

INTERACTIVE, VISUAL LEARNING-BASED TOOL FOR HEARING-IMPAIRED CHILDREN TO IMPROVE LANGUAGE

22_23-J 18

DRAFT

Lelkada L L P S M

IT19001708

BSc (Hons) in Information Technology

Specializing in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

May 2023

INTERACTIVE, VISUAL LEARNING-BASED TOOL FOR HEARING-IMPAIRED CHILDREN TO IMPROVE LANGUAGE

22_23-J 18

DRAFT

Lelkada L L P S M

IT19001708

BSc (Hons) in Information Technology

Specializing in Data Science

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

May 2023

DECLARATION

I declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or Institute of higher learning, and to the best of our knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

Signature:



Date: 01/05/2023

Signature of the Supervisor:

Date:

Signature of the Co-Supervisor:

Date:

ABSTRACT

Hearing impaired children exhibits low level of linguistic abilities that primarily caused by limited access to auditory inputs during the critical period of language development. Limited auditory simulation hinders the natural language process. Consequently, low level of linguistic abilities significantly impacts the education outcomes and quality of life of hearing-impaired children.

First language acquisition begins from the birth and continue until age five. The brain plasticity during this stage supports rapid development that closely related to cognitive maturity. First language learning is an unconscious process. Children learn their first language by getting exposed into various inputs that primarily includes auditory and visual stimuli. Listening to sounds of native language and observing facial expressions, gestures and body language of the people who interact with them often. Constant observations and engagement help children to understand the meaning s semantics of a language. These combined inputs make a children master the first language rapidly with short period of time.

However due to lack of auditory simulations, hearing impaired children have low level of linguistic abilities. Even though they were able to receive a medical instrument that can bring their hearing later in life, it is an arduous task for them to master language skills as they missed the optimal window of language development. It is essential to develop a comprehensive learning tool for hearing impaired children to learn their first language that caters their unique needs.

ACKNOWLEDGEMENTS

Hearing impaired children exhibits low level of linguistic abilities that primarily caused by limited access to auditory inputs during the critical period of language development. Limited auditory simulation hinders the natural language process. Consequently, low level of linguistic abilities significantly impacts the education outcomes and quality of life of hearing-impaired children.

TABLE OF CONTENTS

Declaration	3
Abstract	4
Acknowledgements	5
Table of contents	5
1 Introduction	7
1.1 Background	7
1.2 Research gap	10
1.3 Research problem	11
2 Objectives	13
2.1 Main objective	13
2.2 Sub objective	13
2.2.1 Contextually similar word generation	13
2.2.2 Content filtration	13
3 Methodology	14
3.1 System architecture	14
3.1.1 Similar Word Generation	15
3.1.2 Content censoring	18
3.2 Technology Selection	19
3.3 Implementation	19
3.3.1 Requirement Gathering	19
3.3.2 Feasibility Study	20
3.3.3 Design	20
3.3.4 Implementation and Integration	20
3.3.5 Testing	21
3.4 Commercialization	21

4. Project Requirements22

 4.1 Functional Requirements22

 4.2 Non-functional Requirements22

 4.3 User requirements22

 4.4 System requirements23

 4.5 Work Breakdown Structure24

 4.6 Gantt Chart.....24

 4.7 Wireframes25

 4.8 Budget and Justification.....25

5. References26

6. Appendix28

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

1. INTRODUCTION

1.1 Background

Hearing impairment is a condition where a person has difficulty hearing sounds in one or both ears [1]. There are nearly 34 million children worldwide have disabling hearing loss, which is defined as hearing loss greater than 40 decibels (dB) in the better hearing ear for children [1]. This condition can be present at birth due to genetic factors, prenatal exposure to infections or toxins, or complications during birth. It can also be acquired later in life due to infections, noise exposure, or head injuries. Addressing hearing impairment in children is important because it can affect their language development, communication skills, and academic success, which can have long-term effects on their quality of life.

First language acquisition begins from the birth and continue until age five. The brain plasticity during this stage supports rapid development that closely related to cognitive maturity [2]. First language learning is an unconscious process. Children learn their first language by getting exposed into various inputs that primarily includes auditory and visual stimuli [3]. Listening to sounds of native language and observing facial expressions, gestures and body language of the people who interact with them often and primary source of these inputs are parents, siblings and caretakers. Constant observations and engagement help children to understand the meaning s semantics of a language. These combined inputs make a children master the first language rapidly with short period of time [4].

However due to lack of auditory simulations, hearing impaired children have low level of linguistic abilities. Even though they were able to receive a medical instrument that can bring their hearing later in life, it is an arduous task for them to master language skills as they missed the optimal window of language development [5][6].

Inadequate language development has a significant impact on quality of life in various ways. Limited language skills hinder the ability to communicate effectively. Education performance is largely depending on one's ability to read, write, and comprehend. In addition to that, social isolation, poor mental health, lower employment prospects can be considered as some of the challenges that hearing impaired community face. To overcome the social and academic challenges that hearing-impaired children face, a comprehensive learning tool is essential [7].

1.2 Research Gap

In recent years, research efforts have sought to enhance the learning experiences of hearing-impaired children, aiming to close the gap between their linguistic abilities and those of their hearing peers. Two such studies, by Catherine Collins Lu [8] and the Tianjin University of Technology [9], have proposed different approaches to addressing this issue: utilizing residual hearing and providing a personal experience-oriented learning environment, and the development of a web-based teaching and learning system, respectively. While these studies have made significant strides in this field, they each possess limitations that suggest the need for further research in the development of learning tools for hearing-impaired children.

The web-based teaching and learning system proposed by the Tianjin University of Technology [9] capitalizes on the ubiquity of the internet and multimedia, offering a wide range of resources, including texts, videos, voices, and graphics, accessible through the internet. This system presents an appealing alternative to traditional methods, allowing students to access materials at their convenience. However, its reliance on a predefined set of course materials may limit the learners' ability to explore and engage in the natural learning processes experienced by hearing children. Furthermore, the system fails to address the importance of utilizing residual hearing to provide a learning environment that more closely resembles that of normal-hearing children.

On the other hand, the Augmented Reality (AR) education platform proposed by Khon Kaen University employs the "Aurasma" mobile AR model to detect objects from the real world and translate words into sign language in real-time. While this system encourages a more explorative learning experience, it neglects the potential benefits of residual hearing and focuses solely on sign language as the primary mode of communication. The reliance on sign language may hinder the learners' ability to acquire spoken languages and negatively affect their reading and writing skills, as sign language possesses inherent limitations when compared to spoken languages.

In light of these limitations, there exists a substantial research gap in the development of learning tools for hearing-impaired children. Future studies should focus on designing a comprehensive learning system that combines the strengths of both approaches: incorporating the flexibility of web-based and AR systems while emphasizing the importance of residual hearing and a personal experience-oriented learning environment. This would provide a more holistic and adaptable

learning experience, closely mimicking the natural language acquisition process of hearing children and promoting the development of spoken languages, reading, and writing abilities.

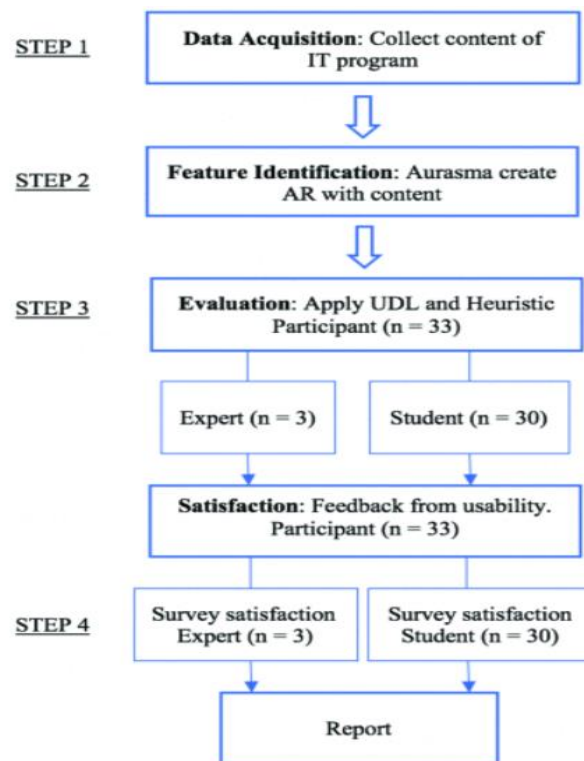


Figure 1: Source <https://ieeexplore.ieee.org/document/8541294>

By addressing the shortcomings of the aforementioned research, further investigation into this area will contribute to the development of more effective and inclusive learning tools for hearing-impaired children. Such advancements will ultimately pave the way for a more equitable educational landscape, empowering these learners to reach their full potential and succeed in their academic pursuits.

2. RESEARCH PROBLEM

3. RESEARCH OBJECTIVES

4. METHODOLOGY

5. TESTING AND IMPLEMENTATION

6. RESULTS AND DISCUSSION

7. CONCLUSION

8. REFERENCES

- [1] Deafness and hearing loss (2021) World Health Organization. World Health Organization. Available at: <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss> (Accessed: April 20, 2023).
- [2] Brain mechanisms in early language acquisition - neuron (no date). Available at: [https://www.cell.com/neuron/fulltext/S0896-6273\(10\)00681-1](https://www.cell.com/neuron/fulltext/S0896-6273(10)00681-1) (Accessed: April 21, 2023).
- [3] Medina, T. N., Snedeker, J., Trueswell, J. C., & Gleitman, L. R. (2011). How words can and cannot be learned by observation. *Proceedings of the National Academy of Sciences*, 108(22), 9014-9019.
- [4] Bainbridge, C. (2022) How do babies and young children learn language?, Verywell Family. Verywell Family. Available at: <https://www.verywellfamily.com/how-do-children-learn-language-1449116> (Accessed: April 21, 2023).
- [5] Mayberry, R. I., & Lock, E. (2003). Age constraints on first versus second language acquisition: Evidence for linguistic plasticity and epigenesis. *Brain and Language*, 87(3), 369-384.
- [6] Yoshinaga-Itano, C. (2003). From screening to early identification and intervention: Discovering predictors to successful outcomes for children with significant hearing loss. *Journal of Deaf Studies and Deaf Education*, 8(1), 11-30.
- [7] Wu, Y. C., Liao, H. F., Lee, P. F., & Huang, S. H. (2020). The effectiveness of interactive multimedia learning tools on language outcomes in children with hearing loss: A randomized controlled trial. *BMC Pediatrics*, 20(1), 1-9.
- [8] Catherine Collins Lu. "Teaching language to hearing impaired children who have had no previous language experience." Portland State University.
- [9] X. Dong and L. Qiang, "Web-Based Teaching and Learning Methods for Deaf Students," 2009 IITA International Conference on Services Science, Management and Engineering, 2009, pp. 344-347, DOI: 10.1109/SSME.2009.146.