Non-Verbal Learning Disability (NVLD)
In age 10 - 13 Children

Project Id: TMP- 24-25J-150

Project Proposal Report

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Personalized Learning Paths Through Interactive Vocabulary Assessments
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DECLARATION

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We declare that this is our own work, and this proposal does not incorporate without acknowledgement 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 acknowledgement is made in the text.

Name	Student ID	Signature
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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor   22/08/24

                                                    Date

Signature of the Co - supervisor   Date

ABSTRACT

In the realm of tailored educational support for children with Non-Verbal Learning Disorder (NVLD), our study introduces the function "Personalized Learning Paths Through Interactive Vocabulary Assessments," a vital component of a comprehensive application designed specifically for NVLD children aged 10-13. This function addresses the unique learning needs of these children by offering adaptive and engaging learning experiences. Through real-time feedback, such as positive reinforcements and partial prompts, this feature aids in navigating errors, helping children through suggested activities based on their performance. By targeting specific challenges in word recognition, long-term memory retention, and cognitive development, this study aims to significantly enhance vocabulary acquisition and, consequently, improve the overall quality of life for children with NVLD.

Keywords—Nonverbal Learning Disability (NVLD), Vocabulary Acquisition, Personalized Learning Paths, Adaptive Learning, Interactive Learning, Real-Time Feedback, Positive Reinforcement, Partial Prompts, Touch-Screen Interaction, Cognitive Development

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LIST OF ABBREVIATIONS

Abbreviation	Definition
NVLD	Non-Verbal Learning Disorder

1. INTRODUCTION

Children with Non-Verbal Learning Disorder (NVLD) face unique challenges in language development, particularly in areas such as word recognition, long-term memory retention, and cognitive processing. These difficulties can significantly impact their academic performance and overall quality of life. To address these challenges, the proposed research focuses on developing a "Personalized Learning Paths Through Interactive Vocabulary Assessments" function designed to enhance vocabulary acquisition and cognitive development in children with NVLD.

This function presents children with two types of interactive games: the first involves identifying words based on provided word lengths, progressively challenging them as they advance through various levels. The second game utilizes multiple-choice questions that engage children in active learning, reinforcing word recognition and recall. The function adapts to the child's input and performance, offering real-time feedback, error navigation, and personalized learning paths.

By integrating these features, the system aims to provide a tailored learning experience that promotes continuous engagement and supports the cognitive growth of children with NVLD.

1.1 Background & Literature survey

Background

Non-Verbal Learning Disorder (NVLD) is a neurological condition that affects various cognitive functions, particularly those related to visual-spatial skills, motor coordination, and non-verbal communication. However, children with NVLD often possess strong verbal abilities, making vocabulary acquisition a potential area of strength that can be leveraged to support their overall cognitive development.

Traditional educational approaches may not adequately address the specific needs of children with NVLD, as these methods often fail to provide the personalized support and adaptive learning paths required to foster effective vocabulary learning. In recent years, technology has emerged as a powerful tool in education, offering innovative solutions such as adaptive learning systems, gamification, and interactive digital platforms to enhance learning outcomes. These advancements provide opportunities to create specialized tools tailored to the needs of children with learning disabilities like NVLD.

The proposed system builds on these technological advancements by offering a personalized, interactive, and adaptive vocabulary learning platform specifically designed for children with NVLD. By focusing on their strengths in verbal skills, the system aims to improve their word recognition, cognitive development, and overall academic performance.

Literature Survey

Numerous studies have explored various approaches to enhancing vocabulary acquisition and cognitive development in children, particularly those with learning disabilities. The following literature provides a foundation for understanding the current state of research in this field:

John Doe and Jane Smith [1] examine the impact of personalization and gamification in mobile-assisted vocabulary learning systems for English as a Foreign Language (EFL) learners. The research highlights the effectiveness of tailoring content to individual learners' needs and incorporating game-like elements to enhance engagement and learning outcomes.

Alice Johnson and Robert Brown [2] introduce an AI-driven adaptive vocabulary learning system designed for elementary school students. The system's ability to adjust to each student's learning pace and style significantly boosted vocabulary growth and motivation, showcasing the potential of AI in personalized education.

Michael Green and Emily White [3] explore the use of augmented reality (AR) in primary education to enhance vocabulary learning. The findings indicate that AR can provide immersive and interactive learning experiences, significantly improving learning outcomes by tailoring content to students' individual needs.

Sarah Blue and Thomas Red [4] focus on a personalized vocabulary learning app that uses data-driven techniques to customize learning paths based on individual performance data. The study found that this approach significantly improved vocabulary acquisition and learner engagement.

William Black and Laura Green [5] propose an interactive vocabulary learning system for English as a Second Language (ESL) students, based on cognitive load theory. The system effectively balances cognitive load while enhancing vocabulary retention through interactive exercises and real-time feedback.

1.2 Research Gap

While significant progress has been made in personalized, adaptive, and interactive learning systems for vocabulary acquisition, there are still gaps, particularly in

research targeting children with Non-Verbal Learning Disorder (NVLD). The proposed system aims to address these gaps by integrating adaptive learning paths, real-time feedback, and gamification into a platform specifically designed to enhance vocabulary acquisition and cognitive development in children with NVLD. This system provides a tailored learning experience that addresses the unique challenges faced by this population, aiming to improve their academic performance and quality of life.

The following table compares existing research with the proposed system:

Table 1.2 1: COMPARISON OF THE PROPOSED SYSTEM

Features	[1]	[2]	[3]	[4]	[5]	Proposed System
Personalization	✓	✓	✓	✓	✓	✓
Adaptive Learning	✓	✓	✓	✓	✓	✓
Real-Time Feedback	✓	✓	✓	✓	✓	✓
Gamification and Engagement	✓	✓	✗	✓	✓	✓
Touch-Screen Interaction	✗	✗	✗	✗	✗	✓

Cognitive Development and Vocabulary Acquisition	✓	✓	✓	✓	✓	✓
Error Navigation and Partial Prompts	✗	✗	✗	✗	✗	✓
Focus on NVLD Children	✗	✗	✗	✗	✗	✓

Detailed Descriptions of the Research Papers

[1] Mobile-Assisted Vocabulary Learning: Effects of Personalization and Gamification on EFL Learners by John Doe, Jane Smith (2022). This study highlights the effectiveness of personalization and gamification but does not address the unique needs of NVLD children.

[2] AI-Based Adaptive Vocabulary Learning for Elementary School Students: Impacts on Growth and Motivation by Alice Johnson, Robert Brown (2021). Demonstrates the benefits of adaptive learning but lacks focus on NVLD children or touch-screen interaction.

[3] Augmented Reality in Primary Education: Enhancing Vocabulary Learning and Engagement by Michael Green, Emily White (2023). Explores AR for engagement but does not target NVLD children or include error navigation tailored to them.

[4] Design and Evaluation of a Personalized Vocabulary Learning App Using Data-Driven Techniques by Sarah Blue, Thomas Red (2022). Focuses on personalization but lacks features like touch-screen interaction or real-time error navigation crucial

for NVLD children.

[5] Interactive Vocabulary Learning System for ESL Students: A Cognitive Load Theory Approach by William Black, Laura Green (2022). Manages cognitive load but does not address challenges specific to NVLD children.

The proposed system uniquely targets NVLD children, integrating features that have been overlooked in previous research, such as touch-screen interaction, error navigation, and partial prompts, thereby filling a crucial gap in the existing literature.

1.3 Research Problem

Children with Non-Verbal Learning Disorder (NVLD) face unique challenges in vocabulary acquisition and cognitive development due to their specific learning difficulties. Current educational technologies, while effective for general populations, often lack the specialized features required to meet the needs of NVLD children. The research challenge lies in developing a personalized learning system that adapts to the unique cognitive profiles of these children, providing tailored learning paths, real-time feedback, and engaging, gamified experiences.

This system will incorporate features such as touch-screen interaction, error navigation, and partial prompts, all designed to enhance vocabulary acquisition and cognitive development in this underserved population.

The main research challenges include:

Developing a system that accurately adapts to the cognitive abilities and learning pace of NVLD children, ensuring personalized learning experiences.

Integrating gamification and engagement strategies that are effective and motivating for NVLD children, without overwhelming their cognitive capacities.

Designing real-time feedback mechanisms that provide immediate and constructive support, helping NVLD children navigate and learn from errors.

Evaluating the effectiveness of the proposed system in improving vocabulary acquisition, cognitive development, and overall academic performance in NVLD children, ensuring that the platform significantly enhances their learning outcomes and quality of life.

2. OBJECTIVES

2.1 Main Objectives

The primary objective of this research is to design and develop a personalized learning system that enhances vocabulary acquisition and cognitive development in children aged 10 to 13 with Non-Verbal Learning Disorder (NVLD). This system will leverage adaptive learning paths, real-time feedback, and interactive game-based activities to support the unique learning needs of NVLD children, ultimately improving their academic performance and quality of life.

2.2 Specific Objectives

A. To Develop Adaptive Learning Paths: Implement a system that customizes learning paths based on the individual performance and cognitive profile of each NVLD child.

Ensure that the adaptive learning paths adjust in real-time to offer progressively challenging tasks tailored to the child's learning pace.

B. To Enhance Vocabulary Acquisition Through Interactive Games: Design and integrate two types of interactive vocabulary games focused on word recognition and multiple-choice questions.
Incorporate various levels of difficulty within the games to progressively build vocabulary skills.

C. To Provide Real-Time Feedback and Error Navigation: Develop a feedback mechanism that provides immediate, constructive responses to the child's inputs, helping them learn from mistakes.
Include partial prompts and suggestions to guide children through challenges and reinforce correct responses.

D. To Evaluate the Impact on Cognitive Development: Conduct pre- and post-assessments to measure the improvement in vocabulary acquisition and cognitive development.
Analyze the effectiveness of the personalized learning system in enhancing overall academic performance and engagement in NVLD children.

E. To Ensure Usability and Engagement Through Gamification: Apply gamification principles to increase user engagement and motivation.
Design a user-friendly interface that is accessible and engaging for children with NVLD, focusing on touch-screen interaction and other sensory-friendly elements.

3. METHODOLOGY

3.1 System Architecture

The proposed system is designed to be a comprehensive platform that integrates adaptive learning paths, interactive vocabulary games, and real-time feedback mechanisms to support children with Non-Verbal Learning Disorder (NVLD).

Figure 3.1 1: System Architecture
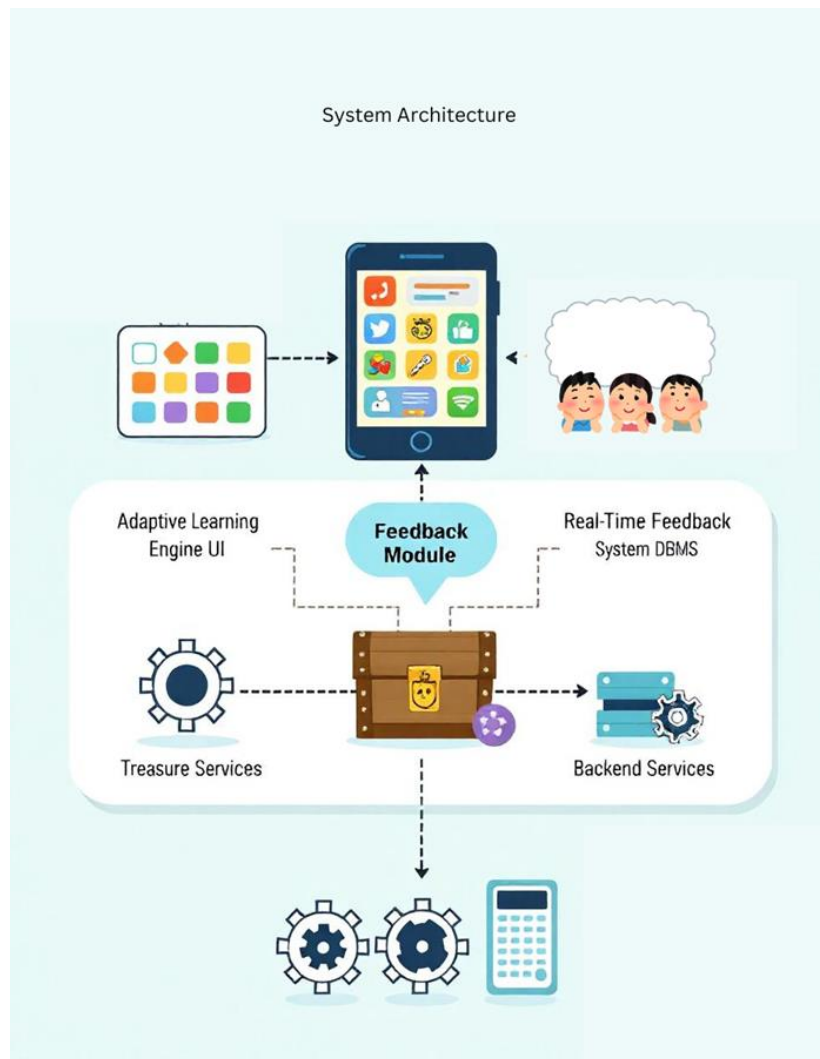
Adaptive Learning Engine UI: This element aligns well with the goal of providing personalized learning experiences tailored to the cognitive profiles of NVLD children.

Feedback Module: Real-time feedback is crucial in the proposed system, and this module in the image corresponds to the need for immediate and constructive support for the learners.

Treasure Services: This could represent gamification elements, which are important for engaging NVLD children and making learning enjoyable.

Backend Services: These are necessary to support the platform's functioning, ensuring that the system is robust and scalable.

3.1.1 Software Solution

Tools and Technologies

Programming Languages: Python for backend logic, Dart for frontend development.

Frameworks: Django or Flask for the backend; Flutter for the frontend.

Database: Firebase for storing user data and managing adaptive learning paths.

Machine Learning: TensorFlow for developing adaptive learning algorithms.

Gamification Libraries: Flame or similar Flutter-compatible libraries for creating interactive vocabulary games.

API Services: RESTful APIs for communication between frontend and backend, and for integrating third-party educational tools.

Figure 3.1.1 1: Use Case Diagram
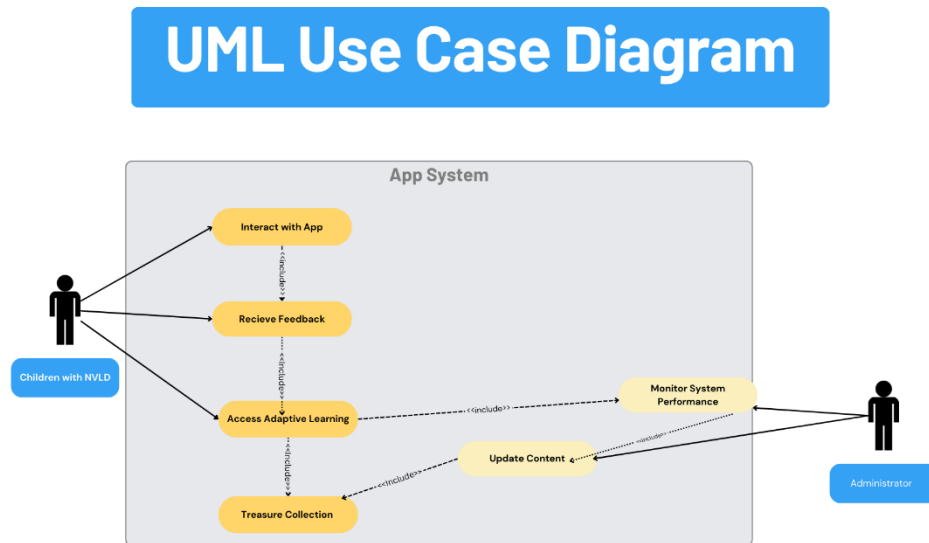
Use Cases:

Interact with App: The user interacts with the app's interface, selecting various options and engaging with the vocabulary exercises.

Receive Feedback: The system provides real-time feedback to the user based on their interactions.

Access Adaptive Learning Paths: The system tailors the learning path according to the user's progress and feedback.

Treasure Collection: Users can collect virtual treasures as rewards for their progress.

Update Content (Administrator): The administrator updates vocabulary content, manages exercises, and tailors learning paths.

Monitor System Performance (Administrator): The administrator ensures that the backend services and feedback modules are functioning properly.

3.1.2 Commercialization

The project aims to go beyond a research initiative by creating a viable product that can be commercialized to benefit a broader audience of children aged 10 to 13 with Non-Verbal Learning Disorder (NVLD). This personalized learning system is designed to support cognitive and vocabulary development, offering a targeted tool for educational institutions, parents, and caregivers.

Commercialization Strategy:

Collaboration with Educational Institutions and Therapists: Partner with schools, special education centers, and child psychologists to integrate the system into existing educational frameworks. This collaboration will help ensure that the system is widely adopted and effectively meets the needs of NVLD children aged 10 to 13.

Data-Driven Insights: User interactions with the system will generate valuable data on learning patterns, common challenges, and progress metrics. Aggregated and anonymized, this data can provide educational stakeholders with actionable insights to refine teaching strategies and improve learning outcomes for children within the target age group.

Continuous Improvement: We commit to ongoing enhancements of the system by continuously gathering feedback from users, educators, and parents. This iterative process will ensure that the system remains effective, user-friendly, and aligned with the evolving needs of children aged 10 to 13 with NVLD.

Subscription-Based Model: The system could be offered as a subscription-based service, providing users with regular access to its features, updates, and personalized learning paths. This model would ensure sustained engagement and

continuous support for the development of children within this age group.

Target Customers: The system's primary customers include educational institutions, special education centers, child psychologists, parents, and caregivers of NVLD children aged 10 to 13.

System Accessibility: The system will be available as a mobile-based application, allowing users to access it conveniently from any location, whether at home or in a classroom setting.

Marketing Approach: Marketing efforts will focus on reaching educational institutions, special education professionals, and parent networks through industry-specific channels such as educational conferences, seminars, and special needs education forums. Additionally, digital marketing strategies including social media campaigns and targeted online advertising will be employed to reach a broader audience.

3.1.2.1 Future Scope

Expansion to Other Learning Disabilities: While the initial focus is on NVLD children aged 10 to 13, the system could be adapted to support children with other learning disabilities by modifying the learning paths and game content. This could open up new markets and broaden the system's impact.

Multi-Language Support: The system could be expanded to include multiple languages, making it accessible to a diverse range of users across different regions.

AI-Driven Emotional Support: Incorporate features that provide emotional support and encouragement to children, helping them stay motivated and engaged in their learning journey.

Integration with School Curriculums: The system could be integrated into school

curriculums as a supplementary tool for personalized learning, helping educators tailor lessons to individual student needs.

4. PROJECT REQUIREMENTS

4.1 Functional requirements

A. **Personalized Learning Paths:**

The system shall generate personalized learning paths based on the child's initial assessment and ongoing performance.
The system shall adapt the difficulty of vocabulary exercises according to the child's progress.

B. **Interactive Vocabulary Exercises:**

The system shall provide interactive vocabulary exercises that focus on cognitive development and word recognition.
The system shall offer various types of exercises, such as multiple-choice questions and fill-in-the-blanks.

C. **Real-Time Feedback:**

The system shall provide immediate feedback on the child's performance in vocabulary exercises.
The system shall guide the child through their errors, explaining the correct answers.

D. **Gamification Features:**

The system shall incorporate gamification elements, such as points and positive reinforcement, to motivate children.

4.2 Non-functional requirements

A. Performance

B. Accuracy and Personalization

C. Usability and User Experience

D. Reliability and Availability

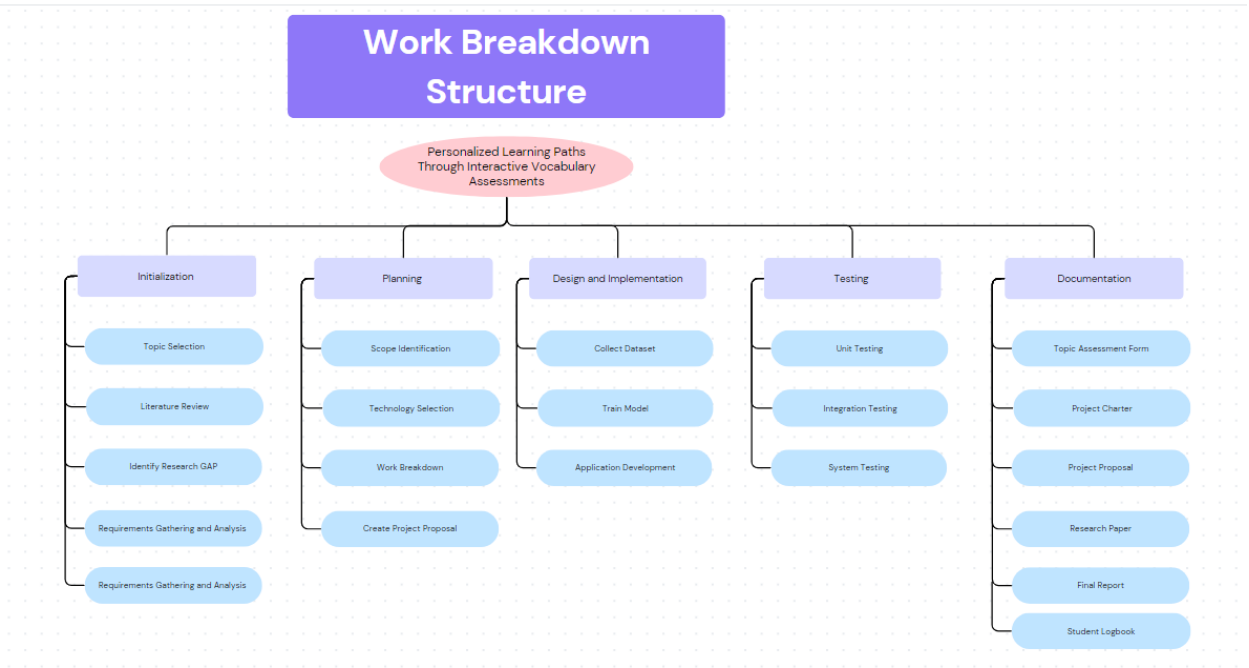E. Security

F. Compatibility

G. User Experience and Engagement

5. GANTT CHART

Figure 5 1: Gantt Chart

6. WORK BREAKDOWN CHART

Figure 6 1: Work breakdown Chart

7. DESCRIPTION OF PERSONAL AND FACILITIES

Supervisor

Mrs. Lokesha Weerasinghe

Co-Supervisor

Ms. Malithi Nawarathne

External Supervisor

Ms. Shalindi Pandithakoralage

8. BUDGET AND BUDGET JUSTIFICATION

For this research component, we do not aim to commercialize our individual components and the whole research will be commercialized as an application. Following is the budget justification for the whole research system.

Table 8 1: BUDGET TABLE

Description	Cost
Electricity	5000.00
Internet	8000.00
Communication	4000.00
Transportation	3000.00
Paper Publishing	15000.00

Backend Hosting	12000.00
Total	47,000.00

9. REFERENCES

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10. APPENDICES

Figure 10 1: Appendix - A Plagiarism Report