

Project ID:

24-25J-338

1. Topic (12 words max)

Sign Math: Innovative E-Learning System for Deaf and Mute Students Using Machine Learning.

2. Research group the project belongs to

Software Systems & Technologies (SST)

3. Research area the project belongs to

ICT for Development (ICTD)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

The advancement of society is closely tied to the effectiveness of the teaching and learning process. However, global educational objectives continue to encounter significant challenges, particularly when considering the needs of individuals with disabilities. The World Health Organization (WHO) highlights that children with disabilities, including those who are deaf, face numerous obstacles in accessing quality education due to a lack of appropriate learning environments and resources. This issue is further exacerbated by the variability in the availability and quality of sign language interpretation and educational services across different regions[1].

Despite representing a significant portion of the population, the educational needs of individuals with disabilities are often overlooked. A substantial number of people in our communities are deaf, and many of them struggle with illiteracy. Deaf children, in particular, face difficulties in linking written words or symbols with sign language, a challenge that persists until they acquire literacy skills later in life. Since many children with hearing impairments primarily rely on sign language for communication, learning to read and write presents a greater challenge compared to their hearing peers, as written language is typically associated with spoken language in everyday use[2]. Additionally, each deaf individual's hearing impairment is unique, requiring tailored educational approaches.

Mathematics education poses distinct challenges for deaf children. Difficulties in language development, restricted access to communication, inadequate classroom support, a lack of visual aids, and the impact of stigma and discrimination all contribute to the hurdles these children face in learning mathematics. Deaf children often experience delays in language development, which can hinder their understanding of mathematical concepts and symbols. Limited

communication access can prevent them from fully engaging in classroom activities, asking questions, or receiving feedback. Furthermore, many teachers lack the necessary training or resources to effectively support deaf students in mathematics education. Visual aids, such as graphs and diagrams, which are critical in teaching mathematics, may not be readily accessible to deaf students. The social stigma and discrimination they encounter can also negatively impact their self-esteem and motivation to learn.

Addressing these challenges is essential to ensuring that deaf children receive the support they need in their education. This may include the use of sign language or alternative communication methods, the incorporation of visual aids, and providing specialized teacher training to enhance support for deaf children in mathematics education. By tackling these issues, we can ensure that deaf children have equal opportunities to succeed in mathematics and other academic areas.

References

[1] Who.int. 2021. Improving Access to Quality Education for Children with Disabilities. [online] Available at: <https://www.who.int/publications/i/item/9789240014833> [Accessed 27 August 2023].

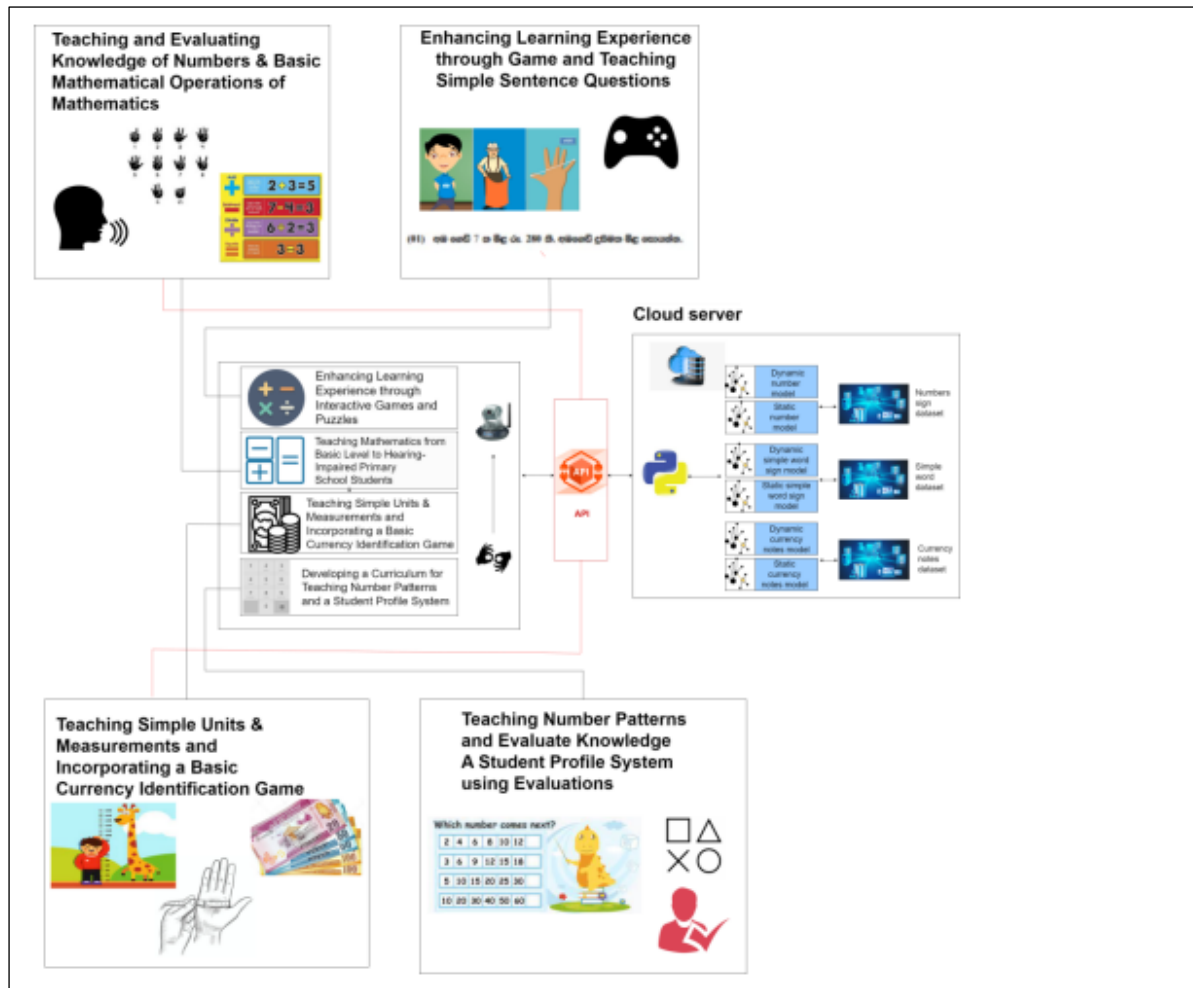
[2] Springer.com. 2022. Language and Literacy Development in Deaf Children: Challenges and Strategies. [online] Available at: <https://link.springer.com/article/10.1007/s11145-021-10173-6> [Accessed 27 August 2023].

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The rise of technology has opened new avenues to address the longstanding challenges in mathematics education for deaf children. Extensive research over the years has consistently shown that deaf students often perform below their hearing peers in mathematical subjects. This performance gap is largely due to communication barriers during the learning process, even though mathematical abilities, such as logical reasoning and comparison, are not inherently tied to language skills.

This project seeks to close the gap in mathematics achievement between deaf and hearing children, a problem well-documented in educational research. The primary barrier identified is the lack of effective communication in teaching mathematical concepts. To tackle this issue, a mobile application has been developed specifically designed to teach fundamental mathematical principles to primary school students with hearing impairments. The application leverages digital tools, such as visual representations, to display numbers and basic instructions using hand signals.

Beyond its role as a teaching tool, the application also serves as an interactive platform for conducting exams and introducing activity-based learning. It includes educational games and puzzles, such as quizzes and currency-related challenges, enhanced by machine learning techniques. Additionally, the system creates a personalized profile for each student, recording their information and assessments to monitor progress and guide future learning paths. This project is committed to making mathematics both accessible and engaging for deaf children, helping to equalize their educational opportunities and close the performance gap with their hearing peers.



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

The proposed project to teach fundamental mathematical concepts to hearing-impaired primary students through a mobile application necessitates specialized expertise across multiple domains. First and foremost, a comprehensive understanding of the primary mathematics curriculum is essential to design an effective and age-appropriate learning tool. This includes knowledge of pedagogical approaches suited for young learners, ensuring that the content is not only accurate but also engaging and accessible.

In addition to mathematics education, expertise in sign language, particularly the mathematical lexicon used in sign language, is critical. This knowledge will ensure that mathematical concepts are accurately and intuitively represented through hand signals, facilitating better comprehension for students who rely on sign language as their primary mode of communication.

The technical development of the mobile application requires proficiency in mobile app development, with a focus on creating a user-friendly interface tailored to the needs of hearing-

impaired children. Moreover, integrating machine learning algorithms is pivotal for capturing and analyzing hand signals, as well as for providing personalized feedback based on individual student performance. Machine learning will play a key role in adapting the learning experience to each student's unique needs, identifying areas where they may struggle, and suggesting tailored exercises to enhance their understanding.

Regarding data requirements, the system must maintain a robust database to store student profiles, track their progress, and record evaluation results. This data will be instrumental in training machine learning models to recognize learning patterns and predict potential challenges that students may face. Additionally, access to a rich repository of educational resources, including mathematical equations, visual aids, quizzes, and interactive games, is necessary to support the learning process.

Furthermore, the project requires expertise in data privacy and security, ensuring that all student information is handled in compliance with relevant regulations and is protected from unauthorized access. The ability to integrate and manage this data within the application is essential for providing a seamless and secure user experience.

In conclusion, the successful implementation of this project hinges on a multidisciplinary approach, combining domain expertise in mathematics education, sign language, mobile app development, machine learning, and data security. By leveraging these areas of expertise, this project has the potential to make significant strides in improving mathematics education for hearing-impaired students, fostering greater inclusion and equity in the learning process.

8. Objectives and Novelty

Main Objective The main objective of this project is to develop an advanced, adaptive website that enhances the mathematical education and language comprehension of primary school students with hearing impairments. The platform will integrate sign language and cutting-edge machine learning techniques to provide personalized, engaging, and accessible learning experiences, ultimately bridging the educational gap and fostering greater inclusion for deaf students.			
Member Name	Sub Objective	Tasks	Novelty
Dissanayaka D.M.S.M	Enhancing Learning Experience through Gamification and Adaptive Learning for Language Comprehension	<ul style="list-style-type: none"> - Design and develop highly interactive games employing machine learning to evaluate language comprehension skills. - Integrate sign language to support language learning. - Perform rigorous testing to evaluate game effectiveness and student engagement. 	The innovative use of gamification combined with adaptive learning through machine learning ensures personalized language learning experiences. The approach to using sign language in teaching sentence structures is rare in current educational systems, particularly for deaf students in Sri Lanka.
Weeraratne H.K.D.P.P	Designing an Advanced Interactive Learning Environment for Teaching and Evaluating Core Mathematics Concepts	<ul style="list-style-type: none"> - Conduct comprehensive research on sign language for mathematical terms and operations. - Develop an intuitive user interface focusing on user 	This project stands out by integrating advanced sign language interpretation into mathematical learning, using cutting-edge machine learning techniques to create a

		experience for interactive learning and evaluation. - Implement advanced machine learning algorithms for adaptive quizzes and progress evaluation.	personalized and adaptive learning environment. The focus on deaf students' unique needs makes this approach novel in the Sri Lankan educational context.
K.R.M.Kelaniyage	Developing a Comprehensive Curriculum and Student Profile System for Advanced Learning Analytics	- Research and curate a structured curriculum for teaching complex number patterns. - Design engaging and interactive quizzes powered by machine learning to assess skill acquisition. - Develop a sophisticated student profile system to track progress, identify strengths, and customize learning paths.	This project's novelty lies in its emphasis on data-driven educational personalization. The use of detailed student profiles, combined with adaptive learning methods, offers a level of customization in education that is not commonly seen, particularly in systems designed for deaf students.
Abeykoon A.M.S.N	Designing a Holistic Learning Environment for Teaching Measurement and Financial Literacy	- Conduct research on effective methods for teaching measurement and currency identification. - Develop an immersive learning environment incorporating interactive games. - Leverage machine learning to personalize and enhance educational outcomes.	This initiative is unique in its approach to integrating financial literacy into the education of deaf students through interactive, machine learning-powered games. This project fills a gap in educational tools available in Sri Lanka, providing critical life skills in a format accessible to deaf learners.

9. Supervisor checklist

- a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes		No	
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- b) Does the proposed topic exhibit novelty?

Yes		No	
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- c) Do you believe they have the capability to successfully execute the proposed project?

Yes		No	
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- d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes		No	
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- e) Supervisor's Evaluation and Recommendation for the Research topic:

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10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor				
Co-Supervisor				
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

This part is to be filled by the Topic Screening Panel members.

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

***Important:**

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.