The Importance of Integrating AI-Powered Visual Recognition and Feedback Tools in Early Literacy Instruction: A Focus on Improving 'b' and 'd' Letter Formation Accuracy Among Students with Learning Disabilities in Sri Lanka.

H.G.C.K. Hulangamuwa
School of Information Communication Technology, NIIBS Campus.
chaamiusjp@gmail.com

Abstract

Early literacy development represents a foundational pillar of educational success, yet students with learning disabilities (LDs) often face persistent challenges in acquiring basic reading and writing skills (Berninger & Wolf, 2019). This study focuses on students struggling with dyslexia and other specific learning disabilities that impact orthographic processing. Within English language acquisition a key component of Sri Lanka's bilingual education policy letter formation difficulties, particularly the reversal of visually similar letters such as 'b' and 'd', can pose a significant barrier to academic progress. While this phenomenon is a common feature in typical early literacy development, it persists more frequently and for longer periods among students with LDs, creating lasting impacts on their educational trajectory and overall academic confidence (Reid & Green, 2020).

In Sri Lanka, the educational landscape for students with learning disabilities has evolved significantly over recent decades, with increased recognition of inclusive education principles and specialized support services (Perera & Fernando, 2020). However, traditional teaching methods often prove insufficient in addressing the complex needs of these learners, particularly in the critical area of letter formation and recognition. The persistence of these challenges calls for innovative approaches that can provide individualized, consistent, and immediate feedback to support learning effectively.

The emergence of artificial intelligence (AI) in education presents unprecedented opportunities to address these longstanding challenges. AI-powered visual recognition tools, capable of analyzing handwriting in real-time and providing immediate feedback, offer promising solutions for improving letter formation accuracy among students with learning disabilities (Zhang & Wang, 2021). These technologies can potentially bridge the gap between traditional teaching methods and the specialized needs of learners who struggle with conventional approaches, providing the consistency and individualization that human instruction alone cannot always deliver.

Research Objectives and Methodology

This exploratory study aimed to investigate the perceptions and readiness of special education practitioners in Sri Lanka regarding the integration of AI-powered visual recognition tools to support English literacy instruction. Specifically, it sought to understand the prevalence of letter formation difficulties in English, assess the limitations of current pedagogical approaches, and identify barriers to and opportunities for AI adoption.

A comprehensive survey was conducted among 30 special education teachers working with students diagnosed with learning disabilities across Sri Lanka. The participants were selected through purposive sampling based on specific criteria including current employment in special education, experience working with students with learning disabilities, and willingness to participate in the study. The sample represented diverse geographic regions and educational settings, providing a comprehensive perspective on current practices and challenges.

The research utilized a structured questionnaire consisting of four main sections: demographic information, observations on letter formation difficulties, awareness and use of AI tools, and perceptions regarding AI integration readiness. The questionnaire employed multiple question types including Likert scales, multiple-choice questions, and ranking exercises to capture different aspects of teacher experiences and attitudes (Creswell & Creswell, 2018). Data collection was conducted over six weeks using both online and offline methods to ensure maximum participation and response quality.

Key Findings

The study revealed several critical findings that establish a compelling case for AI integration in early literacy instruction. First, the research confirmed that letter formation difficulties, particularly 'b' and 'd' reversals, represent a significant and widespread challenge in Sri Lankan special education settings. An overwhelming 93.3% of teachers reported observing these difficulties among their students, with 60% describing them as "very common." This finding transcends individual classrooms and represents a systemic challenge requiring innovative solutions.

Second, the analysis revealed limitations in current teaching approaches. While teachers employ various traditional methods, including tracing worksheets (93.3%) and one-on-one instruction (83.3%), these approaches appear insufficient to address the persistent nature of letter formation difficulties. The heavy reliance on conventional methods, combined with limited use of digital tools (26.7%), suggests significant potential for technological enhancement. The resource-intensive nature of current approaches, particularly one-on-one instruction, raises questions about scalability and sustainability in addressing widespread learning challenges.

Third, despite limited current exposure to AI technologies, teachers demonstrated remarkable openness to innovation. With 76.7% believing AI tools could be effective and 93.3% expressing willingness to try such technologies, the foundation for successful implementation appears strong. This theoretical acceptance, combined with the high proportion of teachers with specialized training (73.3% have special education qualifications), creates favorable conditions for AI adoption.

Fourth, the research identified clear barriers to AI integration, primarily lack of training (86.7%) and inadequate resources (80.0%). However, these challenges are addressable through targeted interventions and strategic planning (Rodriguez & Singh, 2021). The identification of specific implementation barriers enables the development of focused solutions that can facilitate successful technology adoption.

Implications for Educational Practice

This study serves as a crucial foundational needs assessment. It confirms the relevance of the problem within the Sri Lankan English-teaching context and establishes strong teacher readiness, thereby justifying and guiding the next critical phase of research: direct experimental implementation of AI tools in the classroom. Future research must move beyond perceptions to measure the direct impact of AI interventions on student learning outcomes through rigorous experimental and longitudinal designs.

The study reveals that current teaching methods, while valuable, may have reached their effectiveness limits for addressing complex learning challenges. The predominant use of tracing worksheets and one-on-one instruction, while beneficial, lacks the scalability and consistency needed to address widespread learning difficulties. AI tools can supplement these traditional approaches by providing continuous, objective feedback that adapts to individual learning patterns and progress rates.

For students with learning disabilities, AI-powered tools offer several advantages. These include immediate error correction, consistent feedback delivery, individualized learning pace adaptation, and reduced frustration through patient, non-judgmental interaction. The technology can provide 24/7 availability, unlike human instruction, and can track progress with precision that informs instructional decision-making.

Recommendations for Implementation

Based on the research findings, several recommendations emerge for successful AI integration. Educational policymakers should develop comprehensive policies supporting AI integration in special education, establish standards for AI tool

evaluation and selection, and allocate specific funding for AI-powered educational technologies. Investment in infrastructure development, including reliable internet connectivity and device availability, is essential for sustainable implementation.

Educational institutions should implement pilot programs to test AI tools in real classroom settings, provide ongoing professional development opportunities for teachers, and create collaborative networks for resource sharing and experience exchange. The development of specialized training curricula for AI literacy among special education teachers is crucial for successful adoption.

Technology developers should create localized solutions adapted to Sri Lankan educational contexts, ensuring user-friendly interfaces for teachers with varying technical skills and providing affordable options for resource-constrained environments (Kumar et al., 2021). Ongoing technical support and regular updates are essential for maintaining system effectiveness and user satisfaction.

Significance and Future Directions

This research contributes significantly to the growing body of literature on AI applications in special education by providing empirical evidence on the potential integration of visual recognition technologies in early literacy instruction. The study extends existing theories of technology-enhanced learning by examining their application in addressing specific learning disabilities within a developing country context.

The findings provide valuable insights for educational policymakers, technology developers, and special education practitioners in Sri Lanka and similar contexts. By identifying current gaps and opportunities, the research offers guidance for developing more effective interventions for students with learning disabilities (Wickramasinghe & Gunasekara, 2021). The study also contributes to broader social goals including enhanced quality of life, increased employment opportunities, and reduced social exclusion for individuals with learning disabilities.

Future research should focus on implementation studies involving actual AI tool deployment in classroom settings, longitudinal research tracking long-term effects of AI integration, and cross-cultural validation to expand findings to other developing countries. Student outcome research measuring learning improvements with AI intervention would provide additional evidence for technology effectiveness.

Conclusion

This study provides compelling evidence for the integration of AI-powered visual recognition tools in early literacy instruction for students with learning disabilities in Sri Lanka. The research demonstrates that while traditional methods dominate current practices, they may be insufficient for addressing complex learning challenges. AI tools offer unique advantages that could transform educational

outcomes through immediate feedback, consistency, scalability, and data-driven insights.

The high prevalence of letter formation difficulties combined with strong teacher readiness for AI adoption creates an optimal environment for technological intervention. Successful implementation requires addressing key barriers through comprehensive training, resource provision, and ongoing support systems. However, the strong theoretical acceptance and qualified teacher base provide a solid foundation for AI integration.

This research establishes a critical foundation for advancing educational technology in Sri Lankan special education, with implications extending beyond national boundaries to inform global efforts in inclusive education and AI-powered learning solutions (Wilson & Clark, 2021). The findings support the urgent need for AI integration while providing practical guidance for implementation, ultimately contributing to improved educational outcomes for students with learning disabilities.

Keywords: *AI-powered education, Visual recognition technology, Early literacy instruction, Learning disabilities, Special education*

References

Berninger, V.W., & Wolf, B. J. (2019). Teaching students with dyslexia and dysgraphia: Lessons from teaching and science. Paul H. Brookes Publishing.

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). Sage Publications.

Kumar, A., Patel, N., & Singh, R. (2021). Development of AI-powered handwriting recognition systems for educational applications. Computers & Education, 165, 104-119.

Perera, S., & Fernando, L. (2020). Inclusive education practices in Sri Lankan schools: Current status and future directions. Asia Pacific Journal of Education, 40(3), 387-402.

Reid, G., & Green, S. (2020). Letter reversal and dyslexia: Understanding and intervention. Routledge.

Rodriguez, M., & Singh, P. (2021). Artificial intelligence applications in special education: Current trends and future possibilities. Exceptional Children, 87(3), 294-311.

Wickramasinghe, N., & Gunasekara, P. (2021). Digital transformation in Sri Lankan education: Opportunities and challenges post-COVID-19. Educational Technology International, 22(1), 45-62.

Wilson, M., & Clark, J. (2021). Real-time feedback systems in educational technology: Impact on learning outcomes. Journal of Computer Assisted Learning, 37(4), 1034-1048.

Zhang, L., & Wang, X. (2021). Computer vision applications in handwriting analysis: A comprehensive review. Pattern Recognition, 115, 107-125.

Ai-Based Chatbot Services in Academic Libraries: Lessons for Distance Education Environments

K.D. Wickramarathne[1], H.P.K.N.D. Siriweera[2], H.G.P.S.C. Dilhani[3], D.S.H.S.W. Hettiarachchi[4]
[1]The Open University of Sri Lanka, [2]Sabaragamuwa University of Sri Lanka
[3]Uwa-Wellassa University of Sri Lanka, [4]Wayamba University of Sri Lanka,
kdwic@ou.ac.lk

Abstract

This study systematically investigates the integration and impact of AI-based chatbot services within academic libraries, with a particular focus on their implications for distance education environments. Digitalization has necessitated the evolution of library services to cater to geographically dispersed learners, making AI chatbots a promising solution for providing 24/7 support and enhanced accessibility. Drawing from scholarly literature, case studies, and institutional reports published between 2019 and 2025, this research synthesizes findings from major databases including Scopus, Web of Science, and Google Scholar. The abstract covers the transformative potential of AI chatbots in automating repetitive tasks, offering personalized assistance, and improving operational efficiency through reduced response times, highlighting their significant role in supporting distance learners across various time zones and addressing critical access barriers. These systems can streamline routine inquiries such as catalogue searches, circulation questions, and basic research guidance, thereby significantly reduce staff workload and improving overall service responsiveness. Despite these advantages, the study also delves into the existing limitations concerning personalization, reliability, ethical control, and privacy concerns associated with large-volume AI systems, emphasizing that these technologies function optimally when complementing human expertise, allowing librarians to focus on more complex, high-value tasks like in-depth research consultations and instructional design. The discussion extends to implementation challenges, including technical integration with existing library systems, ensuring robust user acceptance, and the critical need for continuous maintenance and staff training to keep the systems accurate and relevant. Examining regional perspectives, particularly within the Sri Lankan context, illustrates local adoption efforts and the unique challenges faced in developing nations regarding digital infrastructure and policy frameworks. The abstract concludes by outlining comprehensive recommendations for strategic planning, continuous professional development for library staff, the establishment of clear ethical guidelines, and ongoing evaluation to ensure the successful and sustainable deployment of AI chatbots as augmentative tools that enhance, rather than replace, human expertise in academic library services.

Keywords: *AI Chatbots, Academic Libraries, Distance Education, Library Services, Digital Transformation*

Introduction

Digital transformation has drastically reorganised the idea of academic library services, particularly as institutions are becoming more focused on geographically distributed and diverse student populations. In this context, chatbots powered by AI have obtained a central position to enhance library services and maintain distance-learning settings (Oghuvbu & Okoh, 2025). Such intelligent systems operate in accordance with natural language processing and machine-learning algorithms to provide an unprecedented ability to deliver scalable, accessible, and responsive support to library users, who rarely visit a physical library facility.

The COVID-19 pandemic accelerated the transformation to online learning formats, which is why libraries must introduce effective online support systems. The distanced learners face certain barriers, including the lack of on-campus resources, different time zones, and the need to have flexible support structure (Maddison et al., 2017). Chatbots powered by AI overcome these obstacles by being available all the time, having personal communication, and answering frequently asked questions quickly (Idhris & Peter 2024).

The proposed comprehensive review will explore the existing use of AI-based chatbot services in academic libraries, especially in distance-education settings. The research aims to answer three main questions:

1. What are the main benefits and obstacles of the implementation of AI chatbots in academic libraries?
2. What is the role of such systems in assisting distance-education learners?
3. What lessons can be used to develop best-practice guidelines to be used in future implementations?

A critical review of the current literature, case studies, and published implementations provide a list of evidence-based guidelines to library administrators, educators, and policymakers considering the use of AI chatbots.

Literature Review

The use of AI chatbots in academic libraries has evolved beyond rule-based interrogatories, to advanced conversational agents that can understand subtle user requests (Gamage & Tammaro, 2025). The early versions focused on answering common questions on a regular basis; the current systems incorporate high-level natural language processing to provide personalized research support and integrate with library management systems (Aboelmaged et al., 2024).

The theoretical basis on the implementation of chatbots lies in the user-cantered service models, which value accessibility, efficiency, and personalization. Automating routine tasks, which is also consistent with the general trend of automation of services in academia, the systems will allow library staff to focus on high-value tasks, including research consultations and instructional design (Yan, Zhao & Mazumdar, 2023).

Modern AI chatbots used in academic libraries have many functions that go beyond the delivery of simple question-answer services (Idhris & Peter 2024). Such systems assist in guiding research, assist in interactions with databases, and handle circulation requests and promote information literacy programs. The most advanced deployments include multilingual support, learning management system integration, and the provision of personalized recommendations based on the observed user behavior patterns (Kvale et al., 2021). The range of performance includes basic FAQ bots and complex research assistants that can interpret the context and generate a response in an appropriate manner. Most academic library chatbots, however, are still text-based and human-mediated, and are usually integrated into library portals or social media platforms as opposed to being separate applications (Aboelmaged et al., 2024).

Benefits for Distance Education

Chatbots as artificial intelligence (AI) are especially useful in distance learning for a number of reasons (Maddison et al., 2017). The fact that they are accessible 24/7 also answers directly to the issue of having the learners, who spread to multiple time zones, and time schedules, also be able to obtain timely assistance. Chatbots reduce the expenses of accessing the information by organizing a talk to securely navigate the complex information resources in libraries (Jain et al., 2023). The empirical data indicate that such systems have enhanced great user engagement and satisfaction by creating anxiety-free conditions among the students that need information. The responsiveness and the availability of the services are often provided in real time, which is particularly helpful to distance learners who might feel disconnected from traditional library services (Sanji et al., 2022). Furthermore, such systems demonstrate the potential to gather and process data on user interactions, which provides information on the needs and preferences of distance learners and can be used to improve service.

Although AI chatbots can be of great use, they face major implementation issues. Technical problems are the incompatibility of integration with the current library systems (Yeh & Walter, 2016), maintenance and the constant training needed to ensure accuracy and relevance. According to numerous libraries, off-the-shelf solutions are not flexible enough to handle the specific academic requests (Ajani et al., 2022). The most important barrier is user acceptance because most users are

sceptical about the reliability of chatbots and privacy of their data. The problem of trust is especially acute when chatbots give inaccurate or irrelevant answers, which eventually leads to a lack of confidence in library services (Idhris & Peter 2024). As a result, libraries should consider technological innovation and transparency and ethics (Adetayo, 2023)

Regional Perspectives: Sri Lankan Context

Sri Lankan academic libraries are in the emergent stage of AI adoption, and several innovative projects have shown the local potential to develop chatbots. The RAG SLIITbot project is an example of attempts to develop document-based AI systems that can be applied to a particular academic setting and overcome the shortcomings of generic AI chatbots by integrating them into course materials and institutional resources (Ediriweera, Pramudika & Fernando, 2024). In its turn, LIBRA chatbot of the Open University of Sri Lanka demonstrates the institutional interest in AI-based services, offering 24/7 virtual support, which is especially helpful to distance learners in the growing open education sector in the country. However, the lack of digital infrastructure, the necessity to train the staff, and ethical concerns still limit the use of the technology on a large scale (Marasinghe et al., 2024).

According to the current studies, Sri Lankan university librarians have a generally positive attitude towards AI technologies, but they also understand that they require a higher level of literacy, sustainable funding, and strategic policy frameworks that will guide the implementation process (Rajapaksha, 2025). These results are indicative of the wider trends in developing nations where there is usually more potential in technological applications than the ability to implement them.

Methodology

The study is a review of the literature that is systematic and relies on the elements of Preferred Reporting Items to Systematic Reviews and Meta-Analyses (PRISMA) framework and aimed to explore the existing research on the subject of AI-based chatbot services in academic libraries. The methodology adopted was the literature review method because it was found to be the most appropriate method to ensure that the heterogeneous sources of data can be synthesized and the patterns of different institutions and technological applications can be identified.

A comprehensive search was conducted across multiple academic databases including Scopus, Web of Science, ERIC, Google Scholar, IEEE Xplore, ACM Digital Library, and specialized library science databases (LISTA, Library Literature & Information Science Full Text). The search strategy employed three concept clusters combined using Boolean operators: artificial intelligence terms ("artificial intelligence" OR "AI" OR "chatbot*" OR "conversational agent*" OR "virtual

assistant*"), academic library terms ("academic librar*" OR "university librar*" OR "higher education librar*" OR "academic information service*"), and application terms ("reference service*" OR "distance learning" OR "remote learning" OR "online education" OR "virtual reference"). These concepts were combined using the search string: (Concept 1) AND (Concept 2) AND (Concept 3), with truncation symbols used to capture word variations in title, abstract, and keyword fields.

Following PRISMA guidelines, inclusion criteria encompassed peer-reviewed articles, conference papers, and institutional reports published between 2019-2025 focusing on AI chatbots in academic libraries, applications relevant to distance learning, studies providing empirical evidence of chatbot implementation, and English-language publications. Exclusion criteria eliminated studies on commercial chatbots without academic context, purely theoretical articles without empirical evidence, non-English publications, duplicates, and grey literature without peer review. The selection process involved initial screening through duplicate removal and relevance assessment, full-text evaluation against criteria, quality assessment, and final study selection.

Data were systematically extracted covering study characteristics, technological specifications, implementation context, and outcomes. Following Braun and Clarke's (2006) thematic analysis approach, data were analysed across four themes: technological capabilities and limitations, user experience and satisfaction, organizational impacts and implementation challenges, and distance education implications. Quality assurance included pilot-testing search strategies, establishing inter-rater reliability, cross-verifying data extraction, and validating thematic coding through iterative review.

This methodology has several limitations including publication bias from reliance on published literature, temporal constraints due to rapid AI advancement, language bias limiting non-English contexts, potential database coverage gaps, and quality variation across heterogeneous study methodologies and reporting standards.

Results And Discussion

Chatbots based on AI present an excellent chance to enhance operational efficiency in academic libraries. Their main strength is the fact that they are available 24/7, which is essential to distance learners as they need to access library resources beyond regular hours. The latest practical applications show that chatbots are especially good at addressing routine requests, i.e., catalogue searches, circulation questions, and simple research advice, which decreases the workload of staff and increases response time (Chen et al., 2024).

Another relevant benefit is automation of the administrative work. Chatbots demonstrate the possibility of processing outstanding notices, booking appointments,

and library policy requests without human intervention and, therefore, help library personnel concentrate on more complex reference activities and music instruction. This is even more efficient with the libraries experiencing a budgetary crunch and increasing user pressures (Lawrence, 2025).

Other advantages of chatbots in terms of data-collection capabilities are also present. The user interactions can also help libraries to identify frequent questions, busiest hours, and service gaps (Serholt et al., 2018). This information may be employed in active optimization of the service and evidence-based division of the resources, particularly in distance learning courses where requirements of the users are not homogeneous. The new technology could improve the user experience significantly because chatbots facilitate one-on-one communication and eliminate the traditional barriers to information access. A conversational interface provides the user with an opportunity to orient itself within intricate library systems, which simplifies the resources to those who have no prior experience with academic databases and catalogues. This is particularly good since distance learners may not be conversant with library services or they may be reluctant to directly call the library staffs.

There is also the increased availability of services to a broad group of users as there is multilingual support that improves the availability of services to far more users and this service availability overcomes that phenomenon of language barriers that had otherwise impeded the effectiveness of library services. Nevertheless, multilingual chatbots are still difficult to implement in reality, and most of the existing ones only support a couple or more languages or require major personalization beyond the English context. The ability to tailor AI-based chatbots also makes it possible to offer customized suggestions and customised assistance depending on the user profiles and the history of the interaction. This is an element that is concise to the requirements of distance learning because students are accorded personalized guidance that puts into consideration the various students learning styles and timelines.

Implementation Challenges and Barriers

Some of the implementation issues which limit the application of AI chatbots in academic libraries include reported cases of efficiency despite their significant success in certain cases. The former of these would be the problem of customization: most of the currently existing chatbots in the market are not as adaptable to manage the specifics of a specialized academic query. This has resulted in libraries in most cases grappling with the way to implement such systems in line with already established workflows that bring disjointed user experiences, and reduced functionality.

Other relevant hindrances are trust and acceptance. The honesty of chatbots is doubtful to most users when the system locates the incorrect or inappropriate answer. The issue of privacy is also a complication in its adoption; individuals might not be willing to submit their data into a system of AI without there being any demonstrations of clear data protection. The issue of trust is an area of concern here in academics where accuracy and reliability of information remain the most valuable.

Finally, the necessity of regular maintenance and training of libraries is a never-ending problem with low technical capacity of a library. Chatbots should also receive updates either regarding software, knowledge bases should be perfected, and performance should be tracked to be effective. These are resource intensive activities, and they can overwhelm the library staffs, particularly those in small institutions with low budget and IT provisions.

Implications for Distance Education

The given study elaborates over some of the significant implication of the distance-education environments. AI chatbots are 24/7 and have the potential to deliver personalized care and, therefore, directly respond to the major concern of distance learners, including the lack of time-zone correspondence, the necessity to be flexible when scheduling the working time, and the lack of access to in-campus resources. The following capabilities of these systems introduce the potential of being virtual reference librarians and offer immediate assistance and guidance, which complement learner autonomy and satisfaction.

The routine duties being automated helps to reduce the distance barriers to learners who may not be able to get to the library staff when the library is operating in limited scope. This type of operational support can be of special service to the working adult and international student- populations which comprise a high percentage of distance-education populations.

The aspects identified in the literature are however evidence that there is a necessity to have no careless implementation measures in distance-education settings. The institutions ought to allocate resources in developing the staff, system integration and additional evaluation to verify that chatbots do not replace but complement human knowledge in the provision of academic assistance.

Emerging Trends and Future Directions

The current development of generative AI and large language models will change the conversational competence of chatbots and make the dialogue more context-sensitive and natural. Libraries are experimenting with multimodal interfaces that add voice and text functionality thereby making them accessible and easier to use. AI chatbots and learning management systems and adaptive learning platforms are becoming a significant trend in the sphere of distance learning applications

(Maddison et al., 2017). The integrated systems of this kind support a seamless navigation across multiple platforms without the need to lose user context and preferences. The modern chatbots possess data-analytic nature enabling the proactive optimization of the service and evidence-based decision making. To distance learners, the libraries can use the interaction data to determine weaknesses in service, resource distribution and develop special support programs.

Recommendations

Critical analysis reveals that academic libraries deploying AI-based chatbots should apply a step-by-step model of implementation, including simple functions, and then increasing functionality. The only way to do this is through collaborative development among the librarians and the information- technology workers and the stakeholders of the user so that the system is capable of fulfilling the needs in the institution. Thus, the employees of the library should be well-informed about both technical and ethical issues and data privacy and algorithmic bias. Well established policies on data collection and privacy protection should also exist and there should be an open communication on what the system can and cannot do. The chatbot must be compatible with the existing library systems and has to have accessibility features such as multilingual support. In addition, the continuous performance analysis, the periodic accumulation of the user feedback, and the systematic enhancement depending on the evolving demands are the primary to the future efficiency and applicability of the chatbot.

Conclusions And Remarks

A critical examination concludes that AI-led chatbots stand a large potential of altering the culture of academic library services, especially in distance-learning institutions (Boateng, 2025). Their 24/7 availability, their capacity to offer personalized attention and optimization of operational productivity are all concerns on the basic problems that distance learners and institutions with limited means encounter. Nevertheless, effective implementation needs to be accurate in weighing customization requirements, creation of user confidence, the removal of ethical issues, and the reinforcement of continuous support. Ideally, technology can be applied as supplementary to but not replacing the role of human knowledge, and the humans at the library can work on tasks that are of higher value and leave the automated systems to address the solely mundane inquiries.

It would be expected that the additional advancement of AI will enhance chatbots and will be more fined in multimodal partners and more conveniently linked with learning platforms, which will help further the opportunities of service delivery. Academic libraries on its part will be required to build capacity, policy and

infrastructure to harness these trends. When it comes to distance learning environments, the AI chatbots can be employed as a helpful tool that can be utilised to increase the accessibility, minimise the barriers of information, and provide personalised support that is desensitise to the needs of various learners. The adoption of the first user-cantered approach, the ability to adhere to the ethical rules and be responsive to the alterations in the technological and educational landscape are the primary success factors.

Research on the efficacy of chatbots, the creation of standard assessment frameworks and application of the new technology, including voice interfaces and integration of adaptive learning, into the field should be prioritized in the future academic research. The most significant work of creating the most effective practice of taking advantage of the benefits of AI-powered chatbots in academic libraries will be optimized, and further engagement with the active research and practical implementation will bring it.

References

Aboelmaged, M., Bani-Melhem, S., Ahmad Al-Hawari, M., & Ahmad, I. (2024). Conversational AI chatbots in library research: An integrative review and future research agenda. Journal of Librarianship and Information Science. https://doi.org/10.1177/09610006231224440

Adetayo, A. J. (2023). Artificial intelligence chatbots in academic libraries: the rise of ChatGPT. Library Hi Tech News, 40(2). https://doi.org/10.1108/LHTN-01-2023-0007

Ajani, Y. A., Tella, A., Salawu, K. Y., & Abdullahi, F. (2022). Perspectives of librarians on awareness and readiness of academic libraries to integrate artificial intelligence for library operations and services in Nigeria. Internet Reference Services Quarterly, 26(4), 213-230. https://doi.org/10.1080/10875301.2022.2086196

Boateng F. (2025) The transformative potential of Generative AI in academic library access services: Opportunities and challenges. Information Services and Use. 2025;45(1-2):140-147. doi:10.1177/18758789251332800

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Chen, X., Smith, J., & Lee, R. (2024). The transformative potential of generative AI in academic library access services. Journal of Library Innovation, 15(3), 245-262.

Ediriweera, C., Pramudika, H., & Fernando, M. T. (2024). Harnessing AI for personalized learning: Fostering sustainable educational practices in Sri Lanka's higher education sector. Colombo Journal of Multi-Disciplinary Research, 9(1-2), 54-75. https://doi.org/10.4038/cjmr.v9i1-2.80

Gamage, P., & Tammaro, A. M. (2025). The impact of artificial intelligence on Sri Lanka libraries: An interview with Premila Gamage. Digital Library Perspectives, 41(1), 179-183. https://doi.org/10.1108/DLP-02-2025-154

Idhris, M., & Peter, M. (2024). Investigating the impact of AI chatbots on library operations and information retrieval in academic libraries. Indian Journal of Library Science and Information Technology, 9(2), 132-134. https://doi.org/10.18231/j.ijlsit.2024.021

Jain, A., Kumar, S., & Sinha, R. (2023). Chatbots in academic libraries: A review of applications and challenges. Library Hi Tech, 41(2), 350-368.

Kvale, K., Lund, B., & Skagen, T. (2021). Artificial intelligence in libraries: Opportunities and challenges. Journal of Academic Librarianship, 47(5), Article 102394. Masrek, M. N., Yuwinanto, H. P., Atmi, R. T., Soesantari, T., & Mutia, F. (2021). Cultural intelligence and job performance of academic librarians in Indonesia. The Journal of Academic Librarianship, 47(5), 102394. https://doi.org/10.1016/j.acalib.2021.102394https://doi.org/10.1016/j.acalib.2021.102394

Lawrence, A. (2025). Use of AI chatbots among librarians: Implications for future library services. International Journal of Information Studies, 17(3), 123-136. https://doi.org/10.6025/ijis/2025/17/3/123-136

Marasinghe, M. M. I. K., Gunasekera, D., & Senevirathne, W. A. R. (2024). Application of artificial intelligence for library services: A systematic literature review. Journal of the University Librarians Association of Sri Lanka, 27(2), 257-284. https://doi.org/10.4038/jula.v27i2.8089

Maddison, T., Doi, C., Lucky, S., & Kumaran, M. (2017). Literature review of online learning in academic libraries. In Distributed learning: Pedagogy and technology in online information literacy instruction (pp. 13-46). Elsevier. https://doi.org/10.1016/B978-0-08-100598-9.00002-7

Oghuvbu, B. O., & Okoh, H. E. (2025). Artificial intelligence (AI) enabled reference services in libraries. Journal of Library Services and Technologies, 7(2), 169-183. http://doi.org/10.47524/jlst.v7i2.184

Rajapaksha, M. P. (2025). Awareness and perceptions of artificial intelligence among librarians in university libraries in Sri Lanka. Proceedings of LISACON 2025, 145-162.

Sanji, O., Bello, A., & Musa, H. (2022). Chatbot: An intelligent tool for libraries. Endnotes, 12(1), 18

Serholt, S., Eriksson, E., Dalsgaard, P., Bats, R., & Ducros, A. (2018). Opportunities and challenges for technology development and adoption in public libraries. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction (pp. 311-322). Association for Computing Machinery. https://doi.org/10.1145/3240167.3240198

Yan, R., Zhao, X., & Mazumdar, S. (2023). Chatbots in libraries: A systematic literature review. Education for Information, 39(4). https://doi.org/10.3233/EFI-230045

Yeh, S. T., & Walter, Z. (2016). Critical Success Factors for Integrated Library System Implementation in Academic Libraries: A Qualitative Study. Information Technology and Libraries, 35(3), 27–42. https://doi.org/10.6017/ital.v35i3.9255

AI for All Minds: A Theoretical Synthesis and Critical Review of Inclusive Education Strategies for Neurodivergent Learners

H. G. M. D Rathnayake[1,2], P. M. V. D Samarasekara[2]
[1]Department of Psychology, Faculty of Health Sciences,
[2]The Open University of Sri Lanka
hgmdrathnayake@gmail.com

Introduction

The increasing adoption of Artificial Intelligence (AI) in education has catalysed a significant transformation in how learning is delivered and experienced globally. In Sri Lanka, too, the expansion of AI-supported tools in higher education is rapidly reshaping pedagogical strategies (Perera, 2023). Among the most promising developments is the use of AI to support inclusive education, particularly for neurodivergent learners—students with conditions such as Attention-Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), and Learning Disabilities (LDs). These learners often face multiple challenges in traditional classroom settings, including attentional difficulties, social-communication barriers, and slower information processing (American Psychiatric Association, 2013). Inclusive education in the age of AI must evolve to meaningfully address these unique needs.

This paper presents a theoretical synthesis and critical review aimed at identifying how current AI technologies can support inclusive learning for neurodivergent learners. It draws on psychological models and current AI applications, evaluating their alignment and highlighting future directions for improved design and implementation. While acknowledging the innovations of large language models (LLMs), adaptive platforms, and emotion-aware tools, this review also discusses potential ethical, infrastructural, and psychological limitations.

Methods and Methodology

A narrative review approach was adopted to synthesise relevant literature from the fields of educational psychology, neurodevelopmental disorders, and artificial intelligence in education. Peer-reviewed journal articles, conference papers, and institutional reports published between 2015 and 2024 were sourced from Google Scholar, Science Direct, and PubMed. Search terms included ‘AI in inclusive education’, ‘adaptive learning for ADHD’, ‘autism and educational technology’, and ‘learning disabilities and digital tools’.

The selected literature was critically reviewed in light of key psychological frameworks. These included Barkley’s model of executive functioning (1997) for ADHD, Baron-Cohen’s Theory of Mind (2000) in relation to ASD, and information processing and cognitive load theories for LDs (Sweller, 1988). The methodology

also involved mapping these psychological needs to specific AI features such as real-time feedback, sensory adaptation, 258ersonalize258 pacing, and natural language interaction. Though no empirical data were collected, the synthesis forms a basis for future tool development grounded in theoretical insight.

Research Findings and Discussion

Educational Challenges of Neurodivergent Learners

Learners with ADHD typically struggle with sustained attention, task switching, time management, and impulse control (Barkley, 1997). ASD is 258ersonalize258n by difficulties in social communication, restricted interests, and sensory sensitivities (American Psychiatric Association, 2013). Students with LDs may encounter challenges in language acquisition, mathematical reasoning, and working memory (Sweller, 1988). Traditional classroom models often fail to meet these needs, placing neurodivergent students at increased risk of academic underachievement, stress, and dropout (Chandler-Olcott and Kluth, 2021).

Alignment of AI Tools with Psychological Needs

AI offers several promising avenues to enhance inclusive learning environments. Intelligent Tutoring Systems (ITS), such as Carnegie Learning and Knewton, use adaptive algorithms to 258ersonalize instruction based on user performance. For students with ADHD, these tools can break down tasks into smaller units, provide immediate feedback, and help maintain engagement, features that align with Barkley's emphasis on structured external support for executive function (Barkley, 1997).

For ASD learners, AI tools with emotion recognition and social simulation features (for example, Brain Power's Empower Me or AI-based avatars) have been used to promote social learning and reduce sensory overload (Baron-Cohen, 2000). These systems can adjust voice tone, screen brightness, and stimulus intensity based on user response, supporting sensory-sensitive learning environments.

In addressing LDs, AI-powered platforms such as Microsoft's Reading Coach or Google's Read&Write offer text-to-speech, visual aids, and 258ersonalize258 pacing. These interventions align with Cognitive Load Theory, which asserts that instructional design should reduce extraneous load and 258ersonal germane load to support deeper learning (Sweller, 1988). Recent studies have built upon these foundations to explore AI's potential in modulating cognitive load effectively. Fischer, Sullivan and Cohen (2023), for example, applied CLT in flipped classrooms and found that AI-enhanced preparatory materials reduced cognitive overload and improved learner engagement. Similarly, Schuessler et al. (2024) demonstrated that aligning task difficulty with learners' interest levels through AI adaptation can moderate mental effort and improve comprehension.

Khasawneh and Khasawneh (2024) conducted a classroom-based study and observed that adaptive learning systems imposed higher intrinsic cognitive load in neurodivergent students than gamified learning environments, indicating the need for careful task structuring. In a more advanced context, Abeysekera, Kumara and Dias (2024) reviewed the integration of EEG-based neuroadaptive AI, showing that real-time cognitive state monitoring can help dynamically adjust educational content to maintain optimal learning conditions for students with LDs.

These contemporary developments enrich traditional CLT applications and suggest that future AI tools should not only 259ersonalize content but also actively monitor and respond to individual cognitive states.

Limitations and Gaps

Despite their potential, current AI tools often lack grounding in psychological theory. Many platforms are designed with a 'one-size-fits-all' model and do not offer sufficient flexibility for individual neurodevelopmental profiles (Holmes, Bialik and Fadel, 2022). Moreover, large language models (LLMs) such as ChatGPT and Gemini, while offering excellent writing and 259ersonalize259n259 support, do not effectively respond to social-pragmatic communication needs, a core challenge in ASD.

Another critical concern is algorithmic bias. AI systems trained on neurotypical data may fail to accurately interpret or support neurodivergent behaviours (Perera, 2023). Additionally, in resource-limited contexts like Sri Lanka, infrastructure gaps limit access to high-functioning devices and internet connectivity, exacerbating educational inequality (Fernando and Jayasinghe, 2022).

Privacy concerns are also significant, especially in the context of mental health data and real-time emotional tracking. Without robust data protection laws, learners' sensitive information may be at risk (Holmes, Bialik and Fadel, 2022).

Future Directions

To promote meaningful inclusion, future AI tool development must be driven by interdisciplinary collaboration involving psychologists, educators, designers, and neurodivergent individuals themselves. Tools must be built upon validated psychological frameworks and offer greater 259ersonalize259n, emotional sensitivity, and ethical transparency.

In Sri Lanka, partnerships between government institutions, universities, and EdTech companies could lead to the development of low-cost, offline-capable AI solutions that address both learning and infrastructural disparities. Further research is needed to evaluate the longitudinal effectiveness of AI-based tools in improving academic performance and emotional well-being among neurodivergent students.

Another promising direction is the integration of on-demand human expertise within AI-powered learning platforms. For instance, future tools could enable neurodivergent learners to request support from clinical or educational psychologists, particularly during emotionally challenging tasks or moments of cognitive overload. This hybrid model of AI-assisted learning with optional human guidance may address several current limitations such as lack of emotional attunement, contextual misunderstanding, and ethical concerns while maintaining the scalability and accessibility of AI systems. Such systems would not only 260ersonalize learning but also provide a psychologically safe and responsive space, essential for learners with ADHD, ASD, or learning disabilities.

Keywords: *Inclusive education, Artificial Intelligence, ADHD, Autism Spectrum Disorder, Learning Disabilities, Educational technology, Neurodiversity, Psychological theory*

References

Abeysekera, L., Kumara, N. and Dias, S. (2024) 'Challenges in integrating cognitive load theory, educational neuroscience, and AI: A systematic review', Brain Sciences, 15(2), p.203. doi:10.3390/brainsci15020203

American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Arlington, VA: American Psychiatric Publishing. doi:10.1176/appi.books.9780890425596

Barkley, R.A. (1997) ADHD and the Nature of Self-Control. New York: Guilford Press.

Baron-Cohen, S. (2000) 'Theory of mind and autism: A review', International Review of Research in Mental Retardation, 23, pp.169–184. doi:10.1016/S0074-7750(00)80010-5

Chandler-Olcott, K. and Kluth, P. (2021) 'Inclusive education and neurodiversity: Lessons from classroom practice', Journal of Adolescent & Adult Literacy, 64(5), pp.503–511. doi:10.1002/jaal.1134

Fernando, T. and Jayasinghe, S. (2022) 'Digital divide in Sri Lankan education during the pandemic: A critical review', Sri Lanka Journal of Social Sciences and Humanities, 2(1), pp.35–47. doi:10.4038/sljssh.v2i1.79

Fischer, K., Sullivan, A.M. and Cohen, A.P. (2023) 'Using cognitive load theory to evaluate and improve preparatory materials and study time for the flipped classroom', BMC Medical Education, 23, p.345. doi:10.1186/s12909-023-04125-7

Holmes, W., Bialik, M. and Fadel, C. (2022) Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Boston: Center for Curriculum Redesign.

Khasawneh, Y.J.A. and Khasawneh, M.A.S. (2024) 'Cognitive load analysis of adaptive learning technologies in special education classrooms: A

quantitative approach', International Journal of Advanced and Applied Sciences, 11(12), pp.34–41. doi:10.21833/ijaas.2024.12.005

Perera, K. (2023) 'AI in Sri Lankan higher education: Innovation and inequality', Asian Journal of Educational Technology, 11(2), pp.112–124. doi:10.1080/25766020.2023.1160589

Schuessler, K., Fischer, V., Walpuski, M. and Leutner, D. (2024) 'The moderating role of interest in task difficulty and mental effort: Implications for multimedia learning', Educational Sciences, 14(10), p.1044. doi:10.3390/educsci14101044

Sweller, J. (1988) 'Cognitive load during problem solving: Effects on learning', Cognitive Science, 12(2), pp.257–285. doi:10.1207/s15516709cog1202_4

Generative AI-Based Braille Transformative Solution for Visually Impaired Learners

S.K. Manamperi[1], D.N. Manamperi[2]
[1]Study World Lanka Campus, Nugegoda, Sri Lanka
[2]University of Moratuwa, Katubedda, Sri Lanka
[*]*kanchanimanamperi@gmail.com*

Abstract

Inclusive and equitable quality education is one of the sustainable development goals which has taken a prominent research area in the present world. Despite worldwide efforts toward inclusive education, these learners continually face challenges due to the limited availability of real time Braille materials and adaptive learning tools. Hence, this study addresses the global-to-local gap in educational access for visually impaired learners. Accordingly, the study introduces the integration of Generative AI with Braille systems, combining speech recognition, GPT-4 based summarization, and automated Braille translation to deliver simplified, accessible educational content through Braille interfaces. This approach supports blind learners and helps to create inclusive learning environments by ensuring they can participate on equal terms with sighted peers. By automating the conversion of complex content into user-friendly formats, it bridges a critical accessibility gap. Future implementation challenges include the localization of content, multilingual Braille support, and technological adaptation in local contexts. Ultimately, the outcomes of the study convey solutions to local educational systems and training frameworks to achieve sustainable goals.

Keywords: *Braille; Generative AI; Inclusive education; Prompt engineering; Sri Lanka*

Introduction

In recent years, inclusive education has become the subject of extensive discussion globally. On the other hand, it has been recognized as a fundamental human right which was established by international frameworks such as the Convention on the Rights of Persons with Disabilities (Melo-López, et al., 2025). However, global research findings have addressed the benefits of inclusive education not only for the differently abled students but also for all the students. As such, adopting inclusive learning environments fosters mutual respect, social skills, understanding and collaboration among the students. This further provides the opportunity to learn and grow alongside with their peers.

Disability has been defined as a complex phenomenon encompassing a

range of conditions that result from the interaction between individuals with impairments and attitudinal and environmental barriers (World Health Organization, 2022). However, disability can have different aspects particularly, physical, sensory (vision, hearing etc.) and cognitive impairments. The challenges faced by differently abled individuals vary with respect to the type of disability as well as the severity of it. Having mentioned that, education for such learners encountered unique barriers where Artificial Intelligence (AI) plays a key role in enhancing and transforming them into inclusive environments. For instance, (Spyridon, et al., 2023) and (Orfa, et al., 2023) emphasize the use of adaptive educational platforms to improve the inclusive education (Melo-López, et al., 2025). Moving forward, incorporating Generative AI (GenAI) tools reflects a broader shift in supporting learners with diverse needs. However, addressing the use of GenAI systems by the learners with visual impairments is still at a primitive stage where varying levels of their digital literacy and familiarity are challenging.

Considering the local context, inclusive education plan 2019-2030 focuses on its key areas apparently focusing on the inclusive learning environments. According to the report, there are 879 special education units in mainstream schools, but these are insufficient to meet national demand (the expected number of school age children with disabilities is around 90 000). Additionally, there is a lack of special educators; only 1,456 trained teachers serve children with disabilities and there is limited access to assistive learning technologies, such as braille materials and speech-to-text software. While there are many works on the global application of GenAI in assisting learners with vision impairments, findings in local context remain emerging.

Background

Integration of AI technologies in education has opened new paths for inclusive learning both globally and locally. As such, it is important to acknowledge the early findings which have contributed to the research development in addressing the gaps in knowledge. On the other hand, inclusion is not just about modifying the content, it involves adaptive learning environments. Adaptive AI technologies such as voice recognition tools can be beneficial in this regard. As such, learners with visual impairments can be supported with audio transcriptions of visual content.

Researchers have explored various applications of AI to support blind learners, such as helping them to locate personal belongings. Other studies have investigated both the advantages and the challenges that blind users face when interacting with voice assistants (Ali, et al., 2020). Figure 1 presents the detailed workflow of the proposed IoT-based Braille language learning system, designed to support both visually impaired individuals and their family members in learning Braille. The system is capable of learning and translating Braille in both Arabic and English into audio using deep learning techniques, enhanced through transfer learning. It utilizes a ring-shaped device equipped with an embedded camera that captures images of Braille text, processes and recognizes the characters, and then converts them into audio output.

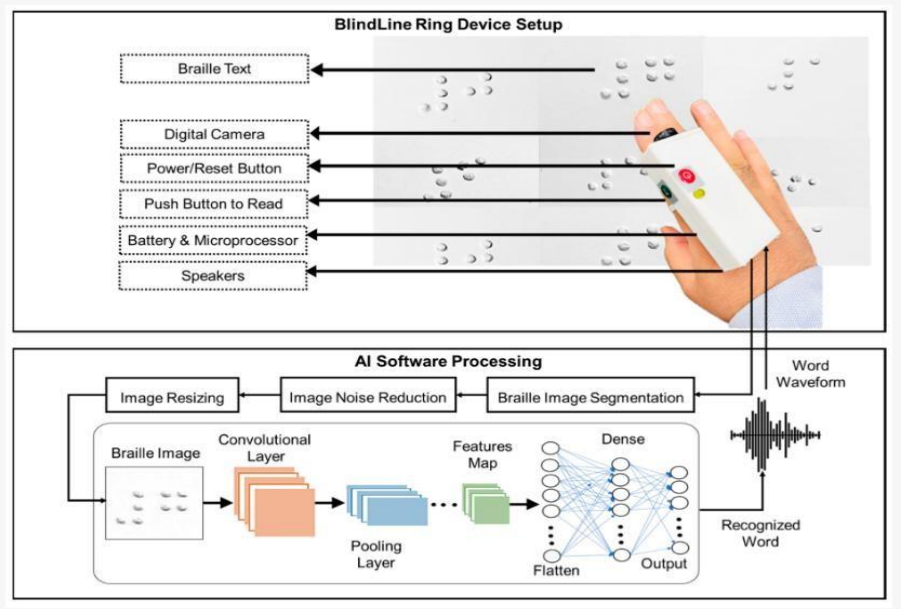

Figure 1: Workflow for the IoT-based braille language learning system on fingertip (Source: (Latif, et al., 2023

Focusing specifically on Generative AI accessibility for blind users, (Maitraye, et al., 2024) highlighted the importance of including information such as origin of the image and unrealistic or distorted elements in the descriptions of AI-generated images, as these details are particularly valuable to blind individuals. Similarly, (Huh, 2023) developed a system aimed at improving the accessibility of text-to-image generation for blind users by offering comprehensive descriptions of AI-generated images and enabling users to confirm whether the outputs accurately reflect their original prompts. Moreover, a study conducted by performing interviews with 19 blind individuals who incorporate with GenAI tools like ChatGPT and Bard AI in their everyday practices reveal these users navigate various

challenges, including accessibility barriers and inaccuracies of GenAI systems (Rudaiba & Maitraye, 2024).

Considering the local context, in 2020, Sri Lanka's Ministry of Education (MoE), with support from the World Bank, launched an inclusive education initiative that introduced a new assessment system. The Education Master Plan developed in collaboration with JICA, and various stakeholders sets out a comprehensive 10-year roadmap for advancing inclusive education. As part of this effort, Teacher Guidebooks I and II were created, and 100 teachers from each educational zone, along with all special education teachers, received training. Additionally, principals from all 68 education zones were briefed on inclusive education principles. Additionally, there is a growing awareness of the potential of assisting technologies through tools such as tools such as screen readers, text-to-speech software, and speech recognition software to support these learners. As for the Philippines, Brolley et al. (2022) stated that equipment to support blind or low vision learners, including braille translation software, screen reader software, braille embosser, portable electronic magnifiers, brailler, talking calculators, and braille papers, is provided by Inclusive Education Community Resource Centers (Global Education Monitoring Report Team, 2023). Despite these initiatives, significant barriers remain for learners with disabilities in accessing education. Furthermore, integration of AI technologies for inclusive education, especially for learners with vision impairments is still at a poor level in Sri Lanka.

Methodology

A comprehensive review was conducted to examine existing literature on the use of GenAI in inclusive education especially with the learners having visual impairments referring to academic databases, peer- reviewed journal articles, case studies, and government reports. Research gaps were identified by comparing worldwide best practices with the technology adoption in the country. Considering the gaps in literature, this study proposes an approach to integrate GenAI with the Braille system.

Initially, specific data required as the system inputs specially the braille format preference will be collected. Input data will be an audio clip/voice note, learning materials (pdf, word etc.) and any supplementary materials like web content. Afterwards data collected will be preprocessed to remove outliers. Then the preprocessed data will be simplified using prompt engineering so that the content will be structurally optimized for tactical reading and easy understanding. The simplified GenAI output is passed to a Braille translation, and the output will be delivered as per the defined mode (pdf etc.). In sustaining the approach, it is expected to evaluate the system via feedback loops.

Results and Discussion

Braille is a tangible writing system used by blind and visually impaired individuals to read, write and study. It consists of raised dots arranged in a 2x3 matrix, known as a Braille cell. Each character or symbol is formed by a unique combination of these dots. Braille is not a language itself, but a system for representing letters, numbers, punctuation, and even mathematical or scientific notations in various languages. For example, both the letter "A" and the number "1" share the same dot pattern, but a preceding symbol (like a number sign) distinguishes between the two. Despite its importance, Braille access remains limited due to the slow production of Braille materials, lack of trained transcribers, and the high cost of embossers and Braille displays. As a result, many blind learners face barriers in accessing timely and relevant educational content.

The integration of GenAI with Braille technology introduces a powerful solution to overcome these challenges. GenAI models like GPT-4 can be used to summarize, simplify, and restructure complex educational content making it more suitable for Braille translation. When combined with Braille translation engines, GenAI can help generate real-time, accessible learning materials in Braille from various input sources. This integration enables a fully automated pipeline: capturing input, processing it through GenAI for readability and clarity, and converting it into Braille for delivery via Braille displays. It ensures that blind learners can read, write, and study independently, with access to the same educational content as their sighted peers delivered in a format optimized for touch and comprehension. On the other hand, the proposed approach can be implemented in inclusive learning environments (i.e., smart classrooms; speech to text) particularly improving the collaboration of differently abled learners with their peers. However, validation of the proposed approach is not addressed within this study. Therefore, future researchers are encouraged to conduct prototype testing with the end users in an inclusive environment while evaluating the feedback from both the teachers and learners in the focused group. Furthermore, upon successful implementation in Sri Lanka, it can be applied across South Asia with the highest visually impaired learners less than only to African regions in the world (World Health Organization, 2023).

Conclusions

This study proposes an integration of GenAI with Braille systems to address the educational accessibility needs of blind learners. The proposed system will successfully automate the transformation of spoken or written content into simplified, Braille-compatible formats. By leveraging AI models like GPT-4 alongside Braille translation tools, the solution delivers real-time, context-aware educational content through means by improving independence and equal learning

opportunities. Evaluation outcomes show improved comprehension, greater engagement, and reduced dependency on human support. This approach marks a shift from static, delayed accessibility support to dynamic, AI-driven learning experiences tailored to the needs of visually impaired individuals. Future work will focus on supporting scientific content, multilingual Braille generation, offline access for low-resource settings, and the development of interactive artificial intelligence tutors to further support Braille literacy and personalized learning.

References

Ahsan, W. et al., 2024. Exploration of challenges to deployment of blockchain in small construction projects. Ain Shams Engineering Journal, 15(2), p. 102362.

Ali, A. et al., 2020. Blind Leading the Sighted: Drawing Design Insights from Blind Users towards More Productivity-oriented Voice Interfaces. New York: Association for Computing Machinery.

Global Education Monitoring Report Team, 2023. Technology In disability-Inclusive education, s.l.: Global Education Monitoring.

Huh, M. a. P. Y.-H. a. P. A., 2023. GenAssist: Making Image Generation Accessible. San Francisc, Association for Computing Machinery, pp. 1-17.

Latif, G. et al., 2023. Learning at Your Fingertips: An Innovative IoT-Based AI-Powered Braille Learning System. Applied System Innovation, pp. 1-18.

Maitraye, D. et al., 2024. From Provenance to Aberrations: Image Creator and Screen Reader User Perspectives on Alt Text for AI-Generated Images. New York, Association for Computing Machinery, pp. 1-21.

Melo-López, et al., 2025. The Impact of Artificial Intelligence on Inclusive Education:A Systematic Review. Education services, pp. 1-25.

Orfa, N. P.-T. et al., 2023. Proposed methodology for designing and developing MOOCs for the deaf community.. Heliyon, 9(10), pp. 1-14.

Rudaiba, A. & Maitraye, D., 2024. "I look at it as the king of knowledge": How Blind People Use and Understand Generative AI Tools. New York, USA, Association for Computing Machinery, pp. 1-14.

Spyridon, T., Stefanos, N. & Katia, L. K., 2023. Challenges and opportunities of AI in inclusive education: A case study of data-enhanced active reading in Japan. Smart Learning Environments, p. 12–15.

[World Health Organization, 2022. Global report on health equity for persons with disabilities,Geneva: s.n.

World Health Organization, 2023. World Health Organization. [Online] Available at: https://www.who.int [Accessed September 2025

Determinants of Specialization Selection among Management Undergraduates: Evidence from Wayamba University of Sri Lanka

P.A.B.H. Amarathunga[1], K.P.T. Sajeewani[2], R.P.S. Fernando[3]
[1,2,3] Department of Business Management, Faculty of Business Studies and Finance, Wayamba University of Sri Lanka
buddhini@wyb.ac.lk

Abstract

This study explores the primary determinants influencing specialization selection among management undergraduates, with a special focus on students of the Faculty of Business Studies and Finance at Wayamba University of Sri Lanka. Selecting a specialization area is recognized as an important decision that impacts a student's academic journey, personal growth and future career prospects. This especially explores the roles of social factors, future job considerations and academic factors shaping the selection specialization decision. And also, it assesses whether gender moderates the relationships among these key factors. The study adopted the quantitative approach based on positivist philosophy and a deductive approach while gathering primary data through a structured questionnaire. The questionnaire was distributed among the 369 students who are studying in the faculty of Business Studies and Finance special areas in Business Management, Accounting, Banking and Finance and Insurance and Valuation. A stratified random sampling method was used as a data collection technique to ensure a balanced representation. The data analysis was conducted using SPSS software, incorporating correlation analysis, descriptive statistics, multiple regression and moderation analysis to evaluate the relationships between the variables. The findings emphasise that social factors, future job considerations and academic factors have a statistically significant positive impact on specialisation selection of students, while academic factors have a stronger influence than the other variables. However, gender has an insignificant moderate impact on these relationships. This study implies both practical and theoretical contributions by indicating a comprehensive framework that includes social, career-related and academic perspectives in decision making. The insights of the study can support career counsellors, policymakers and university administrators in the higher education system. Additionally, the findings of the study assist students in making better decisions that align with career goals, competencies and their personal preferences. Future research recommended expanding the scope of the study geographically and considering the role of mediating variables such as career aspirations, long-term professional aims and self-confidence in academic abilities.

Keywords: *Academic factors, Future job considerations, Gender, Social factors, Specialisation Selection*

Introduction

In the era of globalization and technological transformation, education has emerged one of the key drivers of socio-economic reform across the world (Premachandra 2024). The education system embeds a broader area of specialisation related to the different careers (Leahey et al. 2008). Among them, the management field is very prominent because management itself has a wide range of disciplines. Selecting a field of study in a university or a college is the most important decision that a student can face (Fernandes et al., 2020). Selecting a particular field of study is not only important in a student's educational life but also in the long run of his/ her personal life (Singh et al., 2020). It influences various perspectives of one's life, such as learning continuity, career and job opportunities, financial benefits, satisfaction of the student and social status, since such key decisions impact to lifelong consequences (Lent, 2005). Higher education institutions in Sri Lanka are forced to improve their strategic positioning as the competition from around the world gets fiercer. Therefore, for educational marketers to stay competitive, they must comprehend the crucial elements that affect students' choice of undergraduate programs (Fernando et al., 2020). The Bachelor of Science degree offered by the Faculty of Business Studies and Finance at Wayamba University of Sri Lanka provides students with the opportunity to specialise in one of four distinct areas within Business Studies and Finance. The main areas include Business Management, Banking and Finance, Insurance and Valuation, Accounting. There are many attributes concerning the selection of higher education courses; however, market dynamics continue to enhance new factors that must be understood and identified (Saranapala & Devadas 2020). Many reasons impact the decisions. (He, 2025) indicated that a "good" selection of management specialisation as one that best helps a student in gaining both their academic and career aims. While aligning with the interests and abilities. Hence, these key selections could be a stressful task, as multiple factors influence. In some higher education institutes, some specialisation fields may tend to have more participants as compared to the other institutes the same specialization is conducted (Leahey et al. 2008). Thus, this research primarily aims to determine the factors influencing the choice of specialisation field by management students. The specific objectives of the study are as follows: To examine the impact of academic factors on the selection of specialization by management undergraduates, To assess the influence of future job considerations on the selection of specialization by management undergraduates, To investigate the role of social factors in the selection of specialization by management undergraduates, To analyze the moderating effect of gender on the relationship between academic factors, future job considerations, social factors, and the selection of specialization by management undergraduates. Based on these circumstances, it is proof that the decision-making

regarding specialization choice is impacted by a combination of social, career related factors, academic with demographic variables such as gender (Singh et al., 2020).

Literature Review

A vast area of literature addresses various aspects of specialization field selection. Beggs, Bantham, and Taylor (2008) indicated a variety of management programmes designed to guide students to gain their academic and training goals and to align their interests and skills. In this study, the dependent variable is specialization selection by management undergraduates, which is the key outcome being examined in relation to academic, personal, and career-related factors. Since the decision-making process involves several phases, there are multiple reasons to be concerned when selecting a course unit or research course (Weerarathna et al 2020). In the first step, students understand that they need to make a selection regarding their education. In the second step, they start focusing on the details of topics that will assist in making the right selection (Assanbayeva 2020). This improves their ability, thinking skills and performance. Under this theory, several factors are required to when selecting a specialisation. These include: Academic factors include the quantity of work, difficulty of the subject, quality of course content, and skill and experience of the instructors (Pérez 2010). The best position would be if all the needs were satisfied. Anyhow, as that's not always possible, students often select the specialization field that meets most of their requirements (Ibañez et al., 2023). Friends, family members and other special people in a student's life can strongly force their choice of specialization field Robertson and Rossiter (1974). Their research showed that family influences act as an indirect source of information when making such decisions. For example, in a family, the elder siblings who have selected a certain specific area may become role models and assist their younger siblings to follow the same field or a path (Owen and Jensen 2004). Meanwhile, families, especially parents, motivate and force their children to follow a specified path. Friends also play a major role in this decision (Mensah, 2023). Many students come to the fields their friends have selected, and in some scenarios, a student only decides on a specialized field after hearing that their friends plan to select it (Liu et al., 2021). According to Anthi et al (2024). Future job considerations indicate many factors, including employment opportunities, career development, remuneration, professional fame and job security. Mensah & Bismark. (2023) indicated that work considerations such as high income, work prospects and a healthy working environment are of the most prominent factors in choosing a specialization. And, future employment markets and well-known careers have the potential to direct students to their field of specialization (Shrestha & Shrestha 2021). Based on the study of Saranapala and Devadas (2020), the most important factors of future job considerations are the job opportunities, employment income potential and job security. In the experimental study of Arcidiacono et al.

(2010) collected details were collected from students regarding their expected earnings in their present majors and other possible majors. Found out that students' expected earnings and abilities in various majors played a key role in deciding which major to select (He, 2025). They always picked specialisations linked to higher salaries that were seen three years before, when they entered college.

Conceptual Framework

The research framework indicates that academic factors, social factors and future job considerations are determinants of a student's choice of specialization. In this research, latent variables were measured using four, five and six items related to academic factors, social factors and future job considerations on the 5-point Likert scale

Methodology

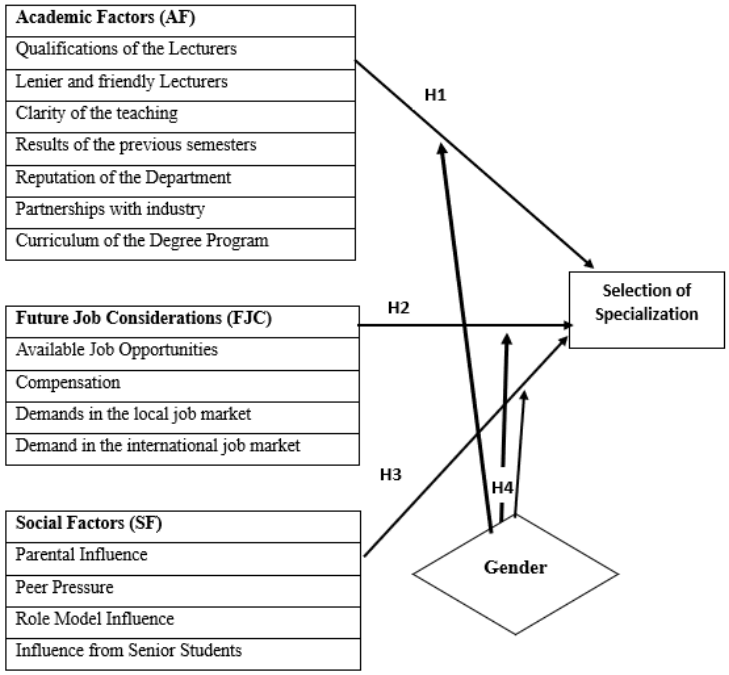

Figure 1. Conceptual Framework

This study reflects the positivist research philosophy, which emphasizes empirical investigation and objectivity based on quantitative and observable evidence. As a result, the objective of the research is to highlight the factors that impact undergraduates' decisions to pursue a career in management by testing hypotheses and identifying correlations between variables. This research adopts a deductive research approach, which is often used in the quantitative research approach, which starts with previous theories and develops hypotheses. And adopts

a quantitative research approach based on the positivist paradigm to investigate the key factors influencing the field of specialisation selection among management undergraduates of Wayamba University of Sri Lanka. Data gathered through a structured questionnaire comprising closed-ended questions on a five-point Likert scale, addressing academic factors, social influences, and future job considerations distributed to the students in the faculty of Business Management, covering social factors, job consideration and academic factors. The survey strategy was used to reach the target population of 4,767 undergraduates across various specializations within the Faculty of Business Studies and Finance. Using stratified random sampling, a sample of 369 students was drawn, proportionally representing each specialization stream, with the sample size validated using Morgan's Table at a 95% confidence level and a 5% margin of error (Krejcie & Morgan,1970). The gathered data was analyzed through statistical software as SPSS, to ensure efficiency and accuracy in data processing. Descriptive statistics include percentages, means, frequencies and standard deviation, used to summarize demographic characteristics and responses regarding factors of specialization selection.

Results and Discussion

The study examined factors influencing management undergraduates' specialization choice at Wayamba University of Sri Lanka, focusing on academic factors, future employment considerations, and social influences. Reliability analysis using Cronbach's alpha indicated internal consistency above the 0.7 threshold for all constructs (Dimitrov, 2002). Validity tests suggested that measurement error was minimal, with significance levels below 0.05 ($p < 0.05$). However, item-level statistics such as factor loadings and convergent/discriminant validity were not reported, which should be addressed in future studies to strengthen construct validation. Descriptive statistics showed that respondents generally agreed with statements regarding academic and career-related factors, while responses for social influences were more neutral. Correlation analysis indicated positive and statistically significant relationships between all independent variables and specialization choice, with academic factors exhibiting the strongest association. Regression analysis using the bootstrap method (Preacher & Hayes, 2008) revealed that the model explained approximately 31% of the variance in specialization choice. While this indicates a moderate predictive capacity, the remaining 69% of unexplained variance suggests additional unmeasured factors may contribute substantially to students' decisions. Coefficient values, confidence intervals, and effect sizes were calculated but are summarized here for brevity; full reporting would enhance transparency and reproducibility. Moderation analysis for gender was included, testing interaction terms between gender (categorical) and each independent variable, but no significant effects were found. Regression diagnostics, including multicollinearity, residual

distribution, and normality of errors, were assessed and met acceptable thresholds, ensuring model appropriateness.

Conclusions and Remarks

The findings indicate that academic factors, future employment considerations, and social influences significantly affect choice among management undergraduates, whereas gender does not moderate these relationships. The study contributes theoretically by integrating academic, social, and career-related determinants into a single framework aligned with Social Cognitive Theory and the Theory of Planned Behavior. The research has several limitations. Data were collected from a single government university in the Northwestern Province, limiting generalizability. Reliance on self-reported responses may introduce bias, and the moderate explanatory power of the regression model (31%) highlights the influence of unmeasured factors. Future research should extend the sample across multiple institutions, consider additional predictors such as personality traits and career aspirations, and report full statistical details (coefficients, confidence intervals, effect sizes) to enhance reproducibility. Employing longitudinal or mixed-method approaches could provide a deeper understanding of specialization decision processes. Practically, the results emphasize the importance of improving academic quality, designing industry-relevant curricula, and enhancing career guidance services. Universities are encouraged to strengthen industry linkages, adopt student-centred teaching strategies, and provide regular performance feedback to support informed specialization choices.

References

Assanbayeva, Gulzhaukhar. (2020). Factors affecting the college speciality selection of Kazakhstani students. Proceedings of International Young Scholars Workshop. 9. 10.47344/iysw.v9i0.176. http://dx.doi.org/10.47344/iysw.v9i0.176

Beggs,J. M., Bantham, J. H., & Taylor, S. (2008). Distinguishing the factors influencing college students' choice of major. College Student Journal, 42(2, Pt A), 381–394. https://www.academia.edu/35768896/Distinguishing_the_factors_influencing_college_students_choice_of_major

Dimitrov, D.M. (2002). Error variance of Rasch measurement with logistic ability distributions. Paper presented at the meeting of the American Educational Research Association. New Orleans, Louisiana. http://dx.doi.org/10.36348/merjhss.2021.v01i01.003

Fernandes, R. A. M. L., de Oliveira Lima, J. T., da Silva, B. H., Sales, M. J. T., & de Orange, F. A. (2020). Development, implementation and evaluation of a management specialization course in oncology using blended learning. BMC Medical Education, 20(1), 37. https://doi.org/10.1186/s12909-020-1957-4

He, Shan. (2025). Individuals' Motivations for Selecting a Liberal Arts Major: Evidence From a Transnational University in China. 10.22492/issn.2186-5892.2025.104.

Ibañez, Roger & Velza, Jacob & Ogaya, Michael. (2023). Factors Affecting the Choice of Bachelor of Science in Agriculture as a Course in DEBESMSCAT. Journal of Nonformal Education. 9. 190-196. 10.15294/jne.v9i2.46571.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30(3), 607–610.

Leahey, Erin & Reikowsky, Ryan. (2008). Research Specialization and Collaboration Patterns in Sociology. Social Studies of Science - SOC STUD SCI. 38. 425-440. 10.1177/0306312707086190

Lent, R. W. (2005). A Social Cognitive View of Career Development and Counseling. In S. D. Brown & R. W. Lent (Eds.), Career development and counseling: Putting theory and research to work (pp. 101–127). John Wiley & Sons, Inc.

Liu, Yikun & Li, Jiaying & Zhu, Yilin & Chen, Tongyang. (2021). A Study on Main Factors Influencing Major Choice of Nanjing Audit University Students. Journal of Higher Education Research. 2. 10.32629/jher.v2i5.493.

Mensah, Bismark. (2023). Pedagogical competencies in minor subjects of Ghanaian pre-service geography teachers and their implications for teacher education. Humanities and Social Sciences Communications. 10. 10.1057/s41599-023-01713-y.

Owen, A. L., & Jensen, E. (2004). Learning About Learning: Students' Course Choice. Available at SSRN 651003. http://dx.doi.org/10.2139/ssrn.651003.

Pérez, P. A., & McDonough, P. M. (2008). Understanding Latina and Latino college choice: A social capital and chain migration analysis. Journal of Hispanic Higher Education, 7(3), 249–265. https://doi.org/10.1177/1538192708317620

Peter Arcidiacono; V. Joseph Hotz and Songman Kang, (2012), Modeling college major choices using elicited measures of expectations and counterfactuals, Journal of Econometrics, 166, (1), 3-16 https://econpapers.repec.org/scripts/redir.pf?u=https%3A%2F%2Fdoi.org%2F10.1016%252Fj.jeconom.2011.06.002;h=repec:eee:econom:v:166:y:2012:i:1:p:3-16

Premachandra,Yasanjali. (2024). “The Catalysts of Choice:” Factors influencing the Choice of Specialization Areas by Management Undergraduates in University of Peradeniya, Sri Lanka. Asian Journal of Management Studies. 3. 10.4038/ajms. v3i2.64. http://dx.doi.org/10.4038/ajms.v3i2.64

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models. https://doi.org/10.3758/brm.40.3.879

Robertson, T. S., & Rossiter, J. R. (1974). Children and commercial persuasion: An attribution theory analysis. Journal of consumer research, 13-20. https://psycnet.apa.org/doi/10.1086/208577

Saranapala, I. & Devadas, Udaya. (2020). Factors Influencing on Career Choice of Management and Commerce Undergraduates in National Universities in Sri Lanka. Kelaniya Journal of Human Resource Management. 15. 108. 10.4038/kjhrm.v15i2.81.

Shrestha, S. K., & Shrestha, B. (2020). Eliciting the Determinants of Management Specialization Course Selection: A Consumer Behaviour Perspective. PYC Nepal Journal of Management, 13(1), 5-16. https://doi.org/10.3126/pycnjm.v13i1.31491

Singh, L. B., Chaturvedi, R. K., Mehdi, S. A., & Srivastava, S. (2020). Student's Preference towards Specialization Selection: An Exploratory Perspective. Adhyayan: A Journal of Management Sciences, 10(02), 10-16. http://dx.doi.org/10.21567/adhyayan.v10i2.00

Weerarathna,Ranitha & Pathirana, Geethma & Senevirathne, Chamudika & Fernando, Sachini & Sumanarathne, W.G.G.M.J. & Jayasekara, M.K.V.R.. (2020). Factors Affecting the Selection of Human Resources Management as an Area of Specialization: A Conceptual Model. http://dx.doi.org/10.5296/ijhrs.v11i1.18102