Handilingo: A Unique Learning Tool for ASL and Braille

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***Abstract*—Special needs education including sign language and braille learning faces many challenges. There is a shortage of special needs teachers; some are not qualified enough to meet the required standards. According to a study on the inclusion of students with disabilities in Egypt, several challenges were identified, including a lack of training in service and before service for teachers, limited programs for students with certain disabilities, and a lack of awareness in the community and family. The 2017 Census of Population, Housing and Establishments reported that 10.6% of the population in Egypt (an estimated 12 million people) have disabilities. However, data from the Ministry of Education in 2016 indicated that only 38,135 students with disabilities were enrolled in the education system, which is less than 0. 19% of the total number of students enrolled. To address this gap, we propose the development of an inclusive educational website designed to provide comprehensive resources and support for special needs educators. This platform aims to offer a wide range of materials and interactive tools to facilitate interactive experiences, all tailored to the unique needs of special education. By ensuring that these resources are readily available and easily accessible, we strive to improve the quality of education and rehabilitation services, ultimately improving the outcomes for individuals with special needs.**

***Index Terms*—Sign Language, E-Learning, Braille, Web Development, Assistive Technology.**

I. Introduction

E-learning platforms have significantly improved accessibility and quality of education for students with hearing and visual impairments. These platforms offer various tools and resources that facilitate independent learning. Despite the benefits, there are still significant challenges in implementing e-learning for Braille and sign language learning. For visually impaired students, the main issues include the accessibility of online resources and the need for specialized training for educators. For deaf students, the challenges are related to the usability of e-learning platforms and the need for more inclusive teaching strategies.

A. Braille Learning

A study presented at the International Conference on Human-Computer Interaction introduced "D-Braille," a mobile application designed for individuals with low vision. This application aims to teach Braille from the basics, allowing users to learn and practice letters and words using a Braille display. The application provides tutorials and practice tools, making it a user-friendly resource for those new to Braille [3].

A systematic review published in "Disability and Rehabilitation: Assistive Technology" evaluated the effectiveness of technology in supporting Braille literacy education for children. The review included 12 peer-reviewed articles evaluating a total of 176 participants aged 0-21 years who were blind or visually impaired and learning braille as their primary literacy medium. It concludes that the quality of research was generally low, with 11 of the 12 studies having an Oxford Level of Evidence of 4 (out of 5), indicating a high risk of bias and uncertain effects. The studies evaluated a variety of technologies for braille literacy education, including apps, slate and stylus tools, braille note-takers, and devices with mechanical/electrical components. While most studies reported positive literacy outcomes for at least some participants, there was no consensus on the methods used to assess literacy or the specific strengths and weaknesses of the technologies [4].

B. Sign Language Learning

E-learning environments embedded with sign language videos are effective in improving the academic performance and learning patterns of deaf students. These platforms often include features such as video conferencing, captioned videos, and interactive sign language dictionaries, which help in creating an inclusive learning environment. However, the transition to online learning during the COVID-19 pandemic highlighted several challenges for deaf and hard-of-hearing students, such as the lack of suitable infrastructure and the complexity of written language [5].

Research published in ”Educational Technology Research and Development” investigated the usability of e-learning environments embedded with sign language videos. The study found that deaf students who accessed sign language videos more frequently showed significant improvements in their academic performance. The research highlighted the importance of incorporating sign language videos into e-learning platforms to enhance the learning experience for deaf students. Implementing sign language videos, animations, graphics, and interactive activities within the e-learning environment positively influenced deaf students' learning and motivation. While the deaf students performed better in the multiple-choice questions, they struggled more with the short essay questions, indicating challenges with written expression despite understanding the content [6].

A systematic literature review published in ”Universal Access in the Information Society” examined the landscape of sign language research based on smartphone apps. The review identified the need for quality assessment of these apps to ensure they effectively bridge the communication gap for hearing-impaired individuals. The study suggested future directions for improving the quality and usability of sign language mobile apps [7].

II. Methodology

A. Application Design and Database

Our learning platform's target audience is the well-being people who want to learn Sign Language to understand and communicate with deaf people or help them learn the language. We first searched for similar websites that help users learn American Sign Language (ASL) to identify and address the gaps that need improvement to ensure a seamless experience and familiarity to users. Secondly, we collected data from different resources on how to make an objective assessment test for the users to help them know their current level and help them with suitable learning resources and difficulty levels accordingly. We also collected and edited images showing signs for the alphabet and some common words. More than 700 hundred questions were made from this data varying from easy questions about basic alphabet signs to complex questions about complete sentences and expressions. These questions were classified into three stages, stage one about letters, stage two about common words, and stage three about complete sentences. Each stage was then divided into three levels of difficulty to ensure that all levels of learners could use the website.

B. Software Features and Implementation

As mentioned above, since we are targeting well-being, not the deaf people themselves, the platform does not support special controls or assistive techniques for navigation. The web application consists of several features, first of all, the user can make an account with an email and password to have a profile with their learning progress, current stage, course enrolled in, and total score. The total score is used to determine the stages the user should enrol in. For the front end, we used the React library for its rich features and community support, and Flask for the back end for a minimalistic approach. We used SQLAlchemy for the database. To minimize distractions and increase learning achievement, when a user starts learning, topics are provided in batches, between 8 to 10 batches for each stage. For example, in the first stage, which is alphabet letters, the first batch is A, B, and C. The second batch is D, E, and F. When a batch is finished, and short quiz is given to the user for feedback on their understanding. For the words stage, we chose about 30 most common words and used them in the sentences stage. All questions are made as MCQ with 4 choices. We used the spaced repetition technique for memory training, questions with different difficulty levels are viewed by the user, and once the correct answer is chosen, this question is less likely to appear again soon. Otherwise, it will appear again in minutes. Total Scores are used to adapt to user learning progress and make questions with suitable levels appear more frequently.

The app use flow starts with signing up and creating an account. Some other online learning platforms do not require registration but this is an important step for our app to provide a personalised experience. The home page then appears and the user can choose between learning braille and sign language as ”Fig. 1” shows

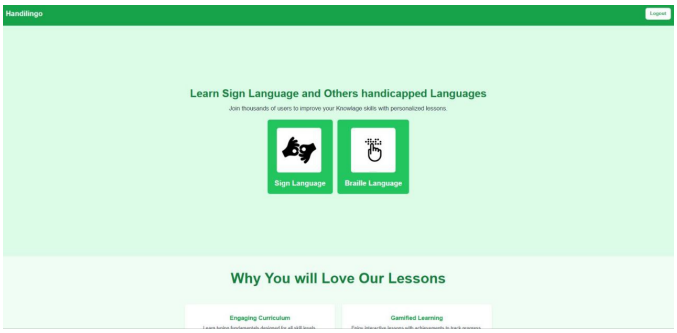

Fig. 1. Home Page.

The user chooses what language to learn and lessons are divided as mentioned in the Application Design section. ”Fig. 2” shows the user can choose to revise lessons or start a new lesson. Depending on the current score, some advanced lessons will not be accessible until the beginner ones are finished.

As in ”Fig. 3”, Flash-card-designed lessons are used as an easy-to-use and efficient technique for memorisation.

The questions part involves multiple choice questions that adapt to the user's progress. ”Fig. 4” Shows how questions get harder (3 Signs appear instead of 1) which reflects the high scores the user achieved.

Results

Although the platform is still in its early demo stage, the design and development process has focused on addressing key challenges in language learning accessibility. The gamified approach is intended to increase motivation and retention among users. Caretakers of individuals with disabilities can engage

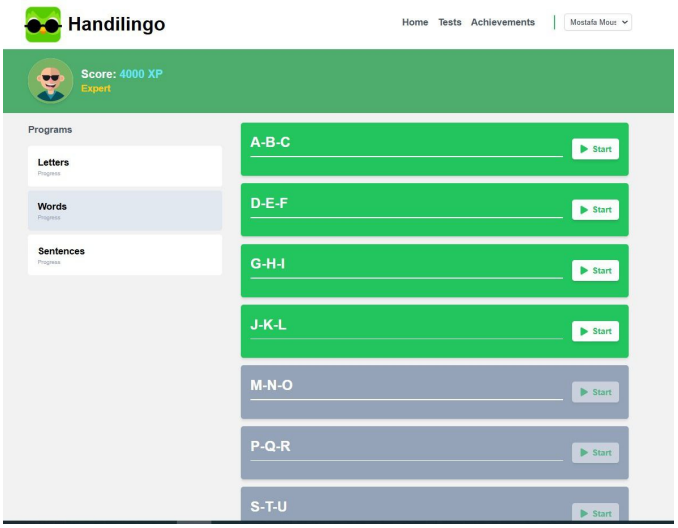

Fig. 2. All lessons page.

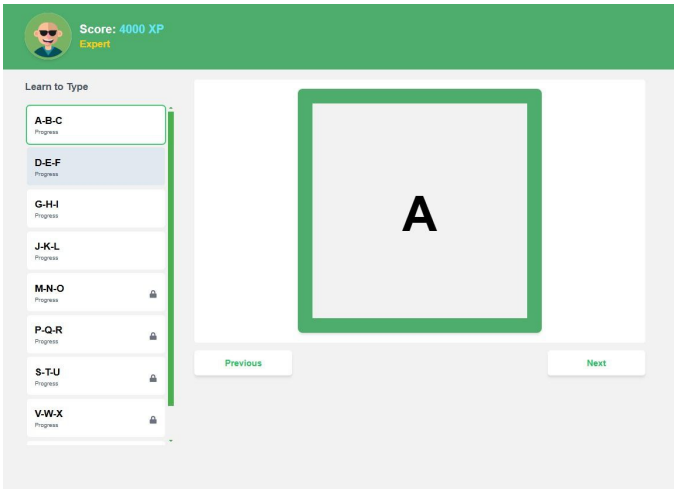

Fig. 3. One lesson page.

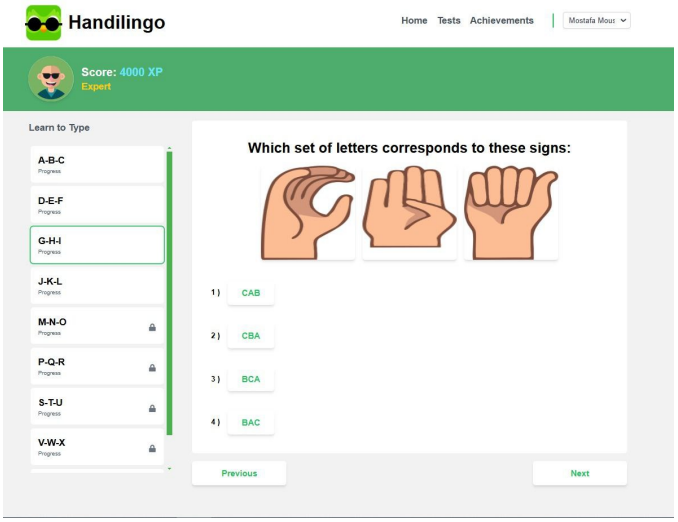

Fig. 4. Questions page.

with the platform through interactive lessons, which simulate real-world scenarios for learning Braille and sign languages. Early feedback from peers and stakeholders highlights the engaging nature of the gamification elements, such as progress tracking, rewards for completed tasks, and visual aids for sign language learning. "Fig. 5" shows the progress of the user and the total score of a given test.

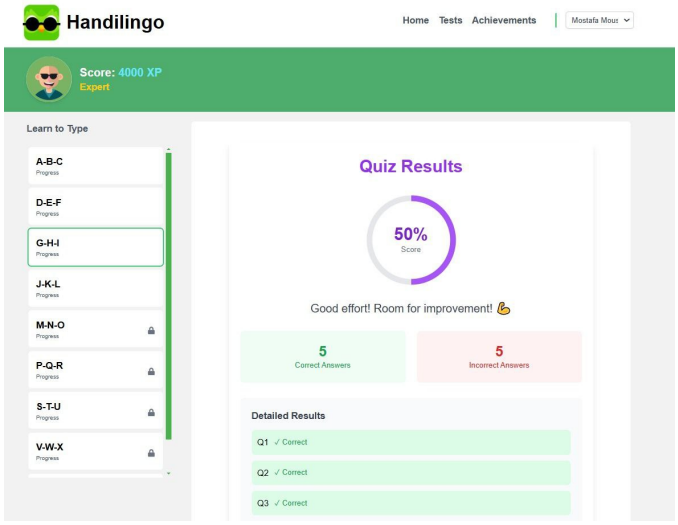

Fig. 5. Results analysis page.

The current version targets caretakers rather than individuals with disabilities, as it lacks advanced accessibility features for end-users with severe impairments. Additionally, the gamification mechanics, while engaging, may require further customization to suit varying skill levels and learning paces.

Conclusion and Future Directions

This project represents an initial step toward creating a comprehensive, gamified platform for learning Braille and sign languages. By targeting caretakers, the platform addresses an immediate gap in accessible learning resources, equipping caregivers with the tools to support individuals with disabilities. The gamified approach makes the learning process interactive and engaging, potentially paving the way for greater adoption. The website has the potential to create a ripple effect, where trained caregivers can better support the disabled community. As the platform evolves, it could directly empower individuals with disabilities to acquire language skills that enhance their independence and quality of life. Future directions should include expanding the audience to include individuals with disabilities through features like gesture recognition for sign language and tactile feedback for Braille, conducting real-world testing to gather user feedback and refine the platform, and incorporating adaptive learning algorithms to personalize the experience based on user needs and progress.

References

[1] A. Elhadi, "Inclusion of Students with Disabilities in Egypt: Challenges and Recommendations," Journal of Education and e-Learning

Research, vol. 8, no. 2, pp. 173–178, Jan. 2021, doi: 10.20448/journal.509.2021.82.173.178.

[2] "DisabilityInclusive education in Egypt.," Handicap International Humanity & Inclusion, Sep. 2023. Accessed: Dec. 21, 2024. [Online]. Available: https://www.hi.org/sn_uploads/document/Briefing-paper_IE_Egypt_September-2023_Final-Version.pdf.

[3] A. A. Gueye and S. Chandna, "D-Braille: A Digital Learning Application for People with Low Vision," in Lecture notes in computer science, 2022, pp. 455–465. doi: 10.1007/978-3-031-05039-8_33.

[4] E. R. Hoskin, M. K. Coyne, M. J. White, S. C. D. Dobri, T. C. Davies, and S. D. Pinder, "Effectiveness of technology for braille literacy education for children: a systematic review," Disability and Rehabilitation Assistive Technology, vol. 19, no. 1, pp. 120–130, May 2022, doi: 10.1080/17483107.2022.2070676.

[5] W. Aljedaani, R. Krasniqi, S. Aljedaani, M. W. Mkaouer, S. Ludi, and K. Al-Raddah, "If online learning works for you, what about deaf students? Emerging challenges of online learning for deaf and hearing-impaired students during COVID-19: a literature review," Universal Access in the Information Society, vol. 22, no. 3, pp. 1027–1046, Jul. 2022, doi: 10.1007/s10209-022-00897-5.

[6] M. H. M. Hashim and Z. Tasir, "An e-learning environment embedded with sign language videos: research into its usability and the academic performance and learning patterns of deaf students," Educational Technology Research and Development, vol. 68, no. 6, pp. 2873–2911, Jun. 2020, doi: 10.1007/s11423-020-09802-4.

[7] D. David et al., "Landscape of sign language research based on smartphone apps: coherent literature analysis, motivations, open challenges, recommendations and future directions for app assessment," Universal Access in the Information Society, vol. 23, no. 2, pp. 687–702, Jan. 2023, doi: 10.1007/s10209-022-00966-9.