Telangana AI Rising Grand Challenge

Adoption of AI-Based Draw-and-Learn tool for Vocabulary Development in School Students

Introduction

Early vocabulary development is integral to a child's cognitive growth, literacy, and overall academic performance. To engage students deeply, enhance interaction and conceptual understanding as per the National Education Policy (NEP) 2020 guidelines—which emphasize competency-based education and technological integration, there is a need for interactive, creative, and inclusive learning experiences.

Challenges Identified

1. **Limited Engagement in Traditional Vocabulary Learning**
   Reliance on memorization without creative or visual reinforcement often leads to poor retention.

2. **Lack of multilingual Learning Support**
   Many digital learning solutions remain monolingual, overlooking linguistic diversity.

3. **Lack of AI-Enabled Personalized Feedback**
   Traditional classroom settings cannot always offer individualized, real-time responses.

4. **Infrastructure & Accessibility Barriers**
   Large class sizes, limited Tablet / Mobile, and inconsistent connectivity in some areas.

Proposed Technological Solutions

1. **AI-Powered Drawing Recognition Engine**
   a. **Machine Learning Model**: Trained in extensive datasets of hand-drawn images.

    b. **Automated Word Association**: Once the AI recognizes the sketch, it displays the corresponding word(s).

    c. **Confidence-Based Feedback**: If confidence is low, the system should ask for teacher/student clarification or suggest likely alternatives.

2. **Multilingual Language Support & Speech Integration**
   a. **Multi-Language Display**: Students can see and learn words in English, and Telugu side by side.
   b. **Audio Pronunciation**: Integrated text-to-speech helps improve spoken language skills, especially beneficial for early learners or second-language learners.

3. **Enhanced Drawing Interactions**
   a. **Color-Fill Feature**:
      i. Students can fill areas of their sketches with color to better distinguish visually similar objects (e.g., oranges vs. tomatoes).
      ii. The AI detects boundaries; if a shape is incomplete, the color fill is contained within the nearest enclosed region to avoid spilling outside.
   b. **Complete-the-Drawing Tasks**:
      i. Students are given partial outlines (e.g., just the legs of a table) and must complete the figure.
      ii. The model identifies partial shapes and checks whether the learner's additions match the intended object, reinforcing both creativity and recognition

4. **Gamified Learning Experience**
   a. **Points & Badges**: Students earn rewards as they master vocabulary.
   b. **AI-Based Hints**: Clues or prompts encourage better drawing techniques and reinforce correct word usage.

5. **Offline Functionality with Cloud-Based Sync**
   a. **Local Queueing**: In low-connectivity environments, drawings and usage data are stored on the device. Once online, they sync to the cloud for AI processing and progress tracking.
   b. **Cloud Storage**: Centralized data helps teachers and administrators monitor performance across classes and schools.

6. **Self-Learning, Reinforcement-Based Model**
   a. **Reinforcement Learning**: Every teacher's real-time feedback (e.g., confirming or correcting the AI's guess) feeds back into the model, incrementally improving accuracy.
   b. **Continuous Retraining**: The system regularly incorporates new drawings—both student-generated and teacher-provided reference samples—allowing it to become more robust and context-aware over time.

Proposed Methodology

1. **AI Model Development & Continuous Training**
   a. **Initial Training**: Models are built using existing datasets of hand-drawn images spanning common vocabulary items.
   b. **Daily Teacher Contributions**: Each teacher is prompted to provide a set of *correct reference drawings* (e.g., "draw an apple, a car, a dog") to enrich the model's dataset.
   c. **Reinforcement Learning Loop**:

        i. Real-time teacher feedback - "Yes, that's correct" or "No, that's incorrect"- is captured and used to fine-tune the model.

        ii. Periodic retraining ensures the AI stays up to date with evolving drawing styles and language usage patterns.

2. **Data Collection & Curation by Startups**
   a. **Student Sketches**: Startups gather hand-drawn images from diverse age groups, capturing different artistic styles.
   b. **Teacher Reference Samples**: Teachers' daily/weekly contributions act as a high-quality baseline, ensuring the model learns from consistent, clearly labeled examples.
   c. **Labeling & Tagging**: Each drawing is tagged with relevant metadata (language labels, object type, partial/complete, color fill, etc.)
   d. **Ethical Practices**: All data is anonymized and collected with appropriate consent, ensuring privacy and compliance with education policies.

3. **Pilot Deployment in Selected Telangana Schools**
   a. **User Flow Trials**:
      i. **Direct Tablet / Mobile Drawing** in classes that have enough devices.
      ii. **Paper Drawing + Teacher Upload** in settings with limited Tablet / Mobile.
   b. **Performance Measurement**: Evaluate accuracy, speed, student engagement, and teacher satisfaction. Feedback here also influences the AI model's next iterations.

4. **Integration & Large-Scale Implementation**
   a. **Alignment with Existing Platforms**: Wherever feasible, integrate with pre-existing digital learning systems in Telangana government schools.
   b. **Teacher Training & Portal**: Provide a simple interface for teachers to:
      i. Upload reference drawings, manage word lists, and track class progress.
      ii. Provide corrections or confirmations in real time, feeding the model's reinforcement loop.
   c. **Scalability**: Leverage cloud-based architecture to handle high volumes of data and inference requests.

5. **Monitoring & Continuous Improvement**
   a. **Key Learning Metrics**: Track vocabulary retention, number of successfully recognized drawings, and average response times.
   b. **Recurrent AI Model Updates**: Incorporate newly collected drawings and teacher feedback.
   c. **Collaborative Feedback Loops**: Ongoing input from educators, linguistic experts, and local communities to refine word sets, translations, and detection accuracy.

Regulatory & Ethical Considerations

1. **Data Privacy & Security**
   a. **Secure Storage**: Student drawings and personal data must be stored in compliance with data protection regulations.
   b. **Anonymization**: Strong protocols to decouple personal identifiers from stored drawings.
2. **Equitable Access**

      a. **Offline Compatibility**: Ensures no student is disadvantaged by connectivity issues.

      b. **Low Hardware Requirements**: Model inference primarily done via cloud to accommodate older or shared devices.

3. **Bias Mitigation**

      a. **Diverse Dataset**: Include drawings across different demographics, cultural contexts, and age groups to avoid skewed recognition.

      b. **Language Neutrality**: Balanced training in English and Telugu to ensure uniform performance across languages.

4. **Inappropriate Content Guardrails**

      a. Implement filters to detect or block offensive sketches or words.

      b. Provide the teacher with an override mechanism for any false positives or missed content.

5. **Teacher-Centric Reinforcement**

      a. **Empowering Educators**: Teachers' expertise is crucial to guide and correct AI predictions.

      b. **Ethical Use of Feedback**: All teacher-provided inputs and reference drawings should be used solely for educational and model-improvement purposes, respecting teacher and student rights.