



AURIVA

Adaptive English Language Learning
Platform for Autistic Children in Sri Lanka



Adapting Autism Education



PROBLEM AND IMPACT



9,000

Identified Children with Autism Spectrum Disorder



23.5 %

Excluded From Mainstream Education



8.6 %

Schools Specialized For Disabled Children



<15 %

In Genuine Inclusive Educational Settings

English language acquisition is a core curriculum subject and ASD children receive no specialised support for it.

Traditional methods lack visual structure and adaptive scaffolding, leaving learners disengaged

Without progress data, schools cannot meet national inclusive education mandates or justify resource allocation

Teachers cannot monitor individual progress or personalise content across diverse cohorts

WHO IT AFFECTS

No adaptive, curriculum-aligned English learning modules suited to their cognitive profile



Cannot track individual progress or deliver differentiated content across diverse student cohorts

Lack of outcome data to demonstrate inclusive education compliance



Panel Guidance Received

Improvements Made

IT22084590

- Check with the real-time feedback from users

- Conducted sessions with autistic children at the special education school to evaluate the practicality and usability of the developed module, and implemented several improvements based on the recorded observations and feedback provided by the teachers.

IT22166838

- Add the backward navigation in order to track student progress
- Need to work on Sinhala audio input as well
- Have only used rule-based, but no ML model has been used
- Check with the voice commands accents to be used, as related to Sri Lankan context

- Sinhala visual and audio translations incorporated
- Phase-boundary backward navigation added across all three dialogue categories
- Hybrid trajectory model introduced - a Random Forest ML model with existing rule-based logic as a fallback.
- Speech assessment made accent-tolerant via phoneme-level fuzzy matching, with locale-correct Sri Lankan English/Sinhala voice output for place names.

IT22216700

- Check with the voice commands accents to be used, as related to Sri Lankan context

- Added clear voice instructions in both English and Sinhala, with UK-English pronunciation for letter and word audio to better suit the Sri Lankan context.

IT22266378

- Demonstrated practice words with voice and animations, and have a sufficient idea.

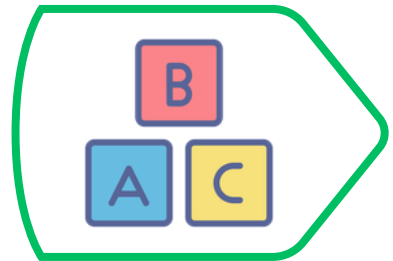
- Expanded the basic voice-and-animation demonstration into a complete pronunciation workflow.
- Added speech recording with MFCC-DTW and GOP phoneme-level assessment.
- Introduced weak-phoneme detection and adaptive practice activities.
- Added progress tracking, confidence scoring, and teacher review support.

RESEARCH GAP & OBJECTIVES

CORE PROBLEM



Children with ASD in Sri Lanka who experience difficulties in language comprehension and concept learning.



Traditional teaching methods lack visual structure and adaptive support needed for autistic learners.



Teachers manage multiple students with different learning needs without accessible tools to monitor progress or adapt lessons.

OBJECTIVES

- Build an adaptive dialogue module that takes autistic ESL learners from vocabulary recognition to real conversation, using mastery-gated progression and adaptive pacing, while remaining accessible to non-verbal learners
- Build an adaptive handwriting practice module that captures and analyzes stroke trajectories using DTW, provides personalized letter and word remediation, and gives teachers clear progress, mastery, and motor-pattern information.
- To provide autistic Grade 3 ESL learners with structured, sensory-aware pronunciation practice that assesses speech at the phoneme level, detects recurring weak sounds, and delivers personalized activities and word recommendations while allowing teachers to monitor progress.
- Build an adaptive concept learning module curating to the individual needs of autistic children in Sri Lanka, incorporating a GKB to record the interactions and record of each child and a GAT to understand their progress and what measures can be taken to improve their learning process.

SOLUTION OVERVIEW

Concept Learning

Graph Neural Network-driven Confusion Detection



- GNN over a knowledge base detects confusion nodes for individuals
- GAT learns complex relationships between learners and concepts to support personalized learning
- LLM converts model inferences into plain-language insights for educators

Dialogue Module

Mastery-Gated Dialogue with Tolerant Speech Assessment



- Machine learning classification with explainability (SHAP).
- Hybrid ML and rule-based fallback architecture.
- Speech processing with fuzzy/phoneme-level string matching
- Microservices architecture: Python/Flask microservice for ML inference and phoneme scoring

Handwriting Learning

Motor-informed Adaptive Letter Sequencing



- X-Y-time handwriting trajectories analysed using DTW and motor features
- Rule-based 3-attempt progression with remediation and mastery checks
- K-Means used for exploratory motor-pattern analysis

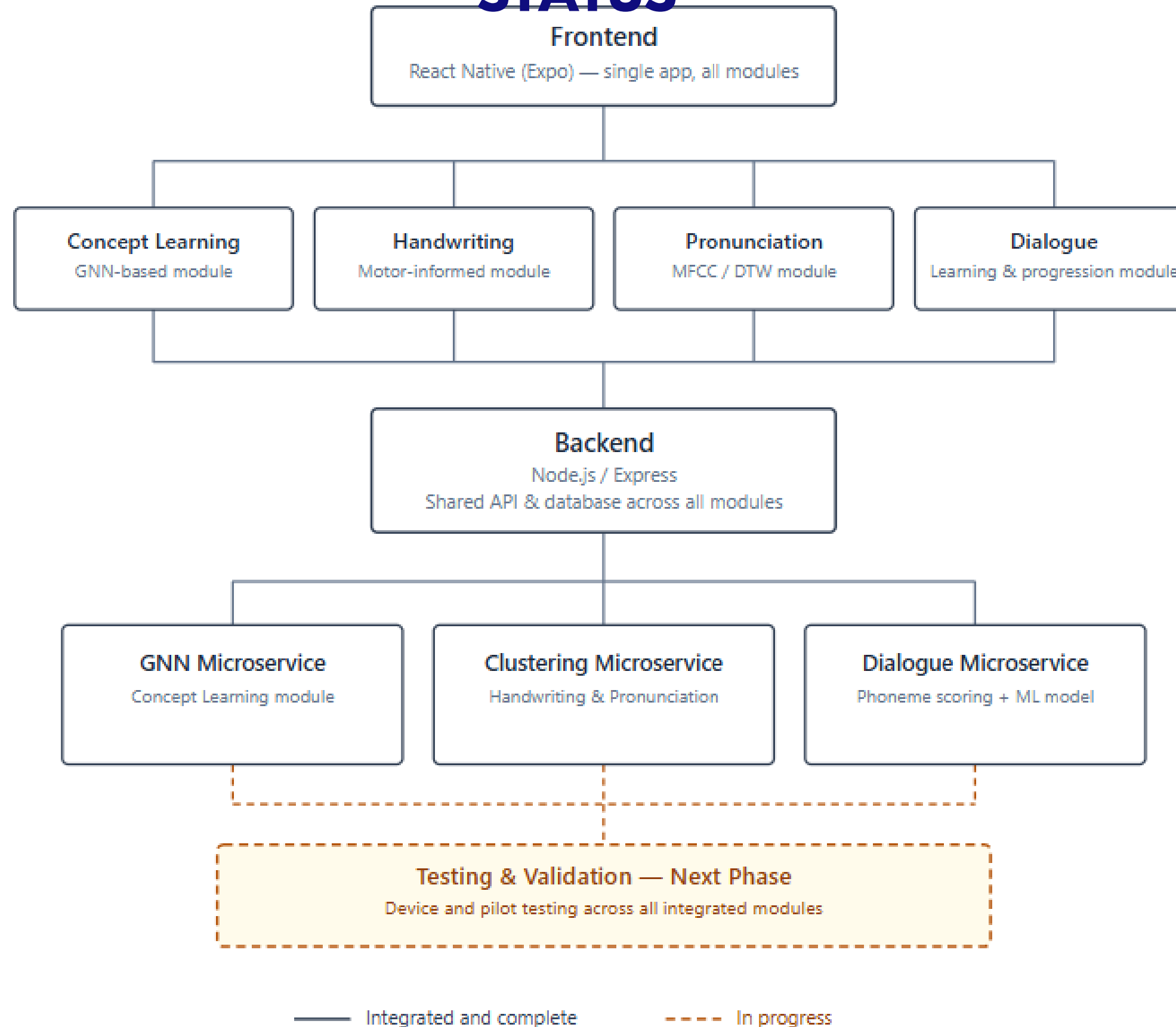
Pronunciation Support

Phoneme-aware Adaptive Remediation



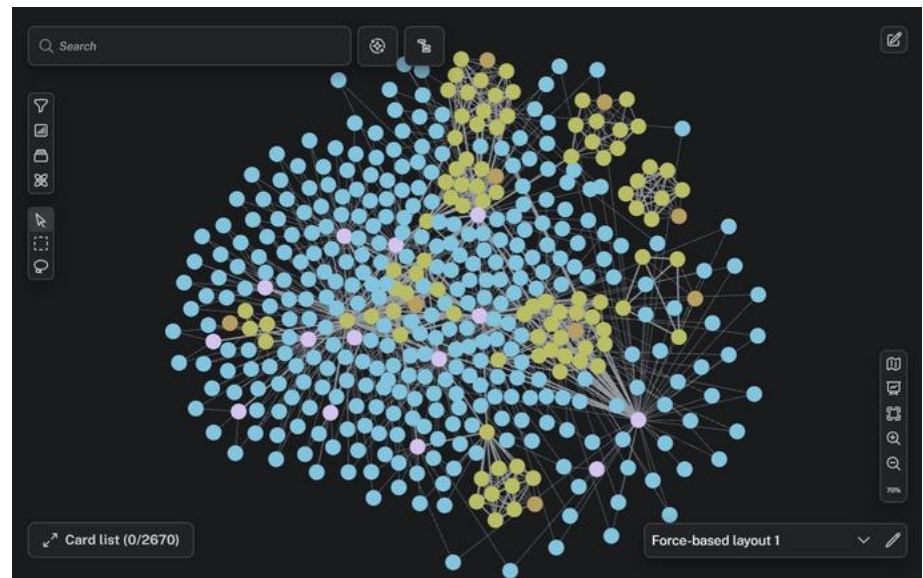
- MFCC-DTW and wav2vec2 GOP score pronunciation by phoneme.
- Recurring weak phonemes trigger targeted listening and sound-focused remediation activities.
- Learner performance, phoneme history, and difficulty guide adaptive next-word recommendations.

INTEGRATION & COMPLETION STATUS



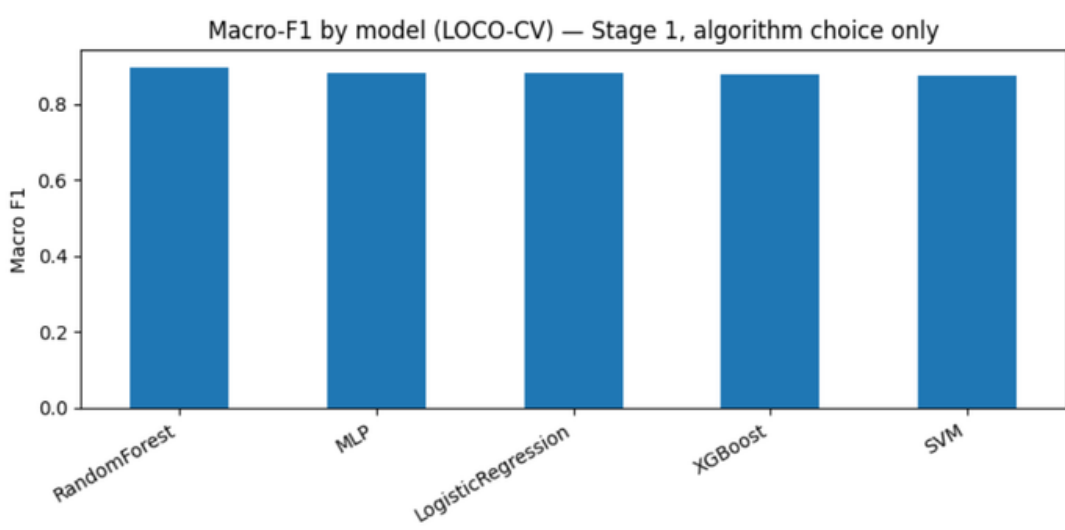
EVALUATION EVIDENCE

Concept Learning



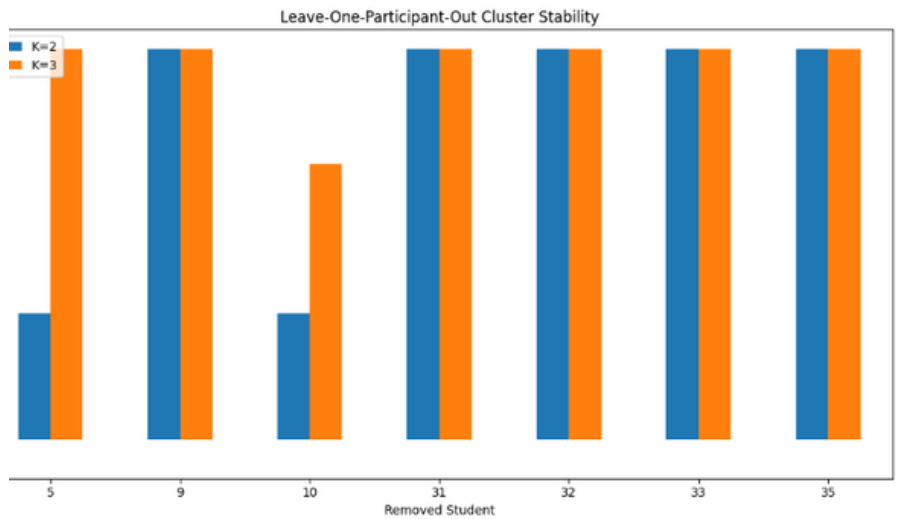
- Graph Knowledge Base that records all the interactions on of the child as nodes and edges, marking the edges as confusions, incorrect attempts and correct attempts, which is later used for the GAT

Dialogue Module



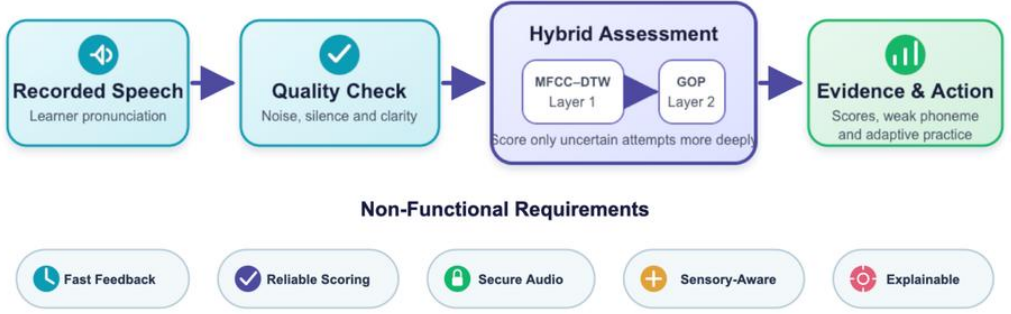
- Real pilot-data ML accuracy, broken down by subset (full vs. verbal-only)
- Explainability layer verified with a 6,482-payload sweep
- Jest unit/integration tests passing per component

Handwriting Learning



- Evaluated using real handwriting and motor data
- Verified DTW, Motor Score, clustering, and adaptive rules
- Tested frontend, backend, and ML reliability

Pronunciation Support



Pronunciation accuracy was validated using audio-quality testing, MFCC-DTW similarity, wav2vec2 GOP scoring, and phoneme-error detection, while ensuring fast feedback, sensory-aware interaction, secure audio handling, reliable scoring, and clear progress insights for teachers.

NON FUNCTIONAL REQUIREMENTS

SECURITY

WT auth on all routes, bcrypt password hashing, tokens in device SecureStore

Role-based access (principal/teacher) + per-student ownership checks

Helmet headers, CORS, rate limiting, file upload restrictions (type + 5 MB)

Children's audio and personal data never logged or echoed back; TLS to database

RELIABILITY

Server survives uncaught errors; no session-wide crashes

Safe retries (reads only), offline finalize queue, 15 s timeouts

Graceful degradation when ML scoring fails - never a fabricated result

USABILITY

20-minute session limit with a calm break prompt at safe transitions

Landscape lock for writing, portrait for reports

Child-friendly typography and consistent teacher wording

Clear, plain-language error and toast messages

PERFORMANCE

5-second live-session polling sized for a full classroom on one IP

DB timeouts tuned to stay under the mobile scoring limit

MAINTAINABILITY

Layered architecture, Swagger API docs, DB migrations, structured logging

Extensive automated test suite (backend + frontend)

ADAPTIVE ENGLISH LANGUAGE LEARNING PLATFORM FOR AUTISTIC CHILDREN IN SRI LANKA

CUSTOMER PERSONA

Autistic Child

ASD Learner (Estimated age between 5-15)

Challenges

- Limited verbal and non-verbal communication
- English as a second language
- Difficulty with abstract or unsupported instruction
- Fine motor difficulties with handwriting

Learning Needs

- Structued, visual and repetitive content
- Clear feedback and consistent pacing
- Non-verbal participation pathway when needed

Special Educator

Special Education Teacher (Estimated age between 21-60)

Challenges

- No data driven tools to track individual progress
- Difficult to identify specific learning gaps manually
- Needs curriculum-aligned, ready to use content

Goals

- Monitor each child's scores and trends at a glance
- Identify which children need additional support
- Deliver structured lessons without technical expertise

MARKET SIZE

27

Special Education Schools

704

Special Education Institutes

REVENUE MODEL

Freemium Trail

Free Trial - to evaluate before committment

Tier I - Up to 30 students

Small Special Education Units

Tier II - 30 – 120 students

Mid-Scale Schools, Larger Special Education Units