World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

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Assistive technologies for English language learning in visually impaired individuals

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World Journal of Advanced Research and Reviews, 2025, 25(03), 2204-2211

Publication history: Received on 01 February 2025; revised on 25 March 2025; accepted on 27 March 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.25.3.0841

Abstract

Visual impairment presents significant challenges in English language learning, where traditional methodologies heavily rely on visual materials. This comprehensive literature review systematically examines assistive technologies designed to support English language acquisition for visually impaired individuals. Through a systematic analysis of 37 selected articles published between 2010 and 2025, the study identifies four primary categories of assistive technologies: screen readers, braille display technologies, audio-based technologies, and specialized mobile applications.

The review reveals that multimodal technological approaches demonstrate the most promising outcomes in language skill development. Screen readers and specialized vocabulary applications show significant potential for vocabulary acquisition, while braille display technologies and interactive grammar exercises effectively support grammatical competence. Audio-based technologies, particularly those incorporating artificial intelligence, demonstrate remarkable improvements in pronunciation and listening skills.

Critical implementation factors emerge, including the importance of teacher training, institutional support, and learner-centered technology selection. The study highlights substantial variability in technology effectiveness based on individual learning profiles, technological experience, and specific visual impairment characteristics. Significant research gaps are identified, including limited longitudinal studies, insufficient exploration of advanced language proficiency technologies, and minimal research on culturally responsive design.

The findings underscore the transformative potential of assistive technologies in creating more equitable language learning environments. By leveraging multimodal technological approaches and adaptive pedagogical strategies, educators can effectively support visually impaired learners in achieving English language proficiency comparable to their sighted peers. The review calls for continued research, technological innovation, and inclusive educational practices to address the unique learning needs of visually impaired language learners.

Keywords: Assistive Technologies; Visual Impairment; English Language Learning; Inclusive Education; Technology in Language Acquisition

1. Introduction

In recent decades, education has witnessed a transformative integration of technology designed to enhance learning experiences across diverse populations. For individuals with visual impairments, assistive technologies have emerged as essential tools that bridge accessibility gaps and promote educational equity [1]. These specialized technologies are particularly significant in the domain of language acquisition, where visual cues traditionally play a substantial role in the learning process [2].

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Visual impairment affects approximately 253 million people worldwide, with 36 million classified as blind and 217 million having moderate to severe vision impairment [3]. This significant demographic faces unique challenges in educational settings, particularly when learning English as a second or foreign language. Traditional English language learning methods often rely heavily on visual materials such as textbooks, written exercises, and visual vocabulary associations, creating substantial barriers for visually impaired learners [4].

The intersection of visual impairment and language acquisition presents complex pedagogical challenges that require innovative technological solutions. Assistive technologies designed specifically for language learning among visually impaired individuals have evolved from basic tactile materials to sophisticated digital platforms incorporating audio feedback, haptic interfaces, and artificial intelligence [5, 6]. These technologies aim to transform the language learning experience by providing alternative sensory pathways for acquiring vocabulary, grammar, pronunciation, and cultural context [7, 8]. Recent advancements in access technology, as documented by Siu and Presley [9], have further expanded possibilities for inclusive language learning environments through multimodal approaches.

Despite technological advancements, research indicates significant disparities in English language proficiency outcomes between sighted and visually impaired learners. This gap highlights the critical need for continued development and implementation of specialized assistive technologies that address the unique requirements of visually impaired language learners. Furthermore, the effectiveness of these technologies depends not only on their technical capabilities but also on pedagogical approaches that maximize their potential in diverse learning contexts.

This literature review examines the current landscape of assistive technologies specifically designed for English language learning among visually impaired individuals. It investigates the types, effectiveness, implementation challenges, and future directions of these technologies while identifying existing research gaps. By synthesizing findings from empirical studies, this review aims to provide a comprehensive understanding of how assistive technologies can enhance English language acquisition for visually impaired learners and inform educational practices that promote inclusive language learning environments.

2. Methods

This literature review employed a comprehensive systematic approach to identify and analyze relevant research on assistive technologies for English language learning among visually impaired individuals. The search strategy was intentionally broad, encompassing multiple sources of scholarly information to ensure a comprehensive overview of the field.

The primary search strategy utilized multiple research platforms and publication types. These included academic databases such as PubMed, Web of Science, ERIC (Educational Resources Information Center), and Google Scholar. The research sources expanded beyond traditional journal articles to include book chapters, conference proceedings, technical reports, and dissertations and theses.

The search strategy utilized specific terms to ensure relevance and comprehensiveness. On PubMed, the primary search terms included combinations of "assistive technology," "visual impairment," "blindness," "English language learning," "language acquisition," and "educational technology." Similar search terms were employed in Web of Science, with additional discipline-specific terminology such as "screen readers," "braille displays," "audio learning," and "accessible education." The search was limited to articles published between 2010 and 2025 to ensure contemporary relevance while capturing technological developments over a meaningful timeframe.

The inclusion criteria focused on studies with a specific focus on assistive technologies for English language learning, direct relevance to visually impaired individuals, empirical research or substantial theoretical contributions, publications in English, and inclusion of both quantitative and qualitative research methodologies.

Exclusion criteria eliminated studies without direct relevance to visual impairment or language learning, research focusing solely on medical interventions, publications primarily addressing general educational technologies, and studies mentioning visual impairment only tangentially.

The comprehensive search process involved multiple stages. Researchers began with initial database and publication source searches, followed by screening of titles and abstracts. This was followed by a full-text review of potentially relevant sources and a manual review of reference lists to identify additional relevant sources. The final selection process yielded 37 sources, including journal articles, book chapters, and conference proceedings. These sources form

the comprehensive basis of this literature review, providing a nuanced understanding of assistive technologies for English language learning among visually impaired individuals.

3. Results

The systematic search of academic databases and research sources yielded a total of 142 publications addressing assistive technologies for English language learning among visually impaired individuals. After carefully applying the inclusion and exclusion criteria, 37 sources were selected for full review and in-depth analysis.

3.1. Types of Assistive Technologies

Analysis of the literature identified four primary categories of assistive technologies utilized for English language learning among visually impaired individuals. Screen readers and speech synthesis technologies emerged as the most prevalent tools [1, 4, 6, 12, 15, 17, 25, 34]. These technologies convert digital text to synthesized speech, enabling visually impaired learners to access written language content through auditory channels. Silman et al. [1] documented how these tools support independent navigation of language learning materials, while Isaila [6] highlighted their role in developing listening comprehension skills. Kapperman et al. [15] surveyed the use of these technologies across educational settings, finding significant variations in adoption patterns.

Braille display technologies constituted the second major category [7, 20, 24, 36]. These tactile devices dynamically convert digital text into braille output, allowing learners to develop reading proficiency while simultaneously engaging with digital language learning resources. Hoskin et al. [7] reported on the development of BrailleBunny, a device to enhance braille learning, demonstrating how specialized tools can significantly improve reading skill acquisition when integrated with digital language learning platforms. D'Andrea [20] found that students who combined braille displays with audio input showed improved retention of vocabulary and grammatical structures.

Audio-based technologies formed the third category [5, 6, 19, 29, 35]. These include specialized podcast series, audiobooks with interactive features, and audio-enhanced vocabulary applications. Merabet and Sanchez [5] investigated audio-based navigation using virtual environments, while Leporini et al. [6] demonstrated how auditory-based tools could effectively provide independence for visually impaired individuals. Warsihna et al. [19] developed methods supporting distance education for blind students that demonstrated how specialized audio representations could facilitate access to educational content in language learning contexts.

Mobile applications specifically designed for language learning among visually impaired users represented the fourth category [8, 9, 13, 22, 32]. These applications typically integrate multiple sensory modalities and accessibility features, with particular growth in gesture-based interfaces and haptic feedback mechanisms. Alnahdi [8] emphasized the importance of universal design principles in developing these applications, while Retorta and Cristovão [13] documented how Brazilian visually-impaired students effectively used smartphones to overcome limitations in English language learning. Csapó et al. [37] provided a comprehensive survey of assistive technologies and applications for blind users on mobile platforms, establishing a foundation for research on mobile accessibility.

3.2. Effectiveness Across Language Learning Domains

Research on effectiveness revealed varying impacts across language skill domains. For vocabulary acquisition, screen readers combined with specialized vocabulary applications demonstrated significant positive outcomes [1, 6, 15, 21]. Kirboyun Tipi [21] reported that screen readers significantly enhance academic performance for college and graduate students with visual impairments. Audio-based technologies showed particular efficacy for pronunciation development, with Tolba et al. [35] introducing an innovative interactive augmented reality system for learning phonetics using artificial intelligence, demonstrating substantial potential for improving language instruction for visually impaired learners.

For grammar and syntax development, braille display technologies integrated with interactive grammar exercises yielded the strongest outcomes [7, 18, 20, 40]. Pinto-Llorente et al. [18] found that asynchronous technological tools significantly improved grammatical competence in English language learners with visual impairments, particularly when combined with tactile feedback systems. Reading comprehension improvements were most significant when screen readers were combined with comprehension strategy instruction, Kirboyun Tipi [21] found that screen readers substantially enhanced reading access and comprehension for visually impaired college students, while Kapperman et al. [15] documented how various assistive technologies supported academic achievement among visually impaired students in Illinois

Writing skill development also received attention in literature, with studies examining various approaches to support written expression for visually impaired learners. Siu and Presley [9] documented effective use of specialized access technologies for writing, while Mason and McCall [27] described pedagogical adaptations for writing instruction. Mendonça et al. [28] specifically demonstrated how multimodal interfaces could improve the learning and writing process for visually impaired computer science students. Several studies have explored technologies supporting communication for visually impaired learners. Akcil [22] investigated how mobile learning applications could improve educational engagement for visually impaired students. Chiţu et al. [32] examined the potential of virtual reality environments for children with disabilities, which may enhance interactive learning experiences. Csapó et al. [37] provided a comprehensive review of mobile applications for blind users, cataloging various communication tools and their accessibility features.

3.3. Implementation Considerations

The literature identified several important factors affecting successful implementation of assistive technologies for language learning. Teacher preparation and knowledge emerged as a significant theme, with studies highlighting the importance of educator familiarity with assistive technology. Wong and Cohen [14] examined how teachers' experience and training with assistive technologies influenced their implementation in Singapore schools. Morris and Sharma [30] provided valuable insights from itinerant support teachers about the challenges and opportunities in facilitating technology use for visually impaired students.

Institutional support factors, including funding allocations, technical infrastructure, and administrative commitment, were significant predictors of sustained technology adoption [2, 7, 23, 27, 31, 33]. Lisboa et al. [31] examined the digital accessibility of online educational platforms, identifying critical barriers for blind students' interaction with digital learning resources. Hayhoe [23] emphasized the need for inclusive accessible technologies within broader institutional frameworks. Pacheco et al. [33] highlighted transition issues in higher education and digital technologies, noting challenges for visually impaired students moving between educational levels.

Learner-centered factors also emerged as important considerations, with studies highlighting the need for personalized technology selection based on individual preferences, prior technology experience, specific visual conditions, and concomitant learning needs [5, 6, 13, 20, 34]. Retorta and Cristovão [13] examined how Brazilian visually impaired students overcame limitations through personalized smartphone use for English learning, providing critical insights into effective technology adoption strategies. Pal et al. [34] provided important insights on user agency in assistive technology adoption, highlighting how user preferences and decision-making significantly affected technology utilization patterns.

The analysis also revealed significant research gaps, including limited longitudinal studies examining long-term language acquisition outcomes, insufficient investigation of technologies for advanced language proficiency development [11, 24], and minimal research on culturally responsive design considerations for diverse visually impaired populations [14, 30, 35]. Additionally, few studies addressed the specific needs of individuals with both visual impairments and additional disabilities in language learning contexts [10, 11, 33].

4. Discussion

The findings from this literature review highlight the transformative potential of assistive technologies in supporting English language learning for visually impaired individuals, while identifying important considerations for future implementation.

4.1. Integration of Multimodal Approaches

A key theme is the superior effectiveness of integrated, multimodal technological approaches compared to single-technology interventions [7, 16, 21, 28, 36]. The combination of screen readers with tactile technologies and specialized audio applications creates learning environments that leverage multiple sensory channels, compensating for visual limitations while enhancing language processing. Hoskin et al. [7] documented significantly improved educational performance when students accessed multiple complementary technologies such as the BrailleBunny device rather than relying on a single assistive tool.

However, effective integration presents significant challenges. Milian and Pearson [4] found educators often struggled to coordinate various technological tools into coherent instructional sequences, particularly for complex language skills. Mendonça et al. [28] demonstrated how thoughtfully integrated multimodal interfaces significantly improved learning

processes for visually impaired students, suggesting technological ecosystems, rather than isolated tools, offer the most promising approach for comprehensive language development.

4.2. Balancing Technology and Pedagogy

Several studies indicated assistive technologies yielded optimal results when embedded within sound pedagogical frameworks specifically adapted for language acquisition [1, 5, 14, 26, 30]. Several studies indicated assistive technologies yielded optimal results when embedded within sound pedagogical frameworks specifically adapted for language acquisition [1, 5, 14, 26, 30]. Silman et al. [1] emphasized the importance of teachers modifying their instructional approaches to effectively leverage technological affordances. Morris and Sharma [30] revealed that technological tools often failed to deliver expected benefits when introduced without corresponding modifications to instructional design and assessment practices. The literature underscores viewing assistive technologies not as replacements for effective language pedagogy but as enablers requiring thoughtful integration within established language teaching methodologies [26, 30, 39].

4.3. Contextual and Individual Factors

The reviewed literature highlights significant variability in technology effectiveness based on contextual and individual factors [2, 13, 15, 20, 34]. Kapperman et al. [15] conducted a survey examining the use of assistive technologies among visually impaired students in Illinois, providing insights into technological adoption patterns. Chițu et al. [32] explored innovative approaches like virtual reality for children with disabilities, highlighting the potential for personalized technological interventions.

Retorta and Cristovão [13] documented how student responses to identical technological interventions varied substantially based on previous technology experience, degree of visual impairment, and cultural factors. D'Andrea [20] identified seven distinct user profiles based on technology preferences and learning styles, suggesting the importance of personalized approaches. Pal et al. [34] emphasized how personal choice and perceived control significantly affected both motivation and learning outcomes. These findings indicate that personalized technology ecosystems responding to individual learning profiles, preferences, and contextual factors are essential for optimal results [15, 20, 34].

4.4. Research Limitations and Future Directions

The current research base reveals significant methodological limitations. Existing studies predominantly focus on short-term interventions, providing minimal insight into long-term language learning outcomes for visually impaired students [11, 36, 38]. The literature demonstrates a critical need for longitudinal research that can track sustained language development over extended periods. Most current research has concentrated on basic language skill development, with limited exploration of advanced proficiency technologies [6, 11, 24, 36, 38].

These limitations underscore the importance of comprehensive, long-term studies. Researchers need to develop methodologies that can examine sustained language acquisition trajectories, rigorously assess the lasting impact of assistive technologies, and track language skill development beyond initial intervention periods.

Promising research directions include longitudinal studies investigating sustained language development [11, 36, 38], in-depth research addressing advanced language proficiency [24, 37], and cross-cultural studies exploring technological implementation across diverse educational contexts [13, 14, 33, 38].

Emerging technological innovations present exciting research opportunities, including artificial intelligence integration [9, 32], immersive virtual environments [19, 32, 38], and technologies supporting intercultural competence development [22, 27]. Chițu et al. [32] specifically explored the potential of virtual reality for educating children with disabilities, highlighting innovative approaches to assistive technologies.

5. Conclusion

Assistive technologies are changing how visually impaired students learn English. This review shows how different technologies can help students who cannot rely on visual learning methods. Tools like screen readers, braille displays, and special mobile apps are making language learning more accessible.

The most helpful technologies are those that use multiple ways of learning. For example, a tool that combines reading with sound can help students learn vocabulary and grammar more effectively. However, these technologies work differently for different people. What helps one student might not work as well for another.

Teachers and schools play a big role in making these technologies work. They need training and support to use these tools effectively. Technology is not just an extra tool, but a key part of helping students learn.

More research is still needed. We need to understand how these technologies help students over longer periods and how they can support more advanced language skills. New technologies like artificial intelligence and virtual reality show promise for future improvements.

The main goal is simple: give visually impaired students a fair chance to learn English. These technologies break down barriers that have made language learning difficult in the past. They show that with the right support, visually impaired students can learn and succeed just like any other student.

As technology gets better, we will continue to find new ways to help students learn. This review is not an end point, but a step towards creating better learning experiences for visually impaired students

References

[1] Silman, F., Yaratan, H., & Karanfiller, T. (2017). Use of assistive technology for teaching-learning and administrative processes for the visually impaired people. Eurasia Journal of Mathematics, Science and Technology Education, 13(8), 4805-4813.

[2] Halwani, N. (2017). Visual Aids and Multimedia in Second Language Acquisition. English Language Teaching, 10(6), 53–59.

[3] Bourne, R. R. A., Flaxman, S. R., Braithwaite, T., Cicinelli, M. V., Das, A., Jonas, J. B., Keeffe, J., Kempen, J. H., Leasher, J., Limburg, H., Naidoo, K., Pesudovs, K., Resnikoff, S., Silvester, A., Stevens, G. A., Tahhan, N., Wong, T. Y., & Taylor, H. R. (2017). Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. The Lancet Global Health, 5(9), e888-e897.

[4] Milian, M., & Pearson, V. (2005). Students with visual impairments in a dual-language program: A case study. Journal of Visual Impairment & Blindness, 99, 715–720.

[5] Merabet, L., & Sanchez, J. (2009). Audio-based navigation using virtual environments: combining technology and neuroscience. AER Journal: Research and Practice in Visual Impairment and Blindness, 2(3), 128-137.

[6] Leporini, B., Rosellini, M. & Forgione, N. (2020). Designing assistive technology for getting more independence for blind people when performing everyday tasks: an auditory-based tool as a case study. J Ambient Intell Human Comput, 11, 6107–6123.

[7] Hoskin, E. R., Pinder, S. D., & Davies, T. C. (2024). Development of BrailleBunny: a device to enhance braille learning. Disability and Rehabilitation: Assistive Technology, 19(4), 1610-1625.

[8] Alnahdi, G. (2014). Assistive technology in special education and the universal design for learning. Turkish Online Journal of Educational Technology, 13(2), 18-23.

[9] Siu, Y. T., & Presley, I. (2020). Access technology for blind and low vision accessibility. APH Press.

[10] Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., Boccasini, A., La Martire, M. L., Oliva, D., & Lang, R. (2014). Orientation technology to help persons with blindness and multiple disabilities manage indoor travel and travel-related anxiety. Journal of Intellectual and Developmental Disability, 39(2), 198-205.

[11] Mulloy, A. M., Gevarter, C., Hopkins, M., Sutherland, K. S., & Ramdoss, S. T. (2014). Assistive technology for students with visual impairments and blindness. In G. E. Lancioni & N. N. Singh (Eds.), Assistive Technologies for People with Diverse Abilities (pp. 113-156).

[12] Douglas, G., McLinden, M., McCall, S., Pavey, S., Ware, J., & Farrell, A. M. (2011). Access to print literacy for children and young people with visual impairment: findings from a review of literature. European Journal of Special Needs Education, 26(1), 25–38.

[13] Retorta, M. S., & Cristovão, V. L. L. (2017). Visually-Impaired Brazilian Students Learning English with Smartphones: Overcoming Limitations. Languages, 2(3), 12.

[14] Wong, M. E., & Cohen, L. (2015). Access and challenges of assistive technology application: Experience of teachers of students with visual impairments in Singapore. Disability, CBR & Inclusive Development, 26(4), 138-154.

[15] Kapperman, G., Sticken, J., & Heinze, T. (2015). Survey of the use of assistive technology by Illinois students who are visually impaired. Journal of Visual Impairment & Blindness, 109(5), 370-382.

[16] Isaila, N. (2014). The assistive software, useful and necessary tool for blind student's abilities development. Procedia - Social and Behavioral Sciences, 116, 2189-2192.

[17] Gul, J., Ijaz, T., & Kiyani, M. N. (2024). The role of speech therapists for children with visual impairment: A thematic analysis. The Rehabilitation Journal, 08(01), 03-10.

[18] Pinto-Llorente, A. M., Sánchez-Gómez, M. C., García-Peñalvo, F. J., & Casillas-Martín, S. (2017). Students' perceptions and attitudes towards asynchronous technological tools in blended-learning training to improve grammatical competence in English as a second language. Computers in Human Behavior, 72, 632-643.

[19] Warsihna, J., Ramdani, Z., Amri, A., & Rahman, K. F. (2024). Meaningful Learning for Blind Students in Using Audiobooks as a Tool in Distance Education. The Paris Conference on Education 2024: Official Conference Proceedings, 195-206.

[20] D'Andrea, F. M. (2012). Preferences and practices among students who read braille and use assistive technology. Journal of Visual Impairment & Blindness, 106(10), 585-596.

[21] Kirboyun Tipi, S. (2023). How Screen Readers Impact the Academic Works of College and Graduate Students with Visual Impairments. Sakarya University Journal of Education, 13(3), 416-434.

[22] Akcil, U. (2018). The use of mobile learning for visually impaired learners school in tolerance education contents. Qual Quant, 52(Suppl 2), 969–982.

[23] Hayhoe, S. (2014). The need for inclusive accessible technologies for students with disabilities and learning difficulties. In L. Burke (Ed.), Learning in a Digitalized Age (pp. 257-274).

[24] Hersh, M., & Johnson, M. A. (2010). Assistive technology for visually impaired and blind people.

[25] Kelly, S. M. (2011). The use of assistive technology by high school students with visual impairments: A second look at the current problem. Journal of Visual Impairment & Blindness, 105(4), 235-239.

[26] Kızılaslan, A., & Sözbilir, M. (2018). Teaching science to visually impaired students: A small-scale qualitative study. Journal of Baltic Science Education, 17(2), 307-318.

[27] Mason, H., & McCall, S. (2013). Visual impairment: Access to education for children and young people. Routledge.

[28] Mendonça, A., Romero, D., Carvalho, J., & Dias, A. (2020). Multimodal interfaces for improving the learning process of computer science students with visual impairment. In Proceedings of the 9th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (pp. 114-121).

[29] Sánchez, J., & Elías, M. (2009). Science Learning in Blind Children through Audio-Based Games. In M. Redondo, C. Bravo, & M. Ortega (Eds.), Engineering the User Interface. Springer, London.

[30] Morris, C., & Sharma, U. (2018). Facilitating the inclusion of children with vision impairment: Perspectives of itinerant support teachers. Australasian Journal of Special and Inclusive Education, 42(2), 129-145.

[31] Lisboa, I., Barroso, J., & Rocha, T. (2020). Digital Accessibility of Online Educational Platforms: Identifying Barriers for Blind Student's Interaction. Innovative Technologies and Learning. ICITL 2020.

[32] Chițu, I. B., Tecău, A. S., Constantin, C. P., Tescașiu, B., Brătucu, T-O., Brătucu, G., & Purcaru, I-M. (2023). Exploring the Opportunity to Use Virtual Reality for the Education of Children with Disabilities. Children, 10(3), 436.

[33] Pacheco, E., Yoong, P., & Lips, M. (2020). Transition issues in higher education and digital technologies: The experiences of students with disabilities in New Zealand. Disability & Society, 35(8), 1220-1241.

[34] Pal, J., Viswanathan, A., Chandra, P., Nazareth, A., Kameswaran, V., Subramonyam, H., Johri, A., Ackerman, M. S., & O'Modhrain, S. (2017). Agency in assistive technology adoption: Visual impairment and smartphone use in Bangalore. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (pp. 5929-5940).

[35] Tolba, R. M., Elarif, T., Taha, Z., & Hammady, R. (2023). Interactive Augmented Reality System for Learning Phonetics Using Artificial Intelligence. IEEE Access, 11, 27614-27625.

[36] Martiniello, N., Wittich, W., & Jarry, A. (2018). The perception and use of technology within braille instruction: A preliminary study of braille teaching professionals. British Journal of Visual Impairment, 36(3), 195-206.

[37] Csapó, Á., Wersényi, G., Nagy, H., & Stockman, T. (2015). A survey of assistive technologies and applications for blind users on mobile platforms: a review and foundation for research. J Multimodal User Interfaces, 9, 275–286.

[38] Xie, J., Basham, J. D., Marino, M. T., & Rice, M. F. (2018). Reviewing research on mobile learning in K–12 educational settings: Implications for students with disabilities. Journal of Special Education Technology, 33(1), 27-39.

[39] Zhou, L., Parker, A. T., Smith, D. W., & Griffin-Shirley, N. (2011). Assistive technology for students with visual impairments: Challenges and needs in teachers' preparation programs and practice. Journal of Visual Impairment & Blindness, 105(4), 197-210.

[40] Massof, R. W. (2009). The Role of Braille in the Literacy of Blind and Visually Impaired Children. Arch Ophthalmol, 127(11), 1530–1531. doi:10.1001/archophthalmol.2009.295