (EDUCAUSE, 2024; UNESCO, 2021). AI is contributing to this shift by enabling accessibility to be embedded earlier in content creation, review, and delivery workflows through automated structuring, semantic document understanding, and workflow integration (Amazon Web Services, 2023; Microsoft, 2024).

Rather than focusing only on barriers, recent practice increasingly emphasizes AI-enabled transformation: faster remediation, improved document understanding, accessibility-by-design, and measurable educational impact (EDUCAUSE, 2024; Shneiderman, 2020).

AI-Enabled Accessibility: Current Capabilities and Emerging Practice

AI is increasingly being used to strengthen accessibility across diverse educational formats. Modern accessibility tools can analyze documents, infer structure, generate descriptions, and support workflow automation at a scale that manual methods alone cannot sustain (Amazon Web Services, 2023; Microsoft, 2024).

Current AI-enabled capabilities include:

- AI-assisted tagging**:** identifying headings, lists, reading order, and tables to improve screen-reader navigation (International Organization for Standardization, 2012; World Wide Web Consortium, 2018).
- Contextual alt-text generation: producing image descriptions informed by surrounding content rather than isolated image recognition (Microsoft, 2024; OpenAI, 2024).
- Semantic structure detection: understanding document meaning, hierarchy, and relationships between text, visuals, equations, and tables (Amazon Web Services, 2023; EDUCAUSE, 2024).
- OCR and document understanding: converting scanned files into machine-readable, structured educational content (Bigham et al., 2017; Microsoft, 2024).
- Multimodal accessibility: supporting text, image, audio, video, and interactive content within unified accessibility workflows (EDUCAUSE, 2024; UNESCO, 2021).
- Real-time remediation workflows: integrating accessibility checks and remediation into authoring and publishing systems to support accessibility-by-design approaches (Amazon Web Services, 2023; Lazar et al., 2015).
- Enterprise-scale processing: enabling thousands of documents to be processed within operational timelines and integrated across institutional content ecosystems (EDUCAUSE, 2024; Microsoft, 2024).

These capabilities support same-day access, improved consistency, and reduced manual effort across large repositories of educational materials (Amazon Web Services, 2023; EDUCAUSE, 2024).

Videos and multimedia are also becoming increasingly important within digital learning. Educational videos may contain demonstrations, charts, equations, animations, and on-screen text that are inaccessible without transcripts, captions, audio descriptions, or accessible media controls. AI-enabled multimedia accessibility tools can support transcript generation, audio description drafting, captioning, and multimodal navigation, improving access for learners who are blind or have low vision (Burgstahler, 2015; Microsoft, 2024; World Wide Web Consortium, 2018).

Emerging Innovations in AI-Enabled Accessibility

The accessibility landscape has evolved rapidly due to advances in generative AI and multimodal AI systems (EDUCAUSE, 2024; OpenAI, 2024). One major change is contextual image description. Earlier automated descriptions often produced generic outputs such as “image may contain text” or “person holding object.” Newer AI systems can interpret instructional context and generate more meaningful descriptions aligned with educational intent, improving the quality and usefulness of alt text in educational materials (Microsoft, 2024; OpenAI, 2024).

A second major development concerns STEM and mathematics accessibility. Recent AI tools increasingly support recognition of equations, scientific notation, graphs, chemistry diagrams, and mathematical structures. This development is particularly important because STEM accessibility has historically presented persistent challenges for learners with visual impairment (Microsoft, 2024; World Wide Web Consortium, 2018).

Document understanding has also improved significantly. Modern systems can detect semantic relationships across headings, images, tables, captions, equations, and surrounding narrative, supporting more coherent remediation workflows and improved accessibility-by-design practices (Amazon Web Services, 2023; EDUCAUSE, 2024).

Another important development is the emergence of human-in-the-loop QA workflows. AI is increasingly used to generate draft accessibility outputs while human reviewers validate contextual accuracy, pedagogical appropriateness, and subject-specific precision. This hybrid approach balances speed with quality assurance and human-centered oversight (Amershi et al., 2019; Shneiderman, 2020).

Finally, accessibility is increasingly being implemented at enterprise scale. Higher-education institutions, publishers, and technology providers are moving toward accessibility integrated directly into content pipelines rather than isolated remediation projects. This shift supports operational efficiency, lifecycle integration, same-day access, and measurable educational outcomes (EDUCAUSE, 2024; UNESCO, 2021).

Human-Centered AI in Practice

Although AI capabilities are expanding rapidly, human expertise remains essential, particularly in educational accessibility and subject-specific content interpretation (Shneiderman, 2020; UNESCO, 2021).

A practical example can be seen in STEM education. An AI system may identify a chemistry diagram showing molecular bonding and generate a draft description based on detected labels, symbols, and spatial relationships. However, a chemistry educator or subject-matter reviewer must validate whether the description accurately communicates bond geometry, electron behaviour, or instructional intent before publication. This is especially important because scientific diagrams, equations, and visual models often require disciplinary understanding that extends beyond automated pattern recognition (Microsoft, 2024; World Wide Web Consortium, 2018).

This illustrates the value of human-centered AI. AI contributes speed, pattern recognition, automation, and scalability; human experts contribute contextual judgment, disciplinary accuracy, accessibility expertise, and pedagogical meaning (Amershi et al., 2019; Shneiderman, 2020).

The most effective accessibility workflows therefore combine AI efficiency with expert oversight rather than positioning automation as a replacement for human knowledge. Such human-in-the-loop models help ensure that accessibility outputs remain accurate, meaningful, and educationally relevant across diverse learning contexts (EDUCAUSE, 2024; UNESCO, 2021).

From Barriers to Access: A Learner's Experience

The impact of AI-enabled accessibility is most clearly understood through learner experience (Seale, 2014; UNESCO, 2021).

Research shows that timely access improves participation, autonomy, confidence, and educational engagement among learners with disabilities (Seale, 2014). A secondary school learner with visual impairment described previously receiving scanned worksheets that her screen reader could not interpret. Access often depended on waiting for assistance or missing parts of classroom instruction—an experience consistent with documented accessibility barriers associated with inaccessible digital materials and delayed remediation processes (Lazar et al., 2015; United Nations, 2006).

After the adoption of AI-supported accessibility workflows within her school, materials became available in accessible formats immediately. She could follow lessons alongside classmates, review content independently, and participate more fully in classroom activities. This type of same-time access reflects broader goals of inclusive digital education and accessibility-by-design approaches supported by contemporary accessibility practices (EDUCAUSE, 2024; UNESCO, 2021).

This experience illustrates an important shift: accessibility is not only about standards compliance or technical correction. It directly influences confidence, educational engagement, learner independence, and equitable participation in learning environments (Burgstahler, 2015; United Nations, 2006).

Implementation Insights: Operational Efficiency and Educational Impact

Institutions implementing AI-enabled accessibility workflows increasingly report improvements in both operational performance and educational access (Amazon Web Services, 2023; EDUCAUSE, 2024).

Reported outcomes include:

- Large-scale document processing within days rather than months (Amazon Web Services, 2023).
- Improved consistency across repositories through standardized remediation workflows (Lazar et al., 2015; Microsoft, 2024).
- Reduced remediation turnaround times enabled by automation and workflow integration (EDUCAUSE, 2024).
- Accessibility integrated directly into publishing workflows, supporting accessibility-by-design approaches (Lazar et al., 2015; UNESCO, 2021).
- Same-day learner access to instructional materials, improving timely participation and instructional continuity (EDUCAUSE, 2024; Seale, 2014).

These developments are important because delayed accessibility can undermine participation, autonomy, and educational equity even when content eventually becomes available (Seale, 2014; United Nations, 2006).

AI-enabled remediation also changes educator workflows. Rather than spending extensive time manually restructuring documents, educators and accessibility specialists can focus on reviewing quality, refining complex descriptions, and supporting teaching and learner engagement (Lazar et al., 2015; Shneiderman, 2020).

For institutions managing high content volumes—including universities, publishers, and schools operating in resource-constrained environments—this shift supports scalability, operational efficiency, and sustainable accessibility practices without abandoning quality expectations (EDUCAUSE, 2024; UNESCO, 2021).

Scaling Accessibility Through Accessibility-by-Design

Scaling accessibility requires more than technology adoption alone. Institutions increasingly benefit from a comprehensive strategy combining policy, workflow integration, training, and ethical oversight (Lazar et al., 2015; UNESCO, 2021).

Accessibility-by-design is becoming a central principle. Instead of correcting inaccessible content after publication, accessibility considerations are integrated throughout the content lifecycle—from authoring and review to publishing and delivery—supporting

proactive and sustainable accessibility practices (Lazar et al., 2015; World Wide Web Consortium, 2018).

Training also remains essential. Educators, content developers, and administrators require practical understanding of accessibility principles, AI capabilities, and limitations to effectively implement inclusive digital learning environments (Al-Azawei et al., 2016; Burgstahler, 2015).

Workflow integration is equally important. AI tools are most effective when embedded directly within learning management systems, authoring environments, publishing pipelines, and institutional quality processes, enabling operational efficiency and accessibility integrated into routine educational practice (Amazon Web Services, 2023; EDUCAUSE, 2024).

Institutions should also implement continuous monitoring through audits, feedback, and iterative improvement. AI outputs require ongoing evaluation to ensure reliability, fairness, usability, and contextual appropriateness across diverse educational settings (Shneiderman, 2020; UNESCO, 2021).

Ethical considerations remain critical. AI-enabled accessibility should align with transparency, accountability, privacy protection, and human-centered governance principles, ensuring that accessibility solutions remain inclusive, trustworthy, and educationally meaningful (Amershi et al., 2019; UNESCO, 2021).

Conclusion: Toward Inclusive Digital Futures

Digital accessibility is entering a period of significant transformation. Recent advances in generative AI, multimodal systems, semantic document understanding, and enterprise-scale remediation workflows are changing how institutions create, deliver, and maintain accessible learning materials.

The discussion is no longer limited to remediation challenges. Increasingly, it concerns accessibility-by-design, same-day access, operational scalability, and measurable educational outcomes.

AI alone is not sufficient. The strongest accessibility models combine automation with human expertise, subject-matter validation, ethical oversight, and inclusive institutional practice.

When implemented thoughtfully, AI-enabled accessibility can help ensure that learners with visual impairment access educational content not as an accommodation delivered after the fact, but as an integral part of inclusive digital learning.

References

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A content analysis of peer-reviewed journals from 2012 to 2015. *Journal of the*

Scholarship of Teaching and Learning, 16(3), 39–56. https://doi.org/10.14434/josotl.v16i3.19295

Amazon Web Services. (2023). *Using AI to improve accessibility.* https://aws.amazon.com/blogs/publicsector/using-ai-to-improve-accessibility/

Amershi, S., et al. (2019). Guidelines for human-AI interaction. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems.* https://doi.org/10.1145/3290605.3300233

Burgstahler, S. (2015). *Universal design in higher education: From principles to practice* (2nd ed.). Harvard Education Press.

EDUCAUSE. (2024). *2024 EDUCAUSE AI landscape study: Into the digital AI divide.* https://library.educause.edu/resources/2024/2/2024-educause-ai-landscape-study-into-the-digital-ai-divide

Lazar, J., Goldstein, D. F., & Taylor, A. (2015). *Ensuring digital accessibility through process and policy.* Morgan Kaufmann.

Microsoft. (2024). *Microsoft Accessibility AI and inclusive technology initiatives.* https://www.microsoft.com/accessibility

OpenAI (2024). *GPT-4 Technical Report.* OpenAI. https://cdn.openai.com/papers/gpt-4.pdf

OpenAI. (2024). *GPT-4o and multimodal AI capabilities.* OpenAI. https://openai.com/index/hello-gpt-4o/

Seale, J. (2014). *E-learning and disability in higher education: Accessibility research and practice* (2nd ed.). Routledge.

Shneiderman, B. (2020). Human-centered artificial intelligence: Reliable, safe & trustworthy. *International Journal of Human-Computer Interaction, 36*(6), 495–504. https://doi.org/10.1080/10447318.2020.1741118

UNESCO. (2021). *AI and education: Guidance for policy-makers.* https://unesdoc.unesco.org/ark:/48223/pf0000376709

United Nations. (2006). *Convention on the Rights of Persons with Disabilities.* https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf

World Wide Web Consortium (W3C). (2018). *Web Content Accessibility Guidelines (WCAG) 2.1.* https://www.w3.org/TR/WCAG21/

Seeing Assistant Go: Your Essential Travel Companion — Sławomir Strugarek

Seeing Assistant Project Coordinator

Introduction

It is a great pleasure to present our latest navigation application, Seeing Assistant Go. This is one of several applications designed for blind and visually impaired people. It was created by the Polish Capital Group Transition Technologies (https://www.tt.com.pl/en).

We have been developing these types of solutions for over a dozen years, alongside the main focus of our company. We do this as part of our Corporate Social Responsibility (CSR) strategy. The applications are free, and we create them under a project called Seeing Assistant (https://seeingassistant.tt.com.pl/). Part of our company's business involves creating software, including mobile apps. That is why the owners decided to share our skills and potential with people who need support.

Our Team

For over a dozen years, sighted people were involved in writing the code for all applications in the Seeing Assistant family. This was mainly because native development environments for Android and iOS were not accessible to screen readers used by blind people. In this process, blind people mainly worked on creating functional ideas, designing the interface, and testing. Volunteers helped with translations into foreign languages.

A few years ago, a major breakthrough occurred. Development environments became available that allow developers to create mobile apps for both Android and iOS from a single code base. Most importantly, these tools are accessible to blind programmers. We made very careful use of these new opportunities.

Currently, our team consists of several blind and severely visually impaired people. With the help of artificial intelligence, and only occasional help from sighted people, we manage to maintain the entire development process of Seeing Assistant Go, including all server-side management. I believe we are one of the few teams in the world made up almost entirely of people with visual impairments working as programmers, testers, UX designers, and more.

Our users also play a huge role in the development of all our applications. They often suggest new features, report bugs, translate the interface into foreign languages, perform complex tests, and share their unique needs. We do our best to put those ideas into practice.

We would like to thank everyone very much for this shared, massive contribution to creating all the applications in the Seeing Assistant family, including Go.

Why a Navigation Application?

For many years, we have been watching the mobile app market, including apps dedicated to blind and visually impaired people. We see that none of the leading companies in this field provide navigation services that are well-adapted to the needs of people with visual disabilities. It is hard to blame them, as this is a very niche area.

We know that some people, especially those with low vision, use Apple Maps, Google Maps, or other apps (including those made for blind people) for certain navigation tasks. However, we realize that these apps do not provide the wide and well-tailored support that can be achieved when an app is created by the users themselves. One of the strongest arguments for making our own app is the ability to create an interface that is fully accessible to people with special needs. These factors became our main motivation and goal.

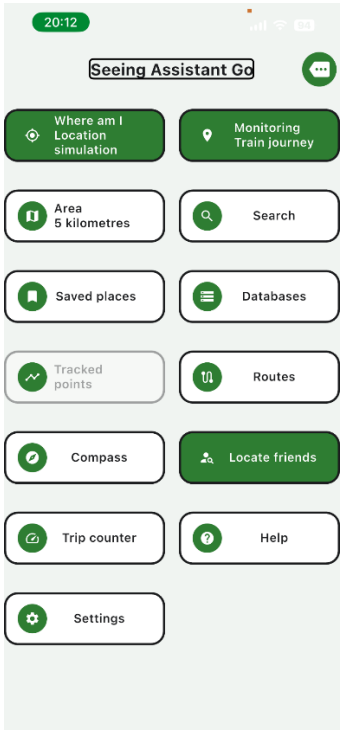
The people involved in creating this app are very active. They travel independently in cities and villages, travel between cities and even abroad, walk in forests and mountains, ride tandem bikes, and sail on kayaks and yachts as crew members. Each of these activities requires different map or navigation information. In every case, this information must be well-selected, delivered at the right moment, available on demand, and easy to share with others. For this reason, the large number of settings in the advanced mode might seem like too much for less experienced travellers.

Creating a dedicated navigation app is not just about designing a tool. It is an investment in the digital independence of the disability community and about building a direct relationship with the user. Moving around freely and independently is one of the main pillars of independence and freedom. But the app alone is not everything. Other elements are also needed for full success. I will write about this below.

What Can Seeing Assistant Go Do?

The Seeing Assistant Go application supports the spatial orientation of blind and visually impaired people. It is a newer, constantly expanded version of our previous navigation app called Seeing Assistant Move. It works almost everywhere on Earth – on land, at sea, and in the air. It works wherever satellite or ground positioning systems are available.

The app provides information about your surroundings using synthetic speech, sounds, and vibrations. It acts as your electronic guide.



Caption: Seeing Assistant Go interface, showing the functions of “Where am I, Location simulation; and Monitoring Train journey”. Additional configurations are also shown on the interface.

The number of different functions and configuration options allows the app to deliver map data in a way that perfectly fits the needs of a blind user in various situations. Seeing Assistant Go is especially useful when you need to:

- Know which bus stop the bus has just stopped at – the function for monitoring places from a selected category.
- Monitor which train station to get off at and how far away it is from you – tracking individual places.
- Know which streets your taxi is taking you through – information about the name of the street you are currently on (we will add information about street intersections soon).
- Check where the nearest grocery store is from the guesthouse where you plan to spend your vacation – displaying nearby points of interest.
- Verify if the beach is really as close to this guesthouse as the owner claims – location simulation.
- Check which route to take to get to any chosen place – turn-by-turn route planning and guidance.
- Record your own route in locations where map data is missing and it is impossible to plan a route using standard tools – route recording.

- Save places that are important to you so you can easily return to them – the ability to save your own places.
- Check your current address – the "where am i" function.
- Know the exact location of another person – "locate friends". This feature is especially useful when blind people want to meet at a specific place or want to know exactly where a smartphone carried by a child is. It also allows you to support other people remotely while they navigate. This means you can not only get where you want by yourself, but you can also help others.
- And much, much more.

As you have probably noticed, this is a comprehensive tool that allows you to do a lot and significantly increases independence for blind people when traveling alone. We know many people who successfully travel completely on their own, even outside their own countries, using Seeing Assistant Go.

Interesting and Useful Solutions

In our applications, we focus heavily on creating solutions that are convenient for the user. We understand very well that moving around with a white cane or a guide dog requires a lot of attention. Using a smartphone at the same time (controlling it and listening to announcements) adds extra difficulty. That is why we developed several solutions that allow you, for example, to hear an announcement about the next turn on your route simply by holding your smartphone in a certain position, without needing to use the touchscreen or even unlock it.

We are working on adding options to control some functions using headphone buttons and smartphone gestures. We highly encourage you to test these different features and share your comments and ideas with us.

Two Versions of the App Interface

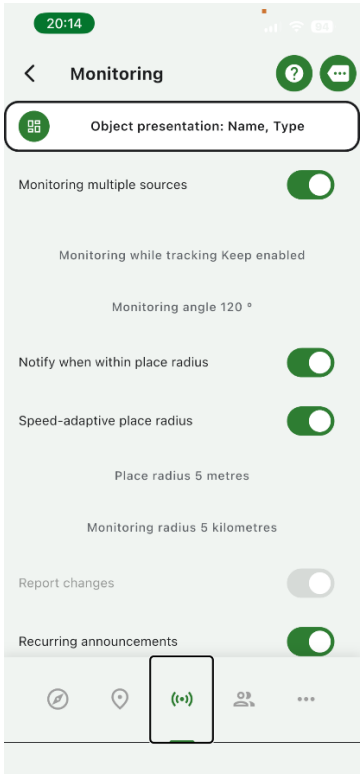
We also know that every user has:

- different smartphone skills;
- different orientation and mobility skills;
- different knowledge of geography, mapping, and how satellite positioning systems work, such as GPS, Galileo, GLONASS, or BeiDou; and
- different habits, needs, and expectations;

This makes it very difficult to create a single, universal application that satisfies everyone. You know that this is generally impossible. However, we are trying our best. That is why we created two operating modes for the app:

- Basic mode for beginners, without unnecessary functions that some of you might not use anyway.

- Advanced mode: many settings and features that are essential for a proper navigation app for blind users.



Caption: The Monitoring function on Seeing Assistant Go, with selection options.

To our knowledge, Seeing Assistant Go is one of the most advanced navigation apps for the blind and visually impaired in the world. It runs on both Android and iOS systems. The app interface is currently available in 16 languages. We warmly invite volunteers to help translate the app into more languages.

What Else Do You Need to Know?

It is important to keep a few things in mind so that using Seeing Assistant Go is convenient and safe for you:

- The application does not replace a white cane or a guide dog. It is an extra tool to support these mobility aids.
- We recommend using the app with headphones that do not block your ear canals – with bone conduction or open-ear air conduction.
- We strongly advise you to start learning how to move around with the app and sometimes verify your skills in an area you know very well. This is very important. It will help you learn how it works and understand its strengths and weaknesses.
- We could not make everything as perfect as we wanted, mainly because map data can sometimes be outdated or incorrectly drawn. We must clearly point out that we mainly use map data from OpenStreetMap. This data is created by a community of volunteers and is available for free (we do not create it ourselves).

However, we know from experience that coverage of lands and water areas is not always complete. Data quality can also vary between countries. Urban areas are often mapped better than less populated ones. If something is missing from the maps or the data is outdated, please contact the mapping communities in your country or region.

- When navigating along routes set by the app, trust the vibrations indicating the next waypoint more than the voice announcements like "turn right" or "turn left".
- Routes suggested by the app do not take into account local conditions, such as sidewalk repairs or other temporary obstacles on the road. Do not trust them blindly.
- The app relies on map data, not on real-time observation of the area. For this reason, it may inform you about places that no longer exist and miss others that no longer have been added to the map yet.
- Seeing Assistant Go is not an app for planning public transit journeys (like city buses or trains) within or between cities.

Please note that inside some train cars, positioning accuracy is very low – sometimes even worse than 5 kilometers. This means the app's readings will be highly approximate. In some situations, it helps to hold your smartphone close to the train window. If this does not improve accuracy (an accuracy of 50 meters is enough on a train), you may sometimes need to step out onto the next station platform with your smartphone for a moment. Unfortunately, many train cars shield the signal so heavily that satellite navigation signals cannot get inside.

To get the most out of navigation apps, it is very helpful to have knowledge about how satellite positioning systems work, how areas are mapped, how the compass works (and the interference it faces), and many other fields. We highly encourage you to systematically gain this knowledge. Having it greatly increases the effectiveness of using navigation tools for blind people. Paradoxically, if blind users want to achieve greater independence, their understanding of these topics must be at a much higher level than that of sighted people.

We have included a very useful and carefully prepared help guide inside the app. You will find answers there to the vast majority of questions that come up during use.

We also encourage caregivers and orientation and mobility instructors for blind people to learn how to use Seeing Assistant Go. In some cases, it may even appeal to and be useful for sighted individuals.

If you are an app developer looking for routing and navigation features, and you would like to use the capabilities offered by Seeing Assistant Go, contact us. We will provide you with the URI scheme, allowing you to quickly switch from your application to ours. The route will be calculated automatically, and you will immediately start navigating to your destination. Currently, we recommend this solution primarily with blind users in mind,

as the route cannot be displayed or previewed on a traditional visual map. We plan to address this in the future.

QR Codes and Links to Download Seeing Assistant GO

Below we provide links and separate QR codes that contain links to download Seeing Assistant GO from the Google Play Store (Android) and the App Store (iOS). You just need to scan the chosen QR code using your camera app and click the link that appears on your screen.

Seeing Assistant Go on the Play Store

https://play.google.com/store/apps/details?id=pl.com.tt.SeeingAssistant.go



Seeing Assistant Go on the App Store

https://apps.apple.com/pl/app/seeing-assistant-go/id6499322150



Summary

Just like in our other applications from the Seeing Assistant family, we put the very best of our Transition Technologies team into Go:

- over a dozen years of experience in creating innovative software for blind people.
- an uncompromising approach to achieving maximum accessibility for screen readers.
- an openness to implementing ideas from our users: we cannot promise that we will add every good idea quickly, but we will certainly do it better than anyone else!

We want to reach more and more users with our applications and introduce innovative solutions to them.

We have many ideas and a lot of positive energy. We love challenges, and creating these useful tools gives us a lot of satisfaction. We warmly invite you to join the many satisfied users of Seeing Assistant Go.

About the Author

Slawomir Strugarek is a legally blind, Polish expert in the field of assistive technologies, with a particular focus on mobile applications. Visionary and long-term coordinator of the

Seeing Assistant project developed at Transition Technologies. This project has yielded several applications operating on iOS and Android operating systems, aimed at supporting blind and visually impaired individuals in various aspects of their daily lives.

Main areas of activity: Navigation based on satellite positioning systems, spatial orientation, various types of graphic codes, optical character recognition (OCR), NFC technology, etc.

Special Feature: ICEVI–WBU Global Braille Literacy Campaign

Global Braille Survey is now open!

We are pleased to announce that the **Global Braille Survey is now open**!

As part of the Global Braille Literacy Campaign – *More Braille: More Empowerment*, the survey provides an important opportunity for people around the world to share their experiences and perspectives on braille literacy.

Led by the International Council for Education of People with Visual Impairment (ICEVI), the World Blind Union (WBU), and partner organisations, this global research initiative aims to strengthen our understanding of how braille is learned, taught, accessed and used – and of the factors that enable or create barriers to braille literacy.

Who can participate?

We warmly invite responses from:

- Adults aged 18 years and over who are blind, have low vision, or are deafblind;
- Parents and guardians of children of any age who are blind, have low vision, or are deafblind;
- Teachers and other professionals involved in braille education; and
- Braille transcribers.

Share your experience - Take the Global Braille Survey: tiny.cc/braillesurvey

When you follow the link, you will first be invited to review the informed consent information and then complete a short set of questions to determine which survey or surveys are relevant to you.

If you are eligible for more than one survey – for example, if you are both an adult braille user and a braille transcriber – you are welcome to contribute from each perspective. Simply complete one survey and then return to the link when you are ready to complete another.

Why does your participation matter?

Every response adds to our global understanding of braille literacy. The findings will help build a stronger evidence base to inform advocacy, policy, research, resources and practice, and to support efforts to strengthen access to braille literacy around the world.

Please help us spread the word

We want to hear from people across countries, regions, languages and communities.

Please share the Global Braille Survey widely through your organisations, professional and community networks, and directly with braille users, families, educators, professionals and transcribers who may wish to participate.

Every experience matters. Every perspective adds to the evidence. Every voice can help strengthen the future of braille literacy.

Thank you for being part of this important global effort.

With warm regards,

Global Braille Literacy Campaign
More Braille: More Empowerment

Legal Recognition of Braille in Education: An Advocacy Framework — Michal Tkáčik and Members of Focus Area 1 (Advocacy and Media), Global Braille Literacy Campaign

International Council for Education of People with Visual Impairment (ICEVI), World Blind Union (WBU) and collaborative partner organisations - *More Braille: More Empowerment* global braille literacy campaign

Introduction

For more than 200 years, braille has been the primary literacy system for people who are blind. It remains the only reading and writing system that provides direct access to spelling, punctuation, grammar, mathematical notation, scientific symbols, and the structure of written language through touch.

Advances in digital technology have transformed access to information and communication. Computers, smartphones, screen readers, refreshable braille displays, and other technologies have expanded educational and employment opportunities for persons who are blind. Rather than reducing the importance of braille, however, these developments have increased the contexts in which braille can and should be used. Digital technology and braille are complementary tools that together support full literacy, independence, lifelong learning, and participation in society.

The legal status of braille is therefore not merely a matter of educational policy. It is a significant factor influencing literacy outcomes, educational achievement, employment opportunities, and social inclusion. Where braille is explicitly recognised, supported, and systematically taught, learners who are blind are more likely to develop strong literacy skills. Where braille is absent from legislation or treated only as an optional support measure, access to literacy often depends on local capacity, individual advocacy, or chance.

A comparative review of legal recognition of braille in selected countries found that countries generally fall within one of three broad models: braille as the default literacy medium, braille as a statutory educational right, or braille as an accessibility or support measure. While each model provides some level of recognition, the strongest literacy outcomes are most likely to be achieved when legal recognition is supported by assessment requirements, implementation mechanisms, and accountability.

Legislative approaches to braille in education

Across countries, the legal recognition of braille in education varies considerably. Three broad legislative approaches can be identified.

1. Braille as the default literacy medium

In some countries, legislation establishes a strong presumption in favour of braille. Every learner who is blind or visually impaired must be assessed for braille, and braille instruction is provided unless an individual evaluation demonstrates that it is not appropriate.

This approach recognises braille as the primary literacy medium for learners who are blind and creates safeguards against its omission. Educational systems are required to support braille through assessment processes, trained professionals, accessible materials, and structured implementation mechanisms.

This model generally provides the strongest protection for braille literacy.

2. Braille as a guaranteed educational right

In other countries, braille is explicitly recognised in legislation as a right. Learners who are blind are entitled to receive education through braille where required, and education authorities have a responsibility to make this possible.

This approach provides important legal protection while preserving individualised educational decision-making. However, implementation may vary depending on local expertise, resources, and policy priorities.

3. Braille as an accessibility or support measure

In many countries, braille is addressed within broader inclusive education and accessibility frameworks. It may be treated as one of several support options rather than

as a recognised literacy medium. While this approach promotes flexibility, it can lead to inconsistent access to braille instruction. Without explicit legal recognition, braille may be overlooked or underutilised despite its importance for literacy development.

Policy Position

The *More Braille: More Empowerment* campaign supports a legislative approach that recognises braille as a legally protected educational right while ensuring that its implementation is supported through clear assessment requirements, professional expertise, educational resources, and accountability mechanisms.

Recognition of braille as a legal right is necessary but not sufficient. Effective legislation should establish practical mechanisms to ensure that learners who are blind can develop literacy through braille and access educational opportunities on an equal basis with their sighted peers.

Legislation and policy should therefore require:

- systematic introduction of braille to learners who are blind alongside the use of digital technologies;
- early and systematic assessment of braille as a medium of literacy and learning for every learner who is blind;
- professionally documented justification for any decision not to provide braille instruction;
- timely production and availability of textbooks and learning materials in braille, tactile graphics, and accessible digital formats;
- access to qualified teachers, specialist support services, and ongoing professional development in braille literacy and instruction;
- provision of clear, accessible information to families and caregivers regarding the role of braille in literacy, education, independence, and future participation;
- meaningful involvement of families in educational decision-making, guided by professional assessment and the best interests of the child;
- recognition that digital technologies complement rather than replace braille;
- explicit recognition of braille, tactile graphics, and accessible technologies as essential tools for participation in mathematics, science, technology, engineering, and related disciplines; and
- ongoing monitoring and accountability mechanisms to ensure effective implementation.

The comparative evidence suggests that legal recognition alone does not guarantee braille literacy. Effective legislation must be accompanied by practical measures that ensure braille is available, taught, and supported throughout a learner's educational

journey. The objective is not simply to recognise braille as a right, but to create the conditions under which braille literacy can flourish.

Key Advocacy message

Braille should be recognised in education law not merely as an optional support measure, but as a legally protected pathway to literacy, learning, independence, employment, and full participation in society. Every learner who is blind should have the opportunity to develop braille literacy through systematic assessment, qualified instruction, accessible materials, and appropriate support.

The right to braille must be supported by clear legal obligations, practical implementation mechanisms, adequate resourcing, and robust systems of accountability. Without these safeguards, braille may remain a right in principle while many learners continue to face barriers to achieving full and independent literacy in practice.

True educational inclusion requires more than access to information. It requires access to literacy. For many learners who are blind, that literacy is braille.

Acknowledging our Campaign Sponsors - Joint ICEVI-WBU Braille Literacy Campaign



Diamond Sponsor: HumanWare

https://www.humanware.com/en-canada/



Platinum Sponsor: CBM (Christian Blind Mission)

https://www.cbm.org/

Platinum Sponsor: Dot Inc

https://www.dotincorp.com/en

Silver Sponsor: Canadian National Institute for the Blind (CNIB)

https://www.cnib.ca/en

Welcome to SPEVI Inc. & SPEVI NZ – combined Platinum sponsor of the Pacific Region

https://www.spevi.net/

The South Pacific Educators in Vision Impairment (SPEVI) association has for almost 70 years been an important professional organisation of people involved in blind, deafblind and low vision education across Australia, New Zealand and South Pacific Island countries. Although originally an association for teachers working in blind and low vision education, its membership is now open to anyone interested or involved in blind, deafblind and low vision education.

SPEVI's mission is to stimulate professional and public debate and action on issues and changes which affect or have the potential to affect the daily lives of people who are vision impaired. SPEVI advocates for excellence and equity in education. Its primary aims include:

- Promoting high standards in general and specialist training for educators.

- Stimulating research and facilitating the exchange of information between parents, professionals, and the community.
- Advocating for equitable educational access and utilizing appropriate assistive technologies.

Although functioning through separate national constitutions and executive structures necessary to accommodate important legal, financial, educational and cultural differences, SPEVI Inc (Australia) and SPEVI NZ (New Zealand) work together to organize professional initiatives, regional Communities of Practice, joint publications, and biennial conferences.

All SPEVI members enjoy the opportunity to be part of a collaborative and inclusive association where they can communicate, debate, learn, and respond to issues that are relevant to the education of children and young people who are blind, deafblind or have low vision within the South Pacific region.

SPEVI Inc and SPEVI NZ are proud to endorse and support the Global Braille Literacy Campaign.

Welcome to Royal Visio - Silver Sponsor

https://www.visio.org/en/

Royal Visio is a centre of expertise in the Netherlands for people who are blind or partially sighted. With nearly 3,000 employees across the country, Visio supports people with visual impairments, including those with additional disabilities, in living, learning and working as independently as possible.

Vision loss can bring significant challenges. At Visio, we focus on possibilities rather than limitations. Through rehabilitation, education, employment services and daily-life support, we help people build confidence, develop their talents and make the most of their opportunities. Using our knowledge and experience, we create opportunities. To achieve this, we work closely with individuals, their support network and other professionals to deliver the best possible outcomes. Visio also collaborates with governments, organisations, businesses and experts to promote accessibility, inclusion and equal opportunities for all.
In addition to our work in the Netherlands, Visio is actively involved in international programmes and partnerships. Together with organisations around the world, we contribute to knowledge sharing, innovation and the development of inclusive solutions for people with visual impairments.
By focusing on what is possible, we help change perceptions of blindness and low vision.

Together, we are building a more inclusive future in which everyone has the opportunity to take part and show their potential.

Royal Dutch Visio
Centre of Expertise for Blind and Partially Sighted People

Call for Submissions – The Educator (January 2027)

The Editorial Committee warmly invites the submission of articles for the January 2027 issue of *The Educator*. The theme for this issue is: Parent, Family and Community Partnerships.

Submission deadline: 30 November 2026

We welcome articles that explore research, policy, innovative practice, case studies, and personal perspectives that highlight the important role of parents, families, communities, and partnerships in supporting the education and inclusion of learners who are blind, have low vision, or are deafblind.

We welcome perspectives from learners, parents, families, organizations, educators, researchers, and disability rights advocates.

Why contribute?

By contributing to The Educator, your work reaches a global audience of professionals, organisations, and advocates working in the blindness and low vision field. Your contribution helps to amplify solutions, innovations, research, and lived experiences across borders. All submissions are fully attributed, providing visibility and connection opportunities for authors and organisations.

Suggested Focus Areas

Personal Perspectives

- Experiences of advocacy from parents and families for learners who are blind, have low vision, or are deafblind
- Experiences from parents and families navigating the education system
- Experiences from learners who are blind, have low vision, or are deafblind, on parents, families, communities, and partnerships
- Educational experiences of learners who are blind, have low vision, or are deafblind, and the impact on student, parent, family, and community well-being

Communities and Partnerships

- Community and partnerships supporting parents and families with advocacy
- Community and partnerships supporting learners who are blind, have low vision, or are deafblind

Research

- Relevant data and experiences of parents, families, communities, and partnerships with supporting learners who are blind, have low vision, or are deafblind
- Relevant data and experiences of learners with education

Case Studies

- Cases of parents, families, communities, and partnerships in supporting learners who are blind, have low vision, or are deafblind
- Educational cases of learners who are blind, have low vision, or are deafblind

Policy

- Educational policies and their impacts on parents, families, communities, and partnerships
- Impact of educational policies for learners who are blind, have low vision, or are deafblind

Innovative Practice

- Programs and projects that benefit parents, families, communities, and partnerships in supporting learners who are blind, have low vision, or are deafblind

Intersectionality

- Impact of gender, culture, family structure, and disability on parents, families, communities, and partnerships in supporting learners who are blind, have low vision, or are deafblind
- Impact of gender, culture, family structure, and disability on learners who are blind, have low vision, or are deafblind

Submission Guidelines:

Language: English

Author information: Include your name, title, country location, and contact details

Format:

- MS Word
- Arial 12-point font
- Double line spacing
- Left-aligned paragraphs

Style:

- Avoid complex jargon

- Define acronyms, abbreviations, and technical terms

Length:

- Scholarly manuscripts: Up to 5,000 words; Must comply with ethics requirements for original research; Include confirmation of permission to use the material
- Reports, reviews, program descriptions, position papers, etc.: approximately 1,500 words

Figures and tables: Must be numbered and clearly labelled

Media:

- Photos and videos are welcome
- Please obtain written permission from parents/caregivers for photos of children under 18 years
- Obtain verbal permission for photos of adults
- The ICEVI Consent Form may be downloaded from the Publications section of the ICEVI website, https://icevi.org/icevi-consent-form/
- Include a brief description or caption with each photo (or Alt Text description)

How to Submit

- Email submissions to: publications@icevi.org
- We warmly encourage organizations and individuals to share research, innovation, practice, and lived experience. Together, we can strengthen global dialogue on technology and AI in education and the daily lives of persons with visual impairment.

We look forward to your contributions.

Recent publications are available in English, Spanish and French (Word and PDF), and Braille (BRF) – go to https://icevi.org/resource-library/the-educator/.

Join ICEVI: Expand Access to Inclusive Education for People with Visual Impairment

For over 70 years, the International Council for Education of People with Visual Impairment (ICEVI) has united a global network of educators, advocates, and policymakers to advance inclusive, equitable, and quality education.

Why Join ICEVI?

Becoming a member of ICEVI means joining a movement to remove barriers and expand educational opportunities worldwide. Members benefit from:

- Engagement with global leaders and decision-makers

- Collective impact through multi-sector collaboration
- Influence on education policy, research, and funding
- Opportunities to share knowledge and participate in global advocacy

Membership Opportunities

ICEVI offers various membership levels for organizations and individuals—from global leaders in inclusive education to small institutions, researchers, and advocates. Members contribute expertise and shape ICEVI's global strategy while benefiting from high-level networking, recognition, and shared learning.

Partner with Us

ICEVI welcomes partnerships and sponsorships for key global initiatives, including the ICEVI Braille Literacy Global Campaign, in partnership with the World Blind Union.

Join us and help create a world where education is accessible to all.

Contact Details

For information about ICEVI membership, publications, and initiatives:

Email: publications@icevi.org; info@icevi.org

Website**:** www.icevi.org