Assistive Reading Technology for Blind Children: A Literature Review of Developments in the Last Five Years (2022–2026)

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Abstract

Reading is a foundational skill for blind children, yet limited access to sensory accessible reading materials remains a major barrier in their education. Over the past decade, rapid advances in assistive technology ranging from RFID and computer vision-based devices for braille learning, Optical Character Recognition (OCR) and Text-to-Speech (TTS) text readers, artificial intelligence (AI)-based smart glasses, to adaptive audio learning platforms have opened up new opportunities to support literacy among blind children. This article presents a narrative literature review of 20 publications from 2022–2026 discussing assistive technology for reading among blind children and individuals, gathered from academic search databases and filtered for relevance to the topic. Thematic synthesis grouped the findings into six categories: (1) tactile braille-based technology; (2) OCR and TTS based text reading devices; (3) AI-based visual assistance and smart glasses; (4) audio learning platforms and AI-based personalization; (5) implementation, perception, and school readiness; and (6) dimensions of context, equity, and family. The review results show that innovation in assistive reading technology is moving from single-function tactile devices toward integrated multimodal systems, but most available research consists of small-scale engineering prototypes that have not been widely tested on populations of blind children in real school settings. Gaps were also found in cost affordability in low- and middle-income countries, teacher readiness, standardized assessment tools for assistive technology skills, and the affective and family dimensions of shared reading practices. This article concludes with recommendations for future research to strengthen child-user-based evaluation, cost-effectiveness studies in developing-country contexts including Indonesia, and the development of standardized assessment instruments.

Keywords: assistive technology; reading; blind children; braille; text-to-speech; inclusive education; literature review.

1. Introduction

The ability to read is one of the primary foundations of a child's academic success and independence, including for children who are blind or visually impaired. According to estimates by the World Health Organization (2021), approximately 2.2 billion people worldwide experience some degree of visual impairment, and some of them are school-age children who require literacy support different from that of sighted students. For blind children, access to reading materials heavily depends on the availability of alternative formats such as braille, audio, or digital text compatible with screen readers.

For several decades, braille has been the primary literacy medium for totally blind children. However, mastering braille requires an intensive tactile learning process, while the availability of teachers, teaching materials, and adequate braille teaching aids remains limited, particularly in low- and middle-income countries (Hoskin et al., 2022). At the same time, reports of declining braille literacy rates in a number of countries have further driven the development of assistive technology as a bridge between the limitations of conventional resources and the continuously growing literacy needs of blind children.

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Over the past five years, developments in digital technology — including Optical Character Recognition (OCR), Text-to-Speech (TTS), Radio Frequency Identification (RFID), computer vision, and generative and multimodal artificial intelligence (AI) — have given rise to a variety of innovative assistive reading devices. These devices range from low-cost interactive braille teaching aids (Bintari, 2023; Putra et al., 2023), portable Raspberry Pi-based text readers (Llorca, 2023; Huynh et al., 2023; Kiyota et al., 2022), to AI-based smart glasses that integrate object recognition, text reading, and remote assistance (Gayathri et al., 2025; Král et al., 2025). Beyond hardware, adaptive audio learning platforms have also emerged, using AI to personalize the learning experience of blind children (Yang & Taele, 2025).

Although technical innovation is developing rapidly, a number of studies show that the successful adoption of assistive technology in schools does not depend solely on the sophistication of the devices, but also on teacher readiness, student perception, availability of training, and the socio-cultural and economic context in which the technology is implemented (Chanana et al., 2022; Prabhu et al., 2023; Booths, 2022). Studies in developing countries, such as Zambia (Kaluta & Kandimba, 2026) and Yemen (Rageh et al., 2023), also highlight infrastructure gaps and the need for standardized instruments to assess assistive technology skills. The family dimension has also begun to receive attention, as shown by research on technology that supports shared reading activities between blind parents and their sighted children (Cassidy, 2025).

To the best of the authors' knowledge, there have not been many literature reviews that specifically map the development of assistive reading technology for blind children across categories — covering braille-based technology, OCR/TTS devices, AI-based visual assistance, audio platforms, and implementation and social-context factors — within a recent publication period. This article aims to: (1) map the types and characteristics of assistive reading technology developed or studied in the last five years; (2) synthesize findings on the effectiveness, challenges, and success factors of their implementation; and (3) identify research gaps that require attention in future research, particularly for developing-country contexts such as Indonesia.

2. Method

This article was prepared as a narrative literature review based on a corpus of 20 scientific articles gathered through a search of academic databases using keywords related to "assistive technology," "reading," "braille," and "blind children," restricted to publication years 2022 to 2026 to represent developments over the last five years. The sources included consist of internationally and nationally indexed journal articles, conference proceedings papers (IEEE and ACM), and one thematically relevant preprint manuscript.

Inclusion criteria covered publications that explicitly discussed: (a) the design or evaluation of assistive technology devices/applications that support reading activities, braille literacy, or access to text for blind children or individuals; (b) perceptions, adoption, or implementation readiness of assistive technology in the context of blind children's education; or (c) contextual factors — including family, policy, and resource equity — that affect blind children's access to reading technology. Publications focusing solely on mobility/navigation technology with no connection to reading literacy were not included in the main synthesis, although a few were briefly referenced as comparative context.

The literature search and screening process followed a flow adapted from the PRISMA diagram (Figure 1): 540 initial records were identified through database searches, then screened based on title, abstract, and inclusion/exclusion criteria down to 35 records assessed for full-text eligibility, ultimately resulting in 20 publications included in the synthesis. Given the high diversity of research designs — ranging from engineering prototypes, case studies, and quantitative surveys, to qualitative research and broader systematic reviews — this article does not follow a full multi-database PRISMA report with detailed exclusion reasons at every stage, but instead presents a thematic synthesis of the assembled corpus. Data extraction included author names, year of publication, country/context of origin, type of technology or focus of study, population/sample (where available), and key findings relevant to blind children's reading literacy. Thematic analysis was conducted manually to group studies into interrelated technology categories and implementation themes, as presented in the Results and Discussion section.

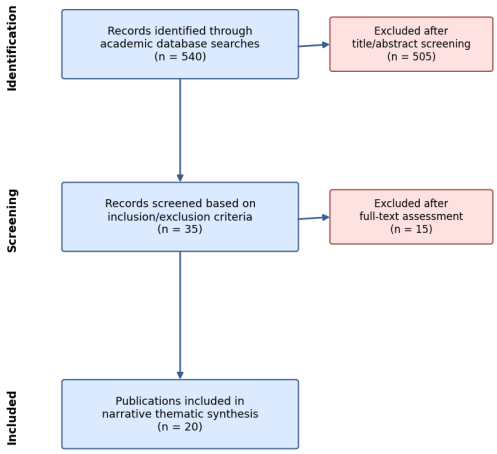


Figure 1. Literature search and screening flow diagram, adapted from PRISMA

As a methodological note, most of the studies covered in this review focus on assistive technology for blind individuals in general (including university students and adults), not solely on school-age children. Studies that specifically target children are explicitly noted in the discussion, while studies with a general blind population are still included because their technology and findings may be relevant or adaptable to the context of blind children.

3. Results and Discussion

3.1 Publication Characteristics

The twenty publications reviewed originate from at least 13 countries/contexts, with a distribution reflecting two distinct poles of research activity. First, a large number of studies are hardware engineering design projects and prototypes from Indonesia, Japan, the Philippines, India, and Slovakia (e.g., Bintari, 2023; Putra et al., 2023; Kiyota et al., 2022; Llorca, 2023; Gayathri et al., 2025; Král et al., 2025). Second, there is a group of survey studies, interviews, and conceptual reviews focusing on aspects of usage, perception, and implementation of assistive technology in educational settings, many of which come from India, Pakistan, Nigeria, Zambia, and Yemen. Broader systematic reviews and literature reviews are also present in this corpus, namely the work of Hoskin et al. (2022) focusing on

braille literacy technology, and Kanchanasuttirak (2025), which synthesizes 37 sources related to assistive technology for English language learning among blind individuals.

Table 1. Characteristics of the 20 Publications Reviewed

Author (Year)	Country/Context	Publication Type	Technology/Study Focus
Hoskin et al. (2022)	Canada	Systematic review	Effectiveness of technology for braille literacy education in children and adolescents
Bintari (2023)	Indonesia	Engineering design	Low-cost RFID-based early braille learning aid for blind children
Kiyota et al. (2022)	Japan	Engineering design & engineering education	Digital reading device for the blind, developed within the KOSEN engineering education program
Putra et al. (2023)	Indonesia	Engineering design	Computer-vision-based (Raspberry Pi) conversion of Latin text to braille and speech
Llorca (2023)	Philippines	Engineering design	AI-WEAR: smart text reader based on Raspberry Pi with TTS, audio-visual calling, and Google Assistant
Huynh et al. (2023)	United States	Conference proceedings (IEEE UEMCON)	Assistive reading device for blind individuals
Gayathri et al. (2025)	India	Engineering design	AI-based visual assistance system on smart glasses for blind students (including exam contexts)
Král et al. (2025)	Slovakia	Engineering design	Low-cost multifunctional glasses-shaped assistive device: text recognition, obstacle detection, remote assistance
Kaluta & Kandimba (2026)	Zambia	Field study (primary school)	Role of assistive technology in learning for blind students in primary schools
Yang & Taele (2025)	United States	Engineering design & educator interviews	Audemy: AI-based adaptive audio learning platform for blind students
Booths (2022)	United States	Survey	Perception and use of “high-tech” assistive technology by blind students
Chanana et al. (2022)	India	Conceptual review	Role of assistive technology in inclusive education for blind children in schools
Prabhu et al. (2023)	India	Conceptual review	Digital and assistive technology for the education of students with visual disabilities
Barq & Rehan (2025)	Pakistan	Semi-structured interviews	Accessibility and usability of braille, screen readers, and other devices for English language learning
Negi (2026)	India	Conceptual review	Role of assistive technology in the academic achievement of children with multiple disabilities
Mahmoud (2025)	Nigeria	Conceptual review	Assistive technology for blind children in inclusive education settings
Meiyani (2026)	Indonesia	Conceptual review	Assistive technology based on rahmatan lil ‘alamin principles for

			blind students' academic achievement
Rageh et al. (2023)	Yemen	Instrument development	Functional assessment scale for assistive technology skills of blind students
Kanchanasuttirak (2025)	Thailand	Literature review (37 sources)	Assistive technology for English language learning among blind individuals: screen readers, braille displays, audio, mobile apps
Cassidy (2025)	United States	Interview & co-design study	Assistive technology to support co-reading activities between blind parents and their children

3.2 Tactile Braille-Based Technology

Braille remains the core literacy medium for totally blind children, and a number of recent innovations seek to address the long-standing challenges of availability and cost of conventional braille teaching aids. A systematic review by Hoskin et al. (2022) evaluated the effectiveness of various technologies supporting braille literacy education for blind children and adolescents aged 0–21 years, and confirmed that although the importance of braille for this population has long been recognized, empirical research on supporting technology remains relatively limited compared to the needs on the ground. In line with these findings, two engineering-design studies from Indonesia demonstrate concrete efforts to fill this gap with low-cost solutions. Bintari (2023) developed an RFID-based early braille learning aid that integrates several braille teaching methods commonly used by teachers in schools, such as the Mangold, Fernald, flashcard, and scrabble methods, with the aim of making the process of learning braille letters more interactive and game-like for children. Putra et al. (2023) developed a complementary approach, namely converting Latin-script text from printed books into braille board and audio output using Raspberry Pi-based computer vision, so that blind children who have not yet mastered Latin letters can still access reading materials that were originally only available in ordinary print format.

3.3 OCR- and Text-to-Speech-Based Text Readers

The second category covers portable devices that scan printed text using Optical Character Recognition (OCR) and convert it into speech via Text-to-Speech (TTS), generally built on affordable microcomputer platforms such as Raspberry Pi. Llorca (2023) developed AI-WEAR, a smart text-reader prototype for blind students that combines TTS capability with audio-visual calling features via Jitsi Meet and Google's voice assistant, allowing students to read text while interacting directly with teachers; this study also includes a cost-comparison analysis to consider the potential for mass production of the device. Kiyota et al. (2022) reported the development of a similar digital reading device carried out as part of an educational initiative for prospective assistive-device engineers at a vocational higher-education institution (KOSEN) in Japan, highlighting the importance of involving prospective engineers in a development process that understands the real needs of people with disabilities. Meanwhile, Huynh et al. (2023) also reported the development of an assistive reading device for blind individuals at an IEEE conference forum, reinforcing the growing trend of relatively affordable portable reading devices as an alternative to far more expensive braille machines.

3.4 AI-Based Visual Assistance and Smart Glasses

The third category represents the latest trend of wearable devices that integrate multiple AI capabilities at once — not only reading text, but also recognizing objects and the surrounding environment within a single device. Gayathri et al. (2025) developed an AI-based visual assistance system in the form of smart glasses specifically for blind students, with an emphasis on the context of use during exams, utilizing a combination of OCR, Automatic Speech Recognition, and TTS. Král et al. (2025) developed a similar but more comprehensive device, namely low-cost multifunctional assistive glasses that combine real-time text recognition, obstacle detection for mobility, and remote assistance features in a single integrated system. Both studies illustrate a paradigm shift from single-function devices toward multimodal systems that unite literacy and mobility needs at once, although both are still at the prototype stage and have not been widely tested on school-age child populations.

3.5 Audio Platforms and AI-Based Personalization

Beyond hardware, innovation has also emerged on the software side in the form of audio learning platforms personalized using generative AI. Yang and Taele (2025) developed Audemy, an audio-based learning platform that adjusts material difficulty level, delivery speed, and engagement patterns based on each blind student's performance; the platform was developed iteratively with more than 20 educators experienced in accessibility and, at the time of reporting, had been used by more than 2,000 blind students. This study emphasizes that although screen readers and braille materials have provided basic accessibility, both are often insufficiently interactive and not adaptive enough to individual learning needs, so the integration of generative AI is viewed as an important complement. In line with this, a literature review by Kanchanasuttirak (2025) synthesizing 37 sources on assistive technology for English language learning among blind individuals also identified that a multimodal approach — combining screen readers, braille displays, audio-based technology, and specialized mobile applications — shows the most promising results for language skill development, with screen readers and vocabulary apps being more effective for vocabulary mastery, while braille displays and interactive grammar exercises are more effective for grammatical competence.

3.6 Implementation, Perception, and School Readiness

The next group of studies highlights that the success of assistive technology is determined not only by the sophistication of the devices, but also by human and institutional factors. Booths (2022), through a survey of blind students and teachers, found that students generally used commercially available "high-tech" assistive technology to access print materials, with variations in usage patterns between elementary and secondary-level students, and that device-use training was strongly aligned with the level of use in the field. Chanana et al. (2022) and Prabhu et al. (2023) both emphasize that teachers play a central role in promoting inclusion through the use of assistive technology in the classroom, but both also note that such use often depends on individual teacher interest and initiative rather than consistent systemic support. Barq and Rehan (2025), through semi-structured interviews with 12 blind university students in Pakistan, found that braille, screen readers (particularly JAWS), recording devices, and computer software had a positive influence on their English language learning, with JAWS rated as the most user-friendly. Negi (2026) and Mahmoud (2025) each examined the role of assistive technology for children with multiple disabilities and blind children in inclusive education settings, respectively, while Rageh et al. (2023) developed a

functional assessment scale to measure assistive-technology-use skills among blind students in Yemen — an important contribution given the continued scarcity of standardized measurement instruments in this field.

3.7 Context, Equity, and the Family Dimension

The final thematic group highlights that access to assistive reading technology is heavily influenced by resource context, cultural values, and family relationships. Kaluta and Kandimba (2026) examined the role of assistive technology in the learning of blind students in selected primary schools in Lusaka, Zambia, a context that represents the infrastructure and resource limitations commonly found in developing countries, consistent with the findings of Bintari (2023) and Putra et al. (2023) that low-cost solutions are highly relevant to such contexts, including Indonesia. Meiyani (2026) offers a different perspective by linking the application of assistive technology for blind students to the principle of rahmatan lil 'alamin, emphasizing religious value and ethical dimensions in supporting the academic achievement of blind students within the Indonesian education context. Meanwhile, Cassidy (2025) brings attention to the family dimension that has thus far received little attention in assistive reading technology research: through interviews with blind parents who read together with their sighted children, this study found that blind parents often prioritize relational intimacy over mere access efficiency, bear significant "access labor," and desire new assistive technologies that do not disrupt the shared reading moment — a concept the author terms "Intimate Assistive Technology." These findings underscore that the design of reading technology for the blind should ideally be evaluated not only in functional-technical terms, but also in terms of the relational and affective aspects of its use.

Table 2. Categories of Assistive Reading Technology and Supporting Studies

Category	Brief Description	Supporting Studies
Tactile braille-based technology	Interactive braille learning aids and devices (RFID, computer vision, text-to-braille conversion)	Hoskin et al. (2022); Bintari (2023); Putra et al. (2023)
OCR & TTS text readers	Portable devices that scan printed text and convert it into speech	Kiyota et al. (2022); Llorca (2023); Huynh et al. (2023)
AI-based visual assistance & smart glasses	Wearable devices combining object recognition, text reading, and remote assistance	Gayathri et al. (2025); Král et al. (2025)
AI-based personalized audio platforms	Adaptive audio-based learning applications using generative AI models	Yang & Taele (2025); Kanchanasuttirak (2025)
Implementation, perception, and school readiness	Studies on adoption, teacher training, and student perception of assistive technology	Booths (2022); Chanana et al. (2022); Prabhu et al. (2023); Barq & Rehan (2025); Negi (2026); Mahmoud (2025); Rageh et al. (2023)
Context, equity, and family	Resource factors in developing countries, socio-cultural/religious values, and family dynamics	Kaluta & Kandimba (2026); Meiyani (2026); Cassidy (2025)

3.8 Discussion

The synthesis of the 20 publications reviewed shows that the development of assistive reading technology for blind children over the past five years is moving in three complementary main directions. First, there is continued innovation in tactile braille-based technology aimed at addressing long-standing issues of affordability and interactivity of teaching aids, as shown by the low-cost RFID and computer-vision solutions from Indonesia (Bintari, 2023; Putra et al., 2023), which directly respond to the gap identified by Hoskin et al.'s (2022) systematic review. Second, there is a convergence of OCR, TTS, and AI technologies into multifunctional wearable devices that are no longer limited to a single type of support (e.g., reading alone), but combine text reading with object recognition and mobility in one system (Gayathri et al., 2025; Král et al., 2025). Third, a layer of generative-AI-based personalization is emerging on the software side, promising a more adaptive learning experience compared to conventional screen readers and braille materials (Yang & Taele, 2025; Kanchanasuttirak, 2025).

Nevertheless, this review also reveals a fairly significant gap between engineering innovation and evidence of classroom-scale implementation. Most of the engineering-design studies in this corpus — including RFID devices, computer vision, and smart glasses — are reported at the prototype stage with limited testing, and do not always systematically involve blind children as primary test users. On the other hand, studies that directly address perception and use by students (Booths, 2022; Barq & Rehan, 2025) are generally based on small-scale surveys or interviews, limiting their generalizability. This gap between "designed technology" and "technology actually used sustainably in schools" is consistent with the findings of Chanana et al. (2022) and Prabhu et al. (2023) that implementation success heavily depends on teacher readiness and institutional support, not solely on device availability.

The dimension of resource equity is also an important common thread in this review. The study from Zambia (Kaluta & Kandimba, 2026) and the emphasis on low-cost solutions from Indonesia (Bintari, 2023; Putra et al., 2023) show that assistive technology designs that assume stable internet availability, expensive devices, or sustained technical support risk being difficult to implement in low- and middle-income countries. This condition is consistent with the need for standardized instruments to assess assistive technology skills, as developed by Rageh et al. (2023) in Yemen, so that the effectiveness of an intervention can be measured consistently across contexts. Meiyani's (2026) perspective, which links the application of assistive technology to the principle of rahmatan lil 'alamin, also shows that technology acceptance among the Islamic education community in Indonesia can be strengthened through value framing, not merely technical efficiency arguments.

Cassidy's (2025) findings on intimate assistive technology for families with blind parents add a dimension rarely discussed in the engineering literature: that the effectiveness of a reading technology cannot be assessed solely by the speed or accuracy of text reading, but also by the extent to which the technology supports — and does not disrupt — social and emotional relationships in shared reading practices. This principle is also relevant to the context of blind children both at school and at home, since a meaningful reading experience for a child is often inseparable from its relational context with teachers, parents, or peers.

Several limitations of this review should be acknowledged. First, the corpus of 20 publications used is curated based on the results of a single-database search with specific

keywords, not the result of a systematic multi-database search with full PRISMA reporting, so the possibility of missing other relevant publications cannot be ruled out. Second, the high heterogeneity of research designs — ranging from engineering prototypes and single case studies to surveys and broader literature reviews — makes quantitative synthesis and direct comparison of effectiveness across technologies difficult. Third, most engineering-design studies focus on blind individuals in general (including university students and adults), not specifically on school-age children, so generalizing the findings to the child population must be done with caution. Fourth, the potential for publication bias cannot be ruled out, given that successful technology prototypes tend to be more easily published than less successful or untested efforts.

4. Conclusion

The literature review of 20 publications from the 2022–2026 period shows that the development of assistive reading technology for blind children is supported by three complementary technical pillars: (1) tactile braille-based technology that continues to be developed to be more interactive and affordable; (2) OCR- and TTS-based text-reading devices that are converging with AI-based visual assistance in the form of multifunctional wearable devices; and (3) audio learning platforms personalized using generative AI. These three technical pillars are accompanied by equally important implementation factors, namely teacher readiness, training, and institutional support, as well as by broader contextual dimensions covering resource equity in developing countries, local socio-cultural values, and family relationships in shared reading practices.

The main contribution of this review is to bring together two research streams that have tended to run separately — assistive-device engineering research on one hand, and educational implementation/perception research on the other — into a single thematic synthesis framework. For educational institutions and policymakers, these findings suggest that investment in assistive reading technology should not be viewed merely as device procurement, but as an investment that needs to be accompanied by teacher training, adaptation to local resource contexts, and attention to the relational dimensions of its use both at home and at school.

Future research needs to prioritize at least four areas: (1) direct evaluation based on blind child users at a larger scale, given that most of the prototypes reviewed have not been systematically tested on this population; (2) studies on the cost-effectiveness and sustainability of assistive technology in developing-country contexts, including Indonesia, taking into account infrastructure and funding limitations; (3) the development and validation of standardized assistive-technology-skills assessment instruments that can be used across contexts, building on the pioneering work of Rageh et al. (2023); and (4) longitudinal research tracing the long-term impact of assistive technology on the literacy achievement of blind children, including its affective and relational dimensions, as pioneered by Cassidy (2025).

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