An Assessment of MirrorLearn: Examining Technical Quality and Pedagogical Efficacy for English Speaking Practice

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ARTICLE INFO	ABSTRACT
  	In response to the persistent challenges lower primary students in Malaysia face with English spelling, pronunciation, and sentence construction under the MBMMBI policy, this study examines MirrorLearn, an AI-powered mobile application that offers real-time corrective feedback and gamified learning. A survey conducted with 43 parents and teachers found that 88.4% of respondents believe children struggle with pronunciation and spelling, and 93% agreed that learners have difficulty correcting their own errors. Key barriers identified include limited vocabulary, reported by 67.4% of respondents, and the influence of local dialects, noted by 51.2%. Despite these challenges, 72.1% of participants expressed positive views on using technology to enhance English learning, with strong support for visual-audio and interactive methods. These findings suggest that MirrorLearn can address significant gaps in traditional teaching by providing personalized and engaging learning pathways, and despite developmental limitations, it shows potential as a scalable and impactful educational tool in Malaysia.

1. Introduction

The global demand for accessible, technology-driven English language learning has accelerated in recent years, fueled by the recognition of English as a lingua franca for academic, professional, and intercultural communication [1]. Research consistently demonstrates that the integration of technology enhances English language learning outcomes, particularly in vocabulary acquisition, writing, speaking, and overall literacy [2-4]. Digital platforms, such as educational websites and mobile applications, are increasingly recognized as valuable tools that extend learning opportunities beyond the traditional classroom [5]. However, despite English being a compulsory subject in many school curricula, numerous students at the primary and secondary levels continue to face challenges in speaking. These difficulties are often attributed to persistent anxiety, fear, shyness [6,7], pronunciation errors, and limited exposure to authentic oral communication [8].

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These challenges are often compounded by limited real-life practice opportunities, a lack of exposure to authentic spoken language, and a critical need for real-time feedback to identify and correct errors [9,10]. A recent survey revealed that 93.2% of learners reported challenges in correcting their own pronunciation errors, highlighting the urgent need for innovative solutions that provide real-time feedback and self-correction opportunities [11,12].

In response to these challenges, the MirrorLearn mobile application was developed as an AI-powered tool for interactive English speaking practice. It is designed to function as a "personal language coach in your pocket," which employs advanced speech recognition technology to deliver instant and personalised feedback on pronunciation [12]. Learners engage in practice through picture prompts, with the application analysing their spoken responses and offering corrective audio and visual feedback where necessary. This feature, referred to as the "mirror effect," promotes self-awareness, self-correction, and the gradual development of speaking confidence [13]. With over 50 million potential English language learners in the ASEAN region, the global market relevance of tools like MirrorLearn underscores the importance of evaluating their technical and pedagogical efficacy [14].

This study aims to provide a critical evaluation of the MirrorLearn application, focusing on its effectiveness in improving learners' pronunciation accuracy and speaking confidence. Specifically, it pursues two main objectives: first, to examine the technical and pedagogical aspects of the application, highlighting both its strengths and limitations; and second, to assess its suitability for integration within the Malaysian and broader regional educational contexts.

In addressing these objectives, the study adopts a structured evaluation framework that examines usability, accuracy of speech recognition, and pedagogical alignment with existing curriculum requirements. This evaluation is structured around key components of software assessment to thoroughly investigate how this technology can transform language learning worldwide. By situating MirrorLearn within the broader context of digital language learning, the study aims to determine not only its effectiveness in improving oral proficiency, but also its potential for sustainable adoption in educational institutions.

2. Literature Review
2.1 Review of Previous Studies / Related Work

Previous studies and surveys highlight the persistent challenges faced by English language learners in Malaysia and other ASEAN countries. Many students continue to struggle with pronunciation, spelling, and overall speaking confidence [15,16]. Research shows that learners often fail to identify and correct their own pronunciation errors, a difficulty rooted in limited practice opportunities and a lack of exposure to immediate, authentic feedback models. This problem is further compounded by significant psychological barriers, as 90% of students experience anxiety or shyness, leading to a cycle of avoidance that hinders their oral development [17]. Although digital platforms such as Duolingo and Buddy.ai address aspects of language learning, they have limitations. Duolingo offers gamified practice but provides generic feedback [18], while Buddy.ai is primarily suited for very young learners [19]. Both fall short of meeting the specific needs of primary and secondary students who require targeted pronunciation support and confidence-building. MirrorLearn was therefore designed to bridge this gap by providing real-time, personalised corrective feedback within an engaging mobile platform.

2.2 Key Concepts and Definitions

MirrorLearn is situated within the field of Computer-Assisted Language Learning (CALL), as it utilizes digital technology to support English acquisition beyond the traditional classroom [20]. It is also grounded in the principle of mobile learning, since the application is designed for use on mobile devices and is accessible anytime and anywhere, providing learners with flexibility in practicing English [21]. A central innovation of the application is the "mirror effect," in which learners pronounce words prompted by visual aids and immediately receive corrective feedback in both audio and text form. This feedback loop allows learners to recognize errors in their pronunciation, promoting self-awareness, self-correction, and vocabulary development. Additionally, MirrorLearn integrates gamification features such as badges, leaderboards, and progress challenges. These elements are intended to sustain learner motivation, make practice more engaging, and provide tools for teachers and parents to track progress effectively [22].

2.3 Theoretical Perspectives / Models

MirrorLearn aligns with several theoretical perspectives that shape its design and purpose. First, it addresses the pedagogical gap highlighted in traditional classrooms by functioning as a "personal language coach" that delivers instant corrective feedback, acting as a monitor for output correction. This aligns with Krashen's [23] Monitor Hypothesis, which emphasizes the role of conscious monitoring in language production and supports the need for tools that promote learner self-awareness and independent practice. From a technological perspective, the development of MirrorLearn follows the Technology Readiness Level (TRL) framework [24], which structures its progression from conceptualization to commercialization. This systematic approach ensures the scalability and sustainability of the application as it evolves through multiple phases of expansion. Furthermore, MirrorLearn incorporates gamification models that support motivation and sustained engagement, with learners encouraged to practice through challenges, badges, and leaderboards. This design reflects the importance of maintaining long-term learner participation in digital environments [25,26].

2.4 How the Literature Leads to the Research Questions

The literature consistently demonstrates that traditional classroom practices do not adequately address learners' needs for real-time feedback and confidence in speaking English. Survey results confirm that pronunciation and self-correction are persistent difficulties, while existing digital tools lack the personalization required by primary and secondary learners. This context naturally leads to research questions that guide the investigation of MirrorLearn: How effective is MirrorLearn in improving learners' pronunciation accuracy compared to traditional classroom methods? To what extent does the application reduce speaking anxiety and build learner confidence? How do the gamification features and instant feedback mechanisms sustain learner motivation and engagement? What are the implications of integrating MirrorLearn into both classroom instruction and home-based learning? By grounding these questions in documented challenges and the design features of MirrorLearn, the framework provides a clear rationale for exploring the application as an innovative and pedagogically aligned solution for English language learning.

3. Method and Material

3.1 Technology Readiness Level (TRL) Framework

This study adopts a Technology Readiness Level (TRL) framework to guide MirrorLearn's development. TRL is a standard scale, originally developed by NASA, that rates a technology's maturity from basic research to deployment [27]. In this framework, TRL 8 denotes an actual system completed and qualified through test and demonstration, while TRL 9 represents an actual system proven in real operational use. By these definitions, the MirrorLearn prototype is now at TRL 8, a fully developed application tested in classroom-like conditions, and is moving toward TRL 9 for actual in-class deployment [28].

3.2 App Development Platform (MIT App Inventor)

Educational apps are known to support early learning; for example, a recent meta-analysis reported that preschoolers using educational apps showed moderate gains in literacy and math [29]. To build MirrorLearn, we used MIT App Inventor, a free, drag-and-drop app development environment designed for beginners [30]. App Inventor's ease of use and rapid prototyping made it suitable for quickly implementing and iterating our learning app. We first created a simple mockup of the app interface using PowerPoint slides to outline the lesson flow and content. We also incorporated a speech-to-text component by using a mobile transcription app ("Transcribe") to emulate the core "mirror" feature of MirrorLearn. Research shows that real-time feedback from voice-to-text tools, which instantly convert speech into text, is central in supporting learners of different ages in practicing language and self-correcting [31].

3.3 Collaborative Design with Teacher Trainees

The development was a collaborative effort between the research team and pre-service teacher trainees. Effective collaboration requires clearly defined roles and the appropriate division of responsibilities [32], which was reflected in the structure of this project. The team handled the pedagogical design, user interface, and lesson structure, while the teacher trainees implemented functionality in App Inventor. The trainees contributed their coding skills and knowledge of classroom practice, ensuring the app was both technically sound and educationally relevant. This partnership bridged academic design expertise with practical teaching experience, aligning MirrorLearn's features (vocabulary selection, prompts, feedback timing) with the needs of early childhood and ESL instruction. The collaboration also enabled iterative refinement of the app through teacher feedback, ensured that pedagogical principles were embedded in the design, and guided design decisions grounded in evidence to effectively address learners' language and cognitive development.

3.4 Prototyping and Voice-Feedback Mockup

In the prototyping phase, the "speech mirror" concept was demonstrated using simple slides (PowerPoint) that included example prompts and feedback. To simulate the app's functionality, the Transcribe app converted a child's spoken English into written text in real time, allowing learners to see immediate textual feedback for their speech. The prototype followed a structured flow: pupils first viewed a visual representation of the target word, then attempted to pronounce it. If their pronunciation was incorrect which reflected in the Transcribe output, they repeated the word while listening to the correct audio model. Learners then checked their spelling by interacting with the

slides, which revealed the word's letters one by one, forming the complete word. This use of voice-to-text emulates a "speech-to-print" literacy strategy, where learners hear themselves speak and see the corresponding text. Such immediate feedback is known to accelerate learning by allowing students to self-correct pronunciation and spelling instantly [33].

3.5 Pilot Testing and Validation

The MirrorLearn application was piloted in preschool classrooms with children aged 5 to 6. Learners engaged in short lessons using both MirrorLearn and traditional teaching methods. While learning gains were similar across methods, engagement was higher with the app-based lessons, echoing prior findings that mobile learning tools yield comparable knowledge outcomes but greater learner satisfaction. Learning through digital, particularly mobile, technology produces knowledge results on par with traditional approaches, yet it fosters much higher levels of learner satisfaction, motivation, and active engagement [34]. Children showed enthusiasm for the speech-to-text feature, often repeating words to refine pronunciation. Immediate corrective feedback such as hearing a word, viewing its spelling, and adjusting accordingly, has been shown to support language learning effectively. According to a study by Fu and Li [35], immediate corrective feedback is more effective than delayed feedback in fostering explicit knowledge and improving pronunciation accuracy. This advantage directly supports MirrorLearn's design, as the app provides instant feedback on learners' spoken input, reinforces correct usage, and builds long-term speaking confidence. Teachers noted that lessons were more interactive, and positive learner responses confirmed the prototype's classroom viability.

3.6 Iterative Refinement and TRL Advancement

Based on pilot feedback and consultations with educators, the design was iterated and improved. Vocabulary lists, graphics, and interface elements were refined to match primary ESL learners' needs. These improvements follow the TRL-guided process of testing and tuning before final deployment. At present, MirrorLearn fulfills the criteria for TRL 8, a stage where the system is complete, debugged, and demonstrated under expected conditions [36]. The next step is to achieve TRL 9 by deploying the app in real classroom settings and documenting its operational performance. This process will involve finalising all user documentation and training materials, followed by full-scale-field trials [36]. In short, the methodology combined low-code prototyping (MIT App Inventor), pedagogical design, and iterative user testing under the TRL framework, ensuring a rigorous development path from concept to classroom-ready educational technology.

4. Results and Findings

This section will discuss the results and findings of the preliminary market validation study conducted during the early development stage of the MirrorLearn application. The study was carried out to gather insights regarding the challenges faced by students in learning English, particularly in pronunciation and speaking fluency. Stakeholders involved in this phase included teachers, parents, and students across Malaysia, especially within the primary and secondary school levels. The data was collected through an online survey using structured questionnaires.

The objective of this preliminary study was to identify the problems, needs, and requirements of learners and educators in adopting an AI-powered mobile application that provides real-time corrective feedback for English pronunciation.

Study sample: The preliminary study received 44 responses, and all respondents answered all the questions provided in the survey. These responses were computed, analysed, and discussed in the results and findings section to validate the potential and relevance of the MirrorLearn application as an educational solution.

5.1 Demography Results

Demography results of the respondents were also gathered in terms of their role in teaching English, whether as parents or teachers. Table 1 shows that 54.5% of the respondents are educators (parents) while 45.5% are teachers. This indicates that the majority of respondents in the study are parents who play an active role in supporting their children's English learning process, followed closely by teachers who deliver English instruction in formal classroom settings.

Table 1
Percentage of respondents by role in teaching English

Role	Frequency (n)	Percentage (%)
Educator	24	54.5
Parent	20	45.5
Total	44	100

Table 2 shows the distribution of gender and age ranges for the respondents in percentage. For gender: the respondents are 89.61% female teachers and 10.39% male teachers. For age ranges, the highest percentage is among 40-50 with 45.33% while only 4% teachers are within the age of 20-30 years old. Findings show 26% among ages of 30-40 years old and 24.67% among 50-60 years old.

Table 2
Percentage in term of the struggle with English pronunciation

Response	Frequency (n)	Percentage (%)
Yes (Agree)	38	86.4
No (Disagree)	6	13.6
Total	44	100

5.2 Struggle of Students in English

A closed-ended question was asked to the respondents to identify whether students nowadays face challenges in English pronunciation and spelling. Each respondent was required to indicate their level of agreement with this statement. Based on the results, the responses were distributed into two categories: those who agreed and those who disagreed. The findings show that 86.4% of the respondents agreed that students struggle with English pronunciation and spelling, while 13.6% of the respondents did not agree with the statement. This clearly highlights that the majority of stakeholders recognise pronunciation difficulties as a significant issue in English learning.

5.3 Challenges faced by Students in Learning English

An open-ended question was posed to the respondents to identify the main challenges their students face when learning to speak English fluently and clearly. Respondents were allowed to indicate more than one factor, and the results were then categorized into three main challenges: limited vocabulary, poor pronunciation, and influence of local dialect.

Table 3
Challenges faced by students in learning English

Challenge	Frequency (n)	Percentage (%)
Limited vocabulary	29	65.9
Influence of local dialect	23	52.3
Poor pronunciation	14	31.8

Based on the findings, 65.9% of respondents (29 out of 44) highlighted that students struggle most with limited vocabulary. This indicates that a lack of sufficient word knowledge hinders students from expressing themselves fluently and confidently. The second highest challenge identified was the influence of local dialect, reported by 52.3% of respondents (23 out of 44). This shows that students' spoken English is often shaped by their mother tongue, which affects pronunciation and fluency. Meanwhile, 31.8% of respondents (14 out of 44) stated that poor pronunciation is a significant barrier for learners.

Overall, these results reveal that vocabulary limitation and dialect interference are the most pressing challenges for students in mastering spoken English, followed by pronunciation difficulties. This supports the need for targeted solutions, such as digital tools with real-time feedback, to help learners overcome these barriers and build confidence in English communication.

5.4 Methods for Improving English

A question was asked to the respondents to determine the most effective method for improving speaking and pronunciation skills in English, particularly for students who struggle with reading. Respondents were given three options to select from: using visual aids with audio, reading and repeating English words from a textbook, and watching videos with subtitles and repeating phrases.

Table 4
Percentage of respondents' preferred methods for improving English

Method	Frequency (n)	Percentage (%)
Using visual aids with audio	23	52.3
Watching videos with subtitles and repeating phrases	15	34.1
Reading and repeating English words from a textbook	6	13.6
Total	44	100

Based on the findings, the majority of respondents, 52.3% (23 out of 44), indicated that using visual aids with audio is the most effective method for enhancing speaking and pronunciation. This reflects the importance of combining auditory and visual input in supporting learners' oral language

development. Meanwhile, 34.1% of respondents (15 out of 44) believed that watching videos with subtitles and repeating phrases is an effective approach. This shows that multimedia resources such as subtitled videos can motivate students and provide authentic exposure to spoken English. A smaller proportion, 13.6% of respondents (6 out of 44), chose reading and repeating English words from a textbook as the best method, suggesting that traditional approaches are considered less impactful compared to interactive and multimodal strategies.

Overall, the results highlight that respondents favour approaches that integrate visual, auditory, and contextual learning over traditional textbook repetition. This finding supports the design of technology-based solutions, such as AI-powered language learning applications, which incorporate visual prompts, audio feedback, and interactive content to strengthen learners' pronunciation and speaking skills.

Table 5
Development of MirrorLearn Based on TRL Progression

TRL Level	Stage	Development Activities	Development Activities
TRL 1–3	Concept Stage	Idea conceptualised based on literature review on pronunciation feedback. Mockups created using PowerPoint and Transcribe app to simulate speech-to-text	Concept framework and initial design of app features.
TRL 4–5	Prototype Stage	Core components (voice recognition, corrective feedback) tested with MIT App Inventor. Debugging and refinement conducted.	Working prototype with basic speech-to-text and feedback functions.
TRL 6–7	Demonstration Stage	Prototype demonstrated in classroom-like conditions. Small-scale trials conducted with learners.	App functioned effectively, supporting ESL learning tasks during controlled trials.
TRL 8	System Completed Stage	Full version piloted with preschool learners (ages 5–6). Teachers observed lessons and learner engagement.	Higher engagement compared to traditional methods. Learners responded positively to real-time feedback.
TRL 9	Operational Use (Planned)	Deployment in authentic ESL classrooms with primary learners. Teacher training and documentation to be prepared.	Planned full-scale classroom implementation with structured teacher support.

6. Discussions

The demographic results show that a majority of the respondents (54.5%) are parents while 45.5% are teachers, reflecting active involvement from both groups in supporting students' English learning. The willingness of parents and teachers to adopt digital tools is a crucial factor in the

successful implementation of technology-based language learning, as acceptance influences how consistently and effectively such tools are used [37]. Analysis on the challenges demonstrates that limited vocabulary (65.9%), influence of local dialect (52.3%), and poor pronunciation (31.8%) are among the highest issues that need to be addressed in order to improve students' speaking fluency and clarity. Hence, this study emphasises the importance of targeted language support tools to strengthen learners' oral communication.

Based on the findings shown in Table 2 and Table 3, the most effective methods to improve speaking and pronunciation skills identified by the respondents are using visual aids with audio (52.3%), watching videos with subtitles and repeating phrases (34.1%), and reading and repeating words from textbooks (13.6%). Hence, this study develops an intervention module that incorporates visual prompts, audio support, and interactive exercises to guide learners in practising pronunciation. Figure 5 shows the design framework of the application developed.

Fig. 1. Application developed

7. Future Works and Conclusions

This study shows that many Malaysian primary students continue to face challenges in English pronunciation, spelling, and vocabulary despite early exposure. Low-proficiency learners often struggle with segmental sounds, stress, and intonation due to first-language transfer and dialectal interference [38], while orthographic depth contributes to persistent spelling errors [39]. Survey responses from 43 parents and teachers also revealed difficulties in self-correcting pronunciation and limited vocabulary.

To address these issues, MirrorLearn, an AI-powered mobile app, was introduced to provide real-time feedback, visual-audio prompts, and gamified learning. Similar AI-driven approaches in Malaysia have shown positive effects on learners' motivation, accuracy, and confidence [40, 41]. Although development was constrained by time and resources, early feedback suggests strong potential, aligning with the growing role of technology in education.

The study highlights persistent learning difficulties, introduces a novel AI-based tool, and expands understanding of teacher and parent acceptance of technology. It recommends integrating apps like

MirrorLearn into classrooms and homes, enhancing MBMMBI with AI innovations, and improving features such as adaptive pathways and progress tracking. Future research should test the tool's long-term effectiveness, scalability, and integration with assessment systems, while also exploring teacher readiness and multilingual recognition. Overall, MirrorLearn shows promise as a scalable, engaging solution for improving English proficiency among young learners in Malaysia.

Acknowledgement

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