2023 Global Education Monitoring Report
on technology and education

All Children Reading: A Grand Challenge for Development
May 19, 2022 Consultation Report

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Acknowledgments

All Children Reading: A Grand Challenge for Development (ACR GCD) wishes to thank the following ACR GCD awardees and collaborators for their participation in the online consultation and contributions to this report:

Asafeer Education Technologies
Benetech
eKitabu
Little Thinking Minds
Lubuto Library Partners
Qué Funciona para el Desarrollo A.C. - (QfD)
Resources for the Blind, Inc. (RBI)
Rochester Institute of Technology National Technical Institute for the Deaf (RIT/NTID)
SIL LEAD
Curious Learning
College of Saint Benilde
The Agora Center at the University of Jyväskylä
The Asia Foundation
World Education

Based on the consultation and follow-up interviews, this report was authored by Shelly Hartman Sunyak/All Children Reading: A Grand Challenge for Development

Cover Photo Credit: Little Thinking Minds

Executive Summary

All Children Reading: A Grand Challenge for Development (ACR GCD), a partnership between the United States Agency for International Development (USAID), World Vision, and the Australian Government, advances EdTech innovation and research to improve reading outcomes for marginalized children in low-resource contexts. Since 2011, ACR GCD has sourced nearly 1,200 innovative proposals and funded and tested 60+ promising applications of EdTech to support language and literacy for children in low resource contexts. Through testing, ACR GCD and our awardees learned what works and does not work to improve access, equity and inclusion. **This includes thinking beyond the EdTech solution itself, to include the appropriate training, needs assessment, screening, infrastructure, device, coaching and monitoring support, advocacy and ecosystem necessary to ensure effective use at scale.**

In response to the research questions posed in the **2023 Global Education Monitoring (GEM) Report concept note**, ACR GCD hosted a virtual GEM Report Consultation on May 19, 2022, with more than 30 current and former ACR GCD awardees and GEM Report researchers. ACR GCD also conducted in-depth follow-up interviews with 11 awardee organizations. The consultation, and focus of this report, is on the **Concept Note's** Research Question #1: **What do we know about the role of technology in addressing each of the education challenges identified with respect to access, equity and inclusion?** More deeply, the consultation focused on two sub-topics:

1. **Access for Disadvantaged Groups**
   How can we provide education to all hard to reach learners?
2. **Access to Content**
   How can more knowledge reach more learners in more attractive and cheaper formats?

When considering **Access for Disadvantaged Groups**, ACR GCD focuses on the 584 million children globally who do not have basic reading skills—100 million more than before the pandemic.[1] EdTech-supported approaches to strengthen learning are needed now more than ever. ACR GCD's EdTech summative report of project evaluations, ***Technology-Based Innovations to Improve Early Grade Reading***

[1] 100 million more children under the minimum reading proficiency level due to COVID-19. Unesco Institute for Statistics. 2021. https://en.unesco.org/news/100-million-more-children-under-minimum-reading-proficiency-level-due-covid-19-unesco-convenes

Through testing, ACR GCD and our awardees learned what works and does not work to improve access, equity and inclusion. This includes thinking beyond the EdTech solution itself, to include the appropriate training, needs assessment, screening, infrastructure, device, coaching and monitoring support, advocacy and ecosystem necessary to ensure effective use at scale.

Key to cost-effective and scalable EdTech solutions is content created under an open license that permits no-cost access, use, resharing, adaptation and redistribution by anyone with no or limited restrictions. In content production, digital does not necessarily mean accessible. Producing born accessible books from the onset is the most cost-effective way to produce high-quality accessible books.

Outcomes in Developing Countries highlights important findings, including that:

- EdTech-based literacy solutions can offer beneficial individualized learning experiences to students.
- Technology has the capacity to capture individual user experiences.

Importantly, awardees highlighted that **for children with disabilities, ebooks with audio, video and ebraille—and technology features such as customizable speed, adjustable font size, and highlighted text—help learners with print disabilities overcome barriers to reading.** For remote populations or children in emergency contexts, technology can be a connector or a bridge to the formal school system, as seen during the COVID-19 pandemic and refugee and migration crises globally. ACR GCD also found that EdTech can support access to literacy for girls who are frequently marginalized in education. However, organic uptake of solutions to support these children is unlikely and requires targeted promotion and distribution strategies. Inclusive assessments are also essential to ensure learning assessments appropriately measure their learning outcomes more validly and reliably.

When considering **Access to Content**, ACR GCD emphasized children with disabilities, for whom books, if available at all, often are not in accessible formats like braille, audio and sign language. **Key to cost-effective and scalable EdTech solutions is content created under an open license that permits no-cost access, use, resharing, adaptation and redistribution by anyone with no or limited restrictions. In content production, digital does not necessarily mean accessible. Producing born accessible books from the onset is the most cost-effective way to produce high-quality accessible books.** In this report, ACR GCD and its awardees share examples or practices, supported by evidence, that strengthen access, equity and inclusion for disadvantaged groups (with a focus on education for hard to reach learners including for disadvantaged groups, children with disabilities, remote populations, education in emergencies and girls) and access to content.

Access, Equity & Inclusion

Technology's capabilities offer education systems tools to overcome long standing inequalities along two key dimensions: reaching disadvantaged populations and ensuring content reaches all learners in more engaging and cheaper formats.

ACCESS FOR DISADVANTAGED GROUPS

How can we provide education to all hard-to-reach learners?

Learners with Disabilities and Special Educational Needs

Since 2011, ACR GCD has compiled a range of research showing that EdTech with high-quality content, when applied appropriately, enables access to learning for marginalized populations, significantly lowers the cost of providing reading content and exponentially improves reading outcomes. Many of our technology-based literacy projects not only effectively disseminated new or existing learning materials to underserved populations in languages they use and understand, but also enabled equitable access to and representation in teaching and learning materials for children with disabilities. **EdTech solutions can help ensure all children, including children with disabilities, receive language and literacy support and resources beginning at an early age.** Beyond EdTech, children with disabilities must see themselves represented in books as characters and protagonists. Awardee RIT/NTID focused their

TABLE 1: MAPPING OF TYPES OF TECHNOLOGY THAT SUPPORT INCLUSIVE EDUCATION FOR CHILDREN WITH DISABILITIES

	SOFTWARE	CONTENT	HARDWARE
Blind/ Low Vision	Text to speech, Narration, Magnification, Large type, Contrast	EPUB 3.1, WCAG 2.0, Image Description, MathML, Braille, Ready Format, Tactile Graphics	Standard Devices, Refreshable Braille Display, 3D Printing
Deaf/ Hard of Hearing	EPUB, WEPUB Mainfest, Media Overlays	Sign Language Visual Narrative	Standard Devices
Deaf-Blindness	EPUB, WEPUB Mainfest, Media Overlays	EPUB 3.1, WCAG 2.0, Image Description, MathML, Braille, Ready Format, Tactile Graphics	Refreshable Braille Display, 3D Printing
Intellectual & Developmental Disabilities	EPUB, WEPUB Mainfest, Media Overlays	Alternative Versions, Image Descriptions, Narration, Video	Standard Devices AAC Boards, Speech Generating Devices
Learning Disabilities	Text to speech, Narration, Magnification, Large type, Contrast	Dyslexic Fonts, Video, Narration, Image Description	Standard Devices
Motor Disabilities	Audio Input	EPUB 3.1+, ARIA, WCAG 2.0	Assistive Technology Input Devices

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eKitabu

book development on representing the deaf experience to ensure children who are deaf can see themselves in the stories. Table 1 from ACR GCD awardee, eKitabu, (previous page) showcases types of technology that support access for children with disabilities.

Children who are Blind or have Low Vision or Print Disabilities

ACR GCD's summative report of evaluations of project that tested EdTech for children who are blind/low vision, *Supporting Technology-Based Innovations to Improve Early Grade Reading Outcomes for Students Who Have Low Vision or are Blind*, highlights the importance of holistic approaches to using EdTech to support learners with disabilities. Children who have blindness, low vision, dyslexia, cerebral palsy or other reading barriers are unable to read standard print. According to the World Health Organization, 90% of the estimated 285 million people worldwide who are visually impaired live in developing countries.[2] **Ebooks with audio, video, and ebraille—and technology features such as customizable speed, adjustable font size, and highlighted text—help learners with print disabilities overcome barriers to reading.** Below are several examples from ACR GCD awardees to highlight how EdTech can support children with low vision, blindness and other print disabilities.

Technology: Bookshare
ACR GCD awardee: Benetech

Benetech Program Management Disability Expert Dr. Homiyar Mobedji, who is blind, shared that for students with visual impairments to succeed in school, they need content in digital, accessible formats, technology to read digital books, as well as training on how to use both the device and an application that allows them to read the accessible books.

Bookshare, an initiative of Benetech, is the world's largest library of accessible ebooks for people with print disabilities, such as visual impairment, severe dyslexia and cerebral palsy. Bookshare India focuses on:

- **content:** providing all content in digital, accessible formats,
- **technology**: providing devices to access digital books (laptop computers and smartphones for reading ebooks and audiobooks), and
- **training**: teaching educators, librarians, resource center staff, and visually impaired students how to use Bookshare and electronic devices.

To support learners in higher education, Bookshare has a complete collection of books for courses like political science, literature, history and psychology in the Marathi language. Android devices and the human-sounding Marathi text-to-speech (TTS) engine from Hear2Read can support learners from pre-primary to college level. Others used Moto E5 smartphones to access academic books in Bookshare for grades 8-12.[3] Dr. Homiyar also shared the importance of ensuring mathematics and science curriculum are developed using accessible formats to enable more learners with print disabilities to study for Science, Technology, Engineering and Math (STEM) professions.

In Benetech's ACR GCD-funded Bookshare India project, students who were blind or had low vision were provided with appropriate reading materials in their mother tongue language,

Ebooks with audio, video and ebraille—and technology features such as customizable speed, adjustable font size, and highlighted text—help learners with print disabilities overcome barriers to reading.

[2] Bookshare Global Brochure. https://benetech.org/wp-content/uploads/2018/07/Bookshare_Global_Brochure_071918.pdf
[3] Bookshare Breaks Through Reading Barriers. Benetech. https://benetech.org/blog/bookshare-breaks-through-reading-barriers-india/

Resources for the Blind, Inc

A child who is deaf takes the Early Grade Reading Assessment, adapted into Filipino Sign Language, through the Gabay (Guide) project, implemented by Resources for the Blind and funded by USAID in the Philippines.

Marathi. A Story Uncle or Story Auntie hosted weekly reading sessions. Students were given independent reading time at school each day to read large-print or braille materials and listen to audio stories using Digital Accessible Information System (DAISY)3 audio players. **Students who were low vision or blind reported high levels of comfort with the technology and high levels of engagement in the project.** On average, students improved their scores on all Early Grade Reading Assessment (EGRA) subtasks, and results at endline were statistically higher than at baseline. "Although some students improved more than others, both male and female students, students in Grades 2 and 3, and both students who were low vision or blind improved from baseline to endline." Students received 2,000 minutes of guided or independent reading time on average over the academic year that helped improve their literacy and comprehension during formative years of schooling.[4]

Technology: Zoomtext, magnifying CCTV & DAISY players
ACR GCD awardee: Resources for the Blind, Inc.

ACR GCD awardee Resources for the Blind's (RBI) approach to engaging learners with disabilities in the ACR GCD-funded Reading Beyond Sight project was exemplary in that it combined appropriate, targeted assistive technology support, parental awareness training and advocacy to the government. Examples of assistive technology that supported children in this project include desktop computers loaded with Zoomtext software,

[4] Evaluation Report. Bookshare India: Improving Reading Skills Among Primary Students with Low Vision or Blindness All Children Reading: A Grand Challenge for Development, June 2017.https://allchildrenreading.org/wp-content/uploads/2019/07/Benetech-Project-Evaluation.pdf

magnifying CCTVs that enabled reading large-print text, and DAISY players.

Through their ACR GCD award, RBI learned that parent and caregiver training sessions are critical to supporting learning for children with disabilities and introducing supportive EdTech solutions. Examples of this include Filipino Sign Language (FSL) Buddy which provides interpretation for family members. It also teaches basic signs for animals, places, food and colors via educational videos of a deaf signer demonstrating variations of the FSL signs with captions noting the interpreted words and phrases in Filipino.

"After the training, the parents committed to learning sign language to help their child communicate better with members of the family and community," says Amy Mojica, Deputy Chief of Party for the Gabay (Guide) project, implemented by Resources for the Blind. "They're positive their child can learn, attend college and have better opportunities by learning sign language."

RBI's USAID-funded Gabay project, an award received after their ACR GCD funding to strengthen inclusive education for children who are blind, deaf and deafblind in the Philippines, is implemented in partnership with the Philippine Department of Education and Innovation in Inclusive Education for Children with Sensorial Disabilities (ISEND), a network of disabled persons organizations (DPOs) and service providers.

Technology: GraphoGame
ACR GCD awardee: Agora Center, the University of Jyväskylä

Represented by Dr. Heikki Lyytinen, GraphoGame is a literacy app developed initially for learners with dyslexia. It is available in six languages, most recently Swahili, Cinyanja and Afrikaans. GraphoGame produces analytics of a child's decoding and phonics practice, allowing teachers and parents to quickly respond to bottlenecks in their learning. GraphoGame is evidence-based, with all content developed, studied and validated by experts from the University of Cambridge, the Aix-Marseille University and the University of Zambia.

Children who are Deaf or Hard of Hearing

Globally, of the estimated 34 million children who are deaf, more than 80% do not have access to any type of formal education and less than two percent receive education in a sign language they understand. More than 90% of children who are deaf are born to hearing parents.[5] Therefore, support is necessary for children and their parents to learn sign language ensuring early exposure to natural language which is critical for language acquisition. Many children who are deaf in developing countries also do not have access to any kind of hearing technology. If technology is available, it is

[5] Unheard Children. Deaf Child Worldwide. 2021. https://www.ndcs.org.uk/deaf-child-world-wide/unheard-children/

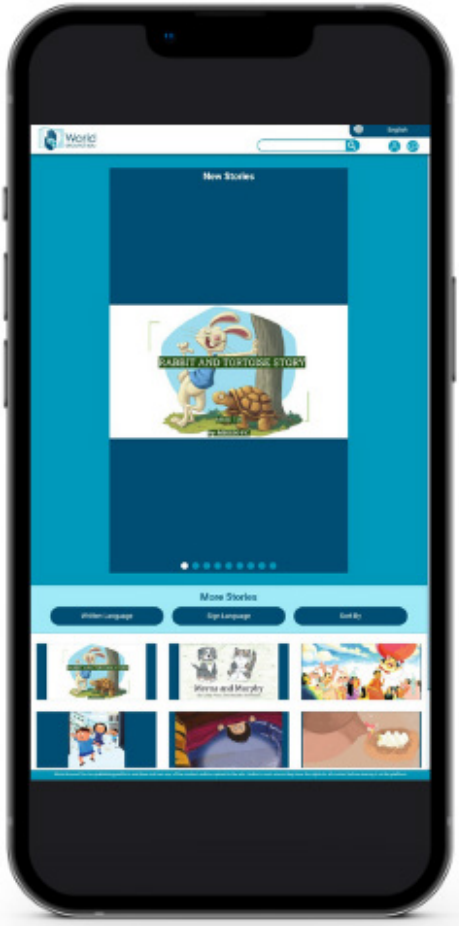
Globally, of the estimated 34 million children who are deaf, more than 80% do not have access to any type of formal education and less than two percent receive education in a sign language they understand.

most often a hearing aid, but this is often not appropriate, desired or available in low resource contexts. Regardless, sign language is imperative for both children who are deaf and their parents and teachers so that they are able to communicate.

Technology: Deaf World Around You (WAY) ACR GCD awardee: Rochester Institute of Technology/National Technical Institute for the Deaf

For learners with disabilities and special educational needs, access to language is crucial. When learners have access to language and communication, it can open up more opportunities. EdTech can help support early language acquisition, which is critical for lifelong success in language, literacy and accessing academic content. Pre-primary children who are deaf may not have access to incidental learning opportunities like their hearing peers. They benefit from visual storytelling, but the challenge is making stories sufficiently visually appealing to hold their attention, especially for 3-4 year-olds. For pre-primary children who are deaf, interventions like sign language rhythm and rhymes[6] can support engagement in storytelling between children who are deaf and their families. Additionally, learning shared bi-lingual reading strategies can help motivate engagement and conversational skills to increase basic interpersonal communication between parents and their children who are deaf, which is what children need for literacy success.[7] Both of these methods are being tested through the ACR GCD-funded Transforming Reading in Early Education (TREE) project for Deaf Children in the Philippines, Papua New Guinea and Fiji.

The Indonesian Sign Language Center, Pusat Bahasa Isyarat Indonesia (PUSBISINDO), which focuses on teaching sign language, is just one of the local organizations of persons with disabilities (OPD) that has partnered with an awardee of ACR GCD's Begin With Books Challenge.[8] PUSBISINDO encourages Deaf Indonesians to participate in the preparation of children's books in sign language, which so far have not existed in this country. In addition, stories from various countries with the main character being a deaf person are expected to make the world understand more about deafness so that the environment becomes inclusive and everyone is connected to each other.



The multilingual platform, Deaf World Around You (WAY), includes an online library of storybooks about different topics, including COVID-19, folktales, deaf experiences, cultural items, foods and sign language genres.

[6] Holcomb, L., & Wolbers, K. (2020). Effects of ASL rhyme and rhythm on deaf children's engagement behavior and accuracy in recitation: Evidence from a single case design. Children, 7(12), 256.; Golos, D. B., & Moses, A. M. (2013). Developing preschool deaf children's language and literacy learning from an educational media series. American Annals of the Deaf, 158(4), 411-425.; Banes, D., Hayes, A., Kurz, C., & Kushalnagar, R. (2019). Using Information Communication Technologies (ICT) to Implement Universal Design for Learning: Working Paper from the Global Reading Network for Enhancing Skills Acquisition for Learners with Disabilities. Global Reading Network.; Flórez-Aristizábal, L., Cano, S., Collazos, C. A., Benavides, F., Moreira, F., & Fardoun, H. M. (2019). Digital transformation to support literacy teaching to deaf Children: From storytelling to digital interactive storytelling. Telematics and Informatics, 38, 87-99.

[7] Graham, Patrick. Deaf techniques of the body in the preschool classroom: preschool as a site for enculturation in deaf culture. 2014. https://esploro.libs.uga.edu/esploro/outputs/doctoral/Deaf-techniques-of-the-body-in-the-preschool-classroom-preschool-as-a-site-for-enculturation-in-deaf-culture/9949334617102959

[8] Indonesia's Participation in All Children Reading: A Grand Challenge for Development and the Global Book Alliance's Begin With Books. September 2020. https://www-pusbisindo-org.translate.goog/artikel-detail/partisipasi-indonesia-di-all-children-reading-a-grand-challenge-for-development-and-the-global-book-alliances-begin-with-books-1?_x_tr_sl=id&_x_tr_tl=en&_x_tr_hl=en-US

An image from eKitabu's Digital Storytime broadcast which includes Kenyan Sign Language

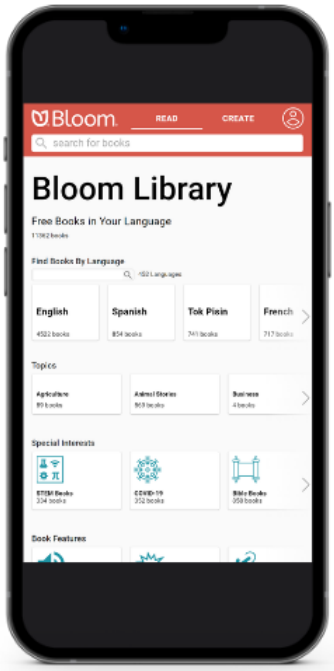
Technology: Digital Story Time
ACR GCD awardee: eKitabu

During the COVID-19 pandemic, learners with disabilities had increased challenges accessing learning materials while at home and not at school. In Kenya, eKitabu leveraged EdTech to help bridge this gap by broadcasting a half-hour Digital Story Time in Kenyan Sign Language (KSL) on Kenya's EDU Channel TV (a channel operated under Kenya Institute of Curriculum Development (KICD) as part of Kenya's Ministry of Education), YouTube and ekitabu.com, reaching more than four million households. These shows, based on sign language video books developed under ACR GCD's Book Boost: Access for All Challenge, enabled learners with and without disabilities to enjoy and learn together in an in or out-of-school setting. eKitabu worked in close collaboration with Kenya's Ministry of Education. In Malawi, during the COVID-19 pandemic, more than 100 teachers accessed materials in Malawian Sign Language shared by eKitabu through WhatsApp, that were developed through ACR GCD's Begin With Books Challenge. In Western Kenya, in collaboration with the EdTechHub and Leonard Cheshire, eKitabu used WhatsApp groups to support teachers' continued learning in braille during COVID-related school closures.[9]

[9] Using Innovative Methods to Train Teachers of Blind Children. EdTech Hub. January 2021. https://edtechhub.org/2021/01/08/using-innovative-methods-to-train-teachers-of-blind-children-what-we-learned/

Technology: Bloom
ACR GCD awardee: SIL International

During the COVID-19 pandemic, civil society deaf organizations in Colombia, El Salvador, Honduras and Guatemala used Bloom to create digital sign language storybooks with important public health and COVID-19 prevention information for deaf people in their respective countries. They worked collaboratively, each reviewing the work of the others, and each adapting the books the others created to their own sign language. Between them, they published 40 sign language books. Bloom's tools for adapting books to new languages made this process straightforward, and Bloom's ease of use made it possible for these groups to learn to use Bloom even though participants involved were not able to attend an in-person training workshop. Because they were comfortable using Bloom, they authored their own materials rather than adapting existing books created for spoken/written languages.



Technology: VL2 Storybooks
ACR GCD awardee: Gallaudet University

The VL2 storybook platform is an iOS application that strengthens visual language and learning. In research conducted by Gallaudet University, Dr. Melissa Herzig and Dr. Melissa Malzkuhn found that visually rich interfaces are the most effective way for children to learn a written language. The platform also includes the functionality of providing interactive text on the screen, which allows users to click on the text to see the American Sign Language (ASL) spelling as well as English words. The app first focuses on story comprehension and then engages users in learning finger-spelling and text-spelling with clickable glossary/phrases.

Remote Populations and Education in Emergencies

According to UNESCO and the World Bank, the digital divide became glaringly evident when millions of children were left behind during the shift to remote learning during the COVID-19 pandemic, which began in 2020. Additionally, many countries adopted technological solutions that were not well suited to their contexts. School closures presented a remote learning paradox. Globally, online platforms were the most common response for remote learning. Yet 1.3 billion school-age children do not have internet access at home, with households in rural areas systematically less likely to have internet.[10]

However, for remote populations or those in emergency contexts, technology can be a connector or a bridge to the formal school system, as seen during the COVID-19 pandemic and refugee and migration crises globally. We've seen technology support Syrian refugee children and empower parents using free and open source books and gaming apps like Feed the Monster, the Global Digital Library and Little Thinking Minds' Qysas app to improve literacy and psycho-social well being while away from formal school.

[10] The State of the Global Education Crisis: A Path to Recovery. Unesco, Unicef and the World Bank. 2021. https://www.worldbank.org/en/topic/education/publication/the-state-of-the-global-education-crisis-a-path-to-recovery

Little Thinking Minds

"With support from UKAid and USAID, Let's Live in Harmony is being institutionalized by integrating it into the extracurricular weekly block for literacy strengthening, while teachers and supervisors trained on the delivery of our program receive professional development points. Currently, Let's Live in Harmony plans to continue expanding to more schools with the aim to make the program accessible online for all."

Nedjma Saifi-Koval
INTEGRATED, partner of ACR GCD awardee, Little Thinking Minds.

Technology: Qysas and Let's Live in Harmony
ACR GCD awardee: Little Thinking Minds

With the goal of extending engaging Arabic literacy content to all 22 countries in the MENA region, Little Thinking Minds (LTM) and partner, INTEGRATED, implemented Qysas (Stories): An Arabic Leveled Digital Library for Every Classroom in public schools in Jordan. Students who participated in the project achieved statistically significant greater gains than the comparison group on three EGRA subtasks: syllable identification, oral reading fluency (ORF), and reading comprehension.[11]

Through partnerships with UNICEF in 2018, and the Jordanian Ministry of Education (MOE), LTM developed a new digital leveled library, Let's Live in Harmony, for use in schools where Syrian refugees attend. The library includes social cohesion content, with concepts of self, emotions, vocabulary, self expression, family and relating to the family, community and others.

During the COVID-19 pandemic, Let's Live in Harmony was digitized to be shared on the MOE digital platform for free public access.

Let's Live in Harmony scaled from 10 to 100 double shifting schools (25 tablets per school, most had individual use, some tablets were shared by 50 students per class). Two 45-minute blocks of time each week within the school day were dedicated to the Let's Live in Harmony curriculum.

Technology: Bloom Reader
ACR GCD awardee: SIL International

Used by Save the Children in the Rapidly Improving Standards of Elementary (RISE) project in Papua New Guinea (PNG), Bloom Reader contributed to improvements in relevant reading scores by 7%.[12] Building on this success, the ACR GCD-funded Yumi Read Together

Training resource images showing how to share books via Bloom Reader.

[11] Qysas (Stories): An Arabic Leveled Digital Library Implemented by Little Thinking Minds in Jordan, Evaluation Report. September 2017. https://allchildrenreading.org/wp-content/uploads/2019/07/Little-Thinking-Minds-Project-Evaluation-2.pdf

[12] Jones, Richard. Sharing Literacy with Bloom Reader: Findings from the RISE Project in Papua New Guinea. 2017 - 2019.

A 2022 World Bank impact evaluation detailed how devices preloaded with Feed the Monster and digital books from the Global Digital Library improved reading outcomes for children in as little as five days in 3,000 homes in Northern Nigeria.

project is focusing on extending learning improvement with Bloom Reader to thousands of children with disabilities in PNG's extremely remote, Western Province. The approach includes loading books onto SD cards and distributing them to teachers and families in the project communities. The SD cards are then inserted into parents' phones and projectors at schools, as well as shared from Android device to device via ShareIt. Project evaluation data from these projects will be available at AllChildrenReading.org by May 2023.

Technology: Feed the Monster
ACR GCD awardee: Apps Factory
Scaled by: Curious Learning

Traditional education approaches view schools as the single entry point to children's learning, however smartphone technology can facilitate extending children's learning into their homes, via parent or caregiver devices (multiple entry points), especially for remote, migrant, displaced and refugee populations. Innovators like Curious Learning are shifting perspectives on using devices like smartphones from communication tools to learning tools, especially for hard-to-reach learners. The organization localizes, distributes and measures the use of digital learning software. To that end, Curious Learning leveraged the code posted on GitHub for Feed the Monster–a literacy gaming app created through the Norad and ACR GCD EduApp4Syria competition–and contextualized the game to make it available in more than 50 languages, achieving more than 600,000 downloads globally, to date.

A 2022 World Bank impact evaluation detailed how devices preloaded with Feed the Monster and digital books from the Global Digital Library improved reading outcomes for children in as little as five days in 3,000 homes in Northern Nigeria. Through this method, content does not need to be delivered by a trained facilitator and can be used alone, in groups or in schools or community centers. The approach resulted in significant increases in literacy skills and the outcomes were second only to an intensive, in-person tutoring program.[13]

To reach parents on the move, Curious Learning implemented digital advertising via Facebook and other social media platforms to notify

The literacy gaming app, Feed the Monster, is available in more than 50 languages on Google Play.

[13] Orozco, Victor. Movies and Mobiles: Empowering Parents to Improve Educational and Learning Outcomes of 6-9 year old children. The World Bank. 2022. https://thedocs.worldbank.org/en/doc/c3a9864363ef028233640f-962c1bd95c-0050022021/original/1-Orozco-Nigeria-Movies-Mobiles.pdf

them of free learning content available for use on their smartphone. During the early months of the war in Ukraine in 2022, Feed the Monster in Ukrainian recorded more than 100,000 downloads within two months with an average advertising cost per download of $0.15. Curious Learning has subsequently built out an extended version of Feed the Monster, as well as a suite of follow-on content in the form of interactive storybooks. While the efficacy of Feed the Monster has been proven by multiple research studies, Curious Learning also embedded a letter sound assessment (in Ukrainian) into the app to help verify learning at scale. As of the start of June 2022, the app had more than 130,000 downloads, with more than 85,000 confirmed learners (data is available to show that the app was opened and played). There may be more learners; however, data tracked is dependent on the individual device settings and multiple-users.

Technology: Studio KSL
ACR GCD awardee: eKitabu

To reach learners in remote contexts, eKitabu loads devices in a central place and delivers them to users in schools or households. Open eKitabu content and software is designed to work offline. However, the challenges of delivering and supporting EdTech solutions in remote locations remain; training, power and connectivity are real constraints. At Kakuma Refugee Camp in Turkana County and Dadaab Refugee Complex in Garissa County in Kenya, eKitabu collaborated with Humanity & Inclusion to train caregivers and 116 Technical and Vocational Education and Training (TVET) teachers on innovative homeschooling approaches for children with disabilities. This work included delivering eKitabu's content, software and programs including early grade reading materials with Kenyan Sign Language (KSL) funded through ACR GCD's Book Boost: Access for All and Sign On for Literacy Challenges.[14]

Children's literacy skills and socio-emotional learning (SEL), especially important in emergency contexts, can be supported and nurtured through books that help children learn they are not alone in the struggles they are facing, develop coping skills, feel empowered, and develop empathy. These digital books incorporate SEL themes and can be adapted to complement education in emergencies programs.

Girls

ACR GCD also found that EdTech can support access to literacy for girls who are frequently marginalized in education.

Technology: 3asafeer app
ACR GCD awardee: Asafeer Education Technologies

Beginning with the content development phase, female protagonists must be included in books, as they serve as powerful role models for children. Students are more interested in reading when they identify with characters in the storybooks—where they see children and people that look, talk and live similarly to

[14] Inclusive Home-Based Learning for Children with Disabilities in Kakuma and Dadaab Refugee Camps. eKitabu. 2022. https://www.ekitabu.com/2022/01/10/inclusive-home-based-learning-for-children-living-with-disabilities-at-kakuma-and-dadaab-refugee-camps/

Grace in Space, developed by Asafeer Education Technologies, is a story about a girl with a disability who journeys to space. It is also available with audio narration on Bloom Library.

them. In literature, this can be implemented by featuring engaging stories with girls as protagonists in accessible storybooks in languages they use and understand.

An excellent example of creative inclusion and use of female protagonists can be found in the collection of 100 open source, digital STEM books in English and Arabic created by ACR GCD awardee Asafeer Education Technologies through the No Lost Generation Summit Tech Prize. These 100 Adventures in Science and Life ebooks present STEM (Science, Technology, Engineering and Mathematics) related content and feature a great diversity of characters. Developed in the context of providing literacy materials for out-of-school child refugees from Syria, Asafeer developed these grade-appropriate, accessible, free and adaptable storybooks in Arabic (also available as an audible book) and English using engaging STEM themes, and intentionally included stories with female protagonists. The books—available on the Global Digital Library, where they can be read, downloaded, or printed for free—were published under Creative Commons Attribution licensing, which allows others to use, translate and adapt them for free, with appropriate accreditation. The books are also available on the 3asafeer app, which offers free reading content and premium services to families and schools that includes tracking and analytics, lesson plans, and interactive exercises.

Technology: Qysas
ACR GCD awardee: Little Thinking Minds

During the ACR GCD-funded Qysas (Stories): An Arabic Leveled Digital Library for Every Classroom project, Little Thinking Minds (LTM) created a total of 145 e-books—126 interactive e-books and 19 basic e-books—that were made available to students through the Qysas platform. On average, each student who participated in the project read 105 books on the Qysas platform. The average number of books read per student was slightly higher at all-girls schools than at all-boys schools: 127 books per student and 102 books per student, respectively. Analysis revealed a weak but statistically significant relationship between the number of books read per student and EGRA gains on four subtasks: syllable identification, nonword reading, ORF, and reading comprehension. This indicates that students who read more of the books tended to have greater gains on these subtasks.[15]

[15] Qysas (Stories): An Arabic Leveled Digital Library Implemented by Little Thinking Minds in Jordan, Evaluation Report. September 2017. https://allchildrenreading.org/wp-content/uploads/2019/07/Little-Thinking-Minds-Project-Evaluation-2.pdf

Little Thinking Minds

ACR GCD Consultation participants also noted additional challenges related to access for disadvantaged groups. EdTech can support access to content for disadvantaged groups, as noted in the examples provided in this report, and contribute to quantitative improvements in learning outcomes. However, using EdTech to support improved learning outcomes is not without challenges. Awardees expressed challenges ranging from scarce or unreliable power sources to platform bugs, difficulty retrieving usage data, tangled headphones, broken and stolen tablets, and limited internet connectivity. To remedy these issues, awardee LTM built charging stations, released several updates to their Qysas learning platform to resolve programming bugs and reconciled the problems faced in downloading usage data. To stabilize internet connections, routers provided by Umniah Telecom were installed in each school. This also led to faster internet access and improved user experience on the Qysas platform. Furthermore, individuals were trained to manage the tablets—ensuring the devices were charged, the platform was connected to the server, and the usage data were properly tracked—which allowed teachers to focus on providing the literacy group sessions to students.

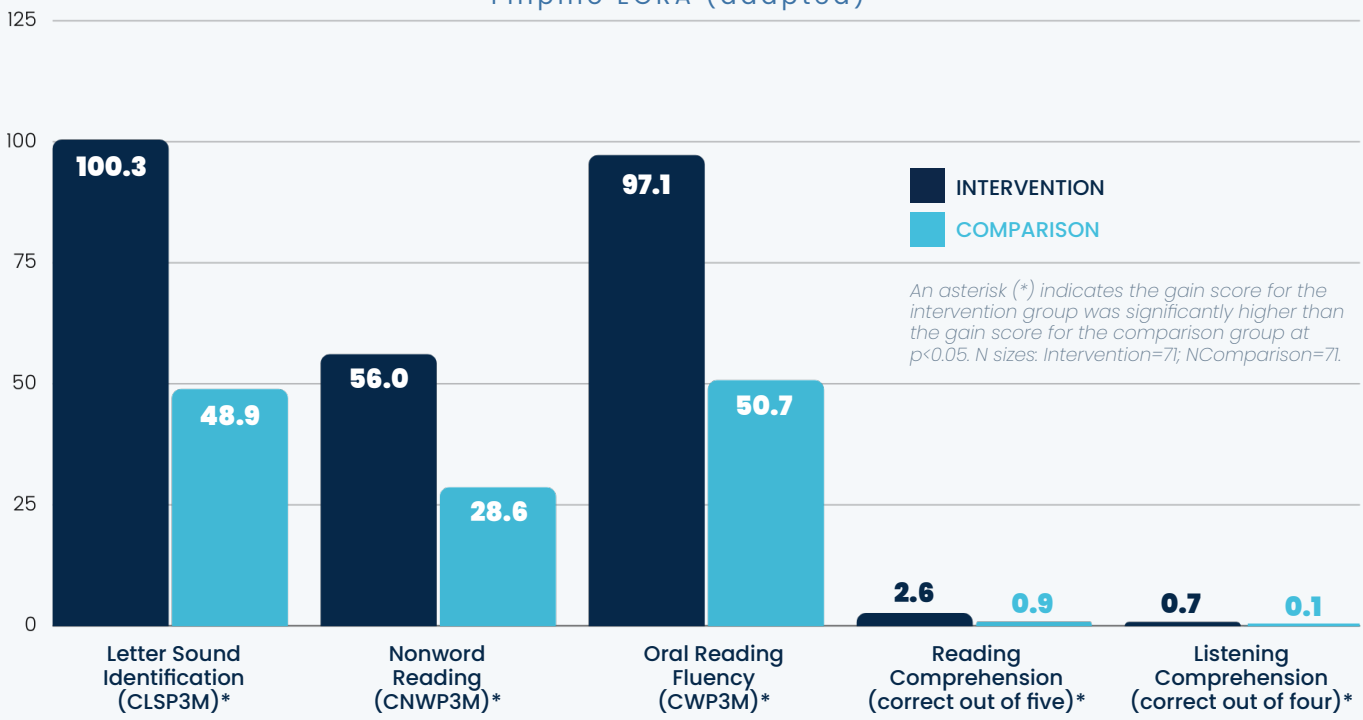
Assessment Data

Inclusive assessments are essential to ensure learning assessments are more inclusive of children with disabilities and measure their learning outcomes more validly and reliably. EdTech can help support inclusive assessments. However, **the World Bank reports that learners with disabilities are largely excluded from assessments in low-income contexts. ACR GCD has seen thousands of children with disabilities in the Philippines, India, Lesotho and Nepal demonstrate their true aptitude or achievement level when using inclusive assessments.** For example, children who used braille materials in the ACR GCD-funded Reading Beyond Sight project in the Philippines had significantly higher gains on all five subtasks than comparison group peers on both the Filipino and English EGRAs, as shown in Table 2.[16] **ACR GCD also coordinated the development of the first known adaptation**

[16] Reading Beyond Sight Evaluation Report. All Children Reading: A Grand Challenge for Development. 2018. https://allchildrenreading.org/wp-content/uploads/2019/07/Resources-for-the-Blind-Project-Evaluation.pdf

TABLE 2: READING BEYOND SIGHT PROJECT RESULTS

Average gain scores from baseline to endline by subtask and group- Filipino EGRA (adapted)



of an Early Grade Reading Sign Language Assessment (EGRSLA) for children who are deaf/hard of hearing in Morocco, making the internationally-recognized literacy assessment accessible to children through the use of Moroccan Sign Language (MSL). The project evaluation report[17] from ACR GCD grantee, Institute for Disabilities Research and Training and École Nationale Supérieure des Mines de Rabat, showcases how they adapted assistive technology to allow educators to easily create and publish MSL-supported materials. The study included newly developed MSL vocabulary and reading comprehension subtasks and results showed a statistically significant difference between baseline and endline scores on the MSL vocabulary assessment for Grade 2 students.

[17] Moroccan Sign Language Assistive Technology for Reading Improvement of Children who are Deaf/Hard of Hearing, Evaluation Report. All Children Reading: A Grand Challenge for Development. July 2018. https://allchildrenreading.org/wp-content/uploads/2019/07/R3_EnsembleMedia_SchoolToSchool_IDRTReport_digital_lowres.pdf

ACCESS TO CONTENT

How can more knowledge reach more learners in more attractive and cheaper formats?

Key to cost-effective and scalable EdTech solutions is content created under an open license that permits no-cost access, use, resharing, adaptation and redistribution by anyone with no or limited restrictions. Table 3 below showcases accessible features of several ACR GCD-supported platforms which provide access to content. By using resources like awardee eKitabu's Accessible EPUB Toolkit and adapting existing books on the Global Digital Library, for example, publisher production costs for accessible EPUBs rapidly decrease. These costs will continue to decrease as more publishers produce books in accessible formats. Including features like text highlighting, audio, e-braille, large print and sign language video storybooks ensure children with disabilities have the same opportunities

TABLE 3: FEATURES OF ACR GCD-SUPPORTED ACCESSIBLE CONTENT PLATFORMS

	Sign Language Storybook Videos	Text to Speech Audio	Offline Access	Magnification	Content Filtering /Distraction Reduction	Export Format to Other Platforms	Other Features
Deaf World Around You (WAY)	☑	☐	☐	☐	☑	☑	
Let's Read	☑	☐	☑	☑	☐	☑	Multiple user profiles can be created
Bloom	☑	☑	☑	☑	☑	☑	
eKitabu App	☑	☑	☑	☑	☐	☐	
Global Digital Library	☑	☑	☐	☐	☐	☑	
African Storybook	☐	☐	☑	☑	☐	☐	
Bookshare	☑	☑	☐	☑	☐	☐	Audiovisual speed control

to participate in education as their peers. In addition, creating born accessible books is not only more efficient and cost effective when compared to retroactively adapting materials to meet accessibility standards, but also helps publishers and writers think more inclusively about children's needs. Born accessible refers to creating accessible books right from the beginning, and building the process into current ebook production workflows, instead of taking apart and updating books post-production to make them accessible. ACR GCD awardee-created content can be easily accessed, adapted or downloaded on multiple platforms, including the Global Digital Library, Bloom Library, World Around You and Asafeer Library. The books and associated training materials developed by ACR GCD innovators are available in our Solutions Hub.

High Quality Accessible Book Production

First and foremost, digital does not necessarily mean accessible. Producing born accessible books from the onset is the most cost-effective way to produce high-quality accessible books.

The helpful resources, toolkits and webinars highlighted in Table 4 support publishers and organizations converting digital books into accessible formats.

Knowledge can reach more learners in a more attractive and cheaper format through designing with accessibility and Universal Design for Learning principles at the start of the content development process. This applies to both content development and production methods. ACR GCD awardee eKitabu develops content according to open standards, for example, EPUB 3.2 and WCAG 2.1, complying with

TABLE 4: RESOURCES TO SUPPORT CONVERTING DIGITAL BOOKS TO ACCESSIBLE FORMATS

eKitabu Accessible EPUB Toolkit (Kenya-Malawi version in process)	This toolkit guides content creators and publishers in creating accessible EPUBs with image descriptions, accessible navigation, and optional sign language videos
Data Mtali Comene demonstration ebook online	This book demonstrates the features of accessible EPUBs including image descriptions, accessible navigation, and sign language videos
WCAG 2.1 Standard	The Web Content Accessibility Guidelines (WCAG) 2.1 define how to make web content more accessible to people with disabilities, more usable by older individuals with changing abilities due to aging, and often improves usability for users in general.
Ace by DAISY	Ace by DAISY is a free, open source tool designed to check the accessibility of EPUB files at any point in the publishing workflow. It has been developed to assist in the evaluation of conformance to the EPUB Accessibility Specification.
Guidelines for Accessible eBooks: EPUB Accessibility **Creating Accessible Images**	In these two webinars, Benetech shares key accessibility guidelines and tools for creating born accessible ebooks and accessible images through alt-text and image descriptions to support children with disabilities.
Bloom: Sharing Books as EPUBs	These training videos instruct on adapting Bloom books to accessible formats.

Ace by DAISY and Benetech Global Certified Accessible publishing. eKitabu is one of ACR GCD's Begin with Books challenge awardees, which are creating more than 2,000 accessible EPUBs in underserved languages, including storybooks in nine sign languages. Accessible books with embedded sign language videos with audio are useful for engagement of hearing parents of children who are deaf. One example is *Talking with My Mum*, which was purposely and collaboratively created by Malawi National Association of the Deaf (MANAD). So far, 155 of these accessible digital books are available on the Global Digital Library. In collaboration with Malawi Union of the Blind, eKitabu has also delivered 118 electronic braille books for use with 253 Orbit Readers with refreshable braille displays deployed in 26 primary and secondary schools in Malawi. These assistive devices are also supported by intensive training and technical assistance for teachers and students using them, addressing typical barriers with under-usage due to unfamiliarity.

With rapidly changing technologies that allow for the inclusion of educational platforms with content in sign languages and the creation of sign language storybooks to promote language and academic development for children and youth who are deaf worldwide, as well as their families and friends, ACR GCD recognized a great need for guidelines to ensure the development and production of high quality sign language storybooks. ACR GCD, in collaboration with Dr. Chris Kurz from RIT/NTID, is developing Minimum and Gold Standards for Sign Language Storybook Production. The Minimum and Gold Standards are also complemented by a series of training videos. Once validated by the Begin with Books awardees and their local DPO partners, these standards will be available publicly (anticipated in 2023) to support the production and availability of accessible books and ensure the highest quality books are available in the smallest file sizes for use in low resource contexts.

Free and Open Digital Content

Free and open digital content clearly supports the Principles for Digital Development to "Design for Scale" and "Reuse and improve." To "Build for Sustainability," eKitabu also recommends engaging and compensating local publishing firms, authors, illustrators and organizations of persons with disabilities (OPDs) to develop content for their communities and countries. In fact, developing, licensing and adapting accessible digital content can be a catalyst to enable local content developers to go digital and grow their business. The Global Digital Library has thousands of high-quality early learning resources, available in more than 90 languages including sign languages, that are ready to be adapted, translated and contextualized for anyone to use.

The apps designed under the EduApp4Syria competition to support foundational literacy and the psycho-social well being of Syrian refugee children were required to be developed under free and open standards with code available on GitHub. **"Feed the Monster had all of this wonderful investment in terms of design, being open source, and all of the audio and video assets being Creative Commons license," said Stephanie Gottwald of Curious Learning. "This created a unique opportunity for us to take Feed the Monster to the next level – to localize it to as many languages as we could."** Curious Learning has since adapted Feed the Monster into more than 50 languages.

Curious Learning also created the Guide for Creating Localized Literacy Apps, which is intended to help anyone interested in learning about reading science, literacy research and app design. "We had no intention of localizing Feed the Monster to every possible language on earth," Gottwald says. "But we wanted to prove that it's inexpensive and doable and doesn't require big publishers. Small teams can do it on their own."

Tools are also available to create free and open sign language dictionaries/glossaries, such as SooSL (http://soosl.net) developed by SIL International.

Content Development and Production Cost Reduction

Born accessible publishing techniques can reduce the cost of developing print and digital outputs through a single production process. eKitabu's benchmarks between 2015 and 2019 demonstrated that born accessible production reduced the cost to produce accessible digital content by 80% versus retroactively converting

early grade storybooks developed for print only. By standardizing and documenting production processes for sign language digital storybooks, eKitabu reduced internal production costs by a similar 80%. Also important is ensuring costs for accessibility are budgeted for and included in cost estimates, noting that previous reports on book production costs such as Good Stories Don't Grow on Trees, do not include costs for accessibility.

Accessible digital content, built on open, accessible standards such as EPUB WCAG 2.1 also enables publishers and content developers to distribute content across multiple platforms. The building blocks of born accessible books in EPUB, HTML, CSS and open standard audio and video can be readily repurposed for the web, any mobile device, radio and broadcast TV.

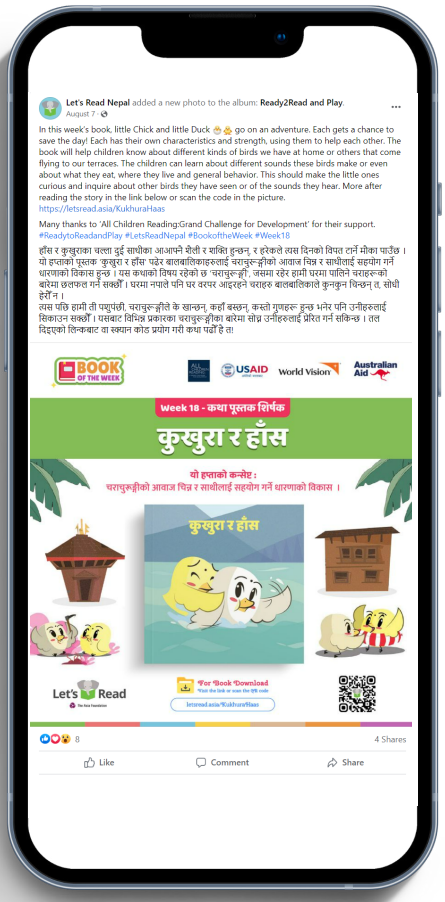
Also important for scaling free and open content, as well as reducing costs, is training authors and publishers to incorporate these key concepts. In 2020, Asafeer scaled their model to reach more aspiring authors with training on creating quality children's content in Arabic. Since the launch, Asafeer has engaged more than 34,000 new authors across the Middle East and created a pipeline of quality children's books in Arabic.

Digital Content Use

Engaging ecosystem stakeholders is crucial to increase the reach and impact of digital content accessed via EdTech solutions. Particular attention must be paid to distribution strategies, device availability and training for users—including teachers and parents— on how to use digital books and content, both in the classroom and at home. Several examples of successful distribution strategies that have increased uptake and use of digital content include:

Leveraging existing technology, through mapping existing solutions and providing training for users on how to use the solutions to support learning, helps ensure uptake and usage of digital content. World Education's ACR GCD-funded LEARN project created an EdTech Matrix and related training to help teachers and parents in Nepal understand more than 80 EdTech resources available to support reading for children with disabilities. Underuse, device malfunctions and general unfamiliarity with many of the EdTech resources limited learning.

Leveraging social media platforms, like Facebook, ACR GCD awardee The Asia Foundation (TAF) promotes the 437 books they created through ACR GCD's Begin with Books Challenge. The books, available in six languages, including Nepali Sign Language, are available on the Global Digital Library and the Let's Read Asia digital platform. They've tracked more than 117,000 views of the books and counting, which is 80% higher than awardees that have not promoted their books. TAF is working with Child Workers in Nepal (CWIN) through their ACR GCD-funded Ready2Read and Play project to enable marginalized children ages 3 to 6 to build foundational language and literacy skills at home or at school. This is accomplished by engaging children and families in 30 weekly, in-person sessions, the content of which is also posted on Let's Read Nepal's Facebook page. The posts feature a "Story of the Week,"



Sample social media post from the Ready2Read and Play project.

"Concept of the Week," and "Activity of the Week" as well as demonstration video-clips. Through the social media platform, families can also access the same books and reading calendar that incentivizes the project's in-person participants. While Early Childhood Education (ECE) enrollment is low among the poorest quintile of citizens (only 41%), Facebook use is high in Nepal, with almost no difference in use between the lowest and highest income brackets, therefore making it a successful promotion and learning tool.

Leveraging existing libraries, Benetech's Bookshare Philippines team partnered with the Philippines Department of Education-Regional Library Division to expand access to learning materials for blind and low-vision Filipinos—even in the most remote communities with weak internet connectivity**.** Bookshare Corners were developed in 33 division libraries and school libraries on off-grid islands. Benetech added a free, open source, portable screen reader, NonVisual Desktop Access (NVDA), to enable access to more than 10,000 accessible books on existing laptops in Filipino libraries. The computers are also equipped with Windows 10 Narrator, an inbuilt screen reader which supports 67 languages. Readers can also download the books that they need to a device for offline reading at home. There is limited content in Filipino, so Benetech is conducting training on converting PDFs to accessible formats, such as being able to jump from chapter to chapter (navigation necessary for content to be truly accessible). ACR GCD has supported multiple Bookshare Global platforms including Bookshare India, Bookshare Philippines, Bookshare Nepal and Bookshare Rwanda.

Challenges

ACR GCD Consultation participants noted the following related challenges related to access to content:

High Quality Content in Small File Sizes: ACR GCD's Sign Language Storybook Cohort has been working to determine how to package digital accessible book files—which have audio and video—into the smallest file sizes to maximize use in contexts with limited connectivity. The Minimum and Gold Standards for Sign Language Storybook Production, being developed by ACR GCD and RIT/NTID seek to address this challenge. (See report section on High Quality Accessible Book Production).

Barriers to Production by Users with Disabilities: Book creation and editing is not currently feasible using earlier versions of the Bloom software for people with who are blind or low vision seeking to create books. This is not unique to Bloom, as most creation and editing platforms are not accessible. Significant changes to the Bloom user interface are likely required to meet the needs of authors who are blind or have low vision to create and adapt books. The accessible books that exist in the library are primarily the result of the efforts of sighted people.

Limited Access to Internet: Many books and learning materials are not accessible because the internet where users in low resource settings are located is very weak, and websites or digital libraries are difficult to open and view unless users have a strong, stable internet connection.

Non-Sustainable Funding: Short term awards and limited market demand continue to be challenges for awardees who want to scale the use of accessible digital books. For organizations to make long-term investments in their platforms, they need financial sustainability.

Quality Assurance: Errors in books often prevent widespread use. Appropriate punctuation, capitalization, content review, leveling, metadata and tagging are all necessary to ensure high-quality content is usable via digital platforms hosted by governments and other organizations to support quality learning. However, rigorous quality assurance often takes time, targeted proceses and funding that is not typically included in technical approaches or budgets.

Conclusion

Evidence-based EdTech solutions can improve reading outcomes for marginalized populations at lower costs and in less time as compared to traditional approaches. ACR GCD awardees who participated in the consultation and follow-up interviews showcased many useful examples of ways that technology can help address challenges related to access, equity, inclusion and others, as well as ways technology can contribute to digital divides. Through implementation and testing, ACR GCD and our awardees learned what works and does not work, thinking beyond the EdTech solution itself to include the appropriate training, needs assessment, screening, infrastructure, devices, coaching and monitoring support, and advocacy and ecosystem engagement necessary to ensure effective use at scale. Engaging ecosystem stakeholders is crucial to increase the reach and impact of digital content accessed via EdTech solutions. Leveraging existing technology, social media and libraries are three examples of ways to improve digital content usage. Finally, since learners with disabilities are largely excluded from assessments in low-income contexts, anyone working in the sector has the responsibility to use inclusive assessments to accurately measure their abilities. ACR GCD has seen thousands of children with disabilities in the Philippines, India, Lesotho and Nepal demonstrate their true aptitude or achievement level when allowed accommodations during assessments that simply enabled them to access the content. ACR GCD innovators have worked tirelessly to use technology to address challenges related to access, equity and inclusion, and they have big, innovative dreams for how their work will continue to transform the 585 million children who are still waiting for the opportunity to learn to read into lifelong readers and learners.

Creative Associates

Annex 1 Presentation Slidedeck

Access the presentation slidedeck and a recording of the consultation at AllChildrenReading.org.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