Fostering Students' Autonomous Learning English Pronunciation Using Mobile-Based Artificial Intelligence[1]

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Abstract

This study explores the potential of ELSA (English Language Speech Assistant), a mobile-based artificial intelligence application, to support English pronunciation development among university students in self-directed learning contexts. Using a one-group pre-test post-test experimental design, we recruited 28 second-year university students (mixed gender) who had previously completed a pronunciation practice course. Participants engaged with ELSA's AI-powered pronunciation features throughout the intervention period. Pre-test and post-test assessments were administered to examine changes in pronunciation proficiency, with data analyzed using paired-sample t-tests. Results revealed a substantial increase in mean pronunciation scores from 55.54 (SD = 13.077) to 80.18 (SD = 10.583) following the intervention ($t(27) = -15.36$, $p < 0.001$, Cohen's $d = 2.90$). These findings illustrate ELSA's practical utility in supporting autonomous pronunciation improvement among university learners. The application's accessibility, immediate feedback mechanisms, and self-paced learning structure demonstrate its viability as a supplementary tool in English language instruction. The observed gains highlight the usefulness of mobile-based AI applications in addressing pronunciation development needs within higher education contexts. Future research could explore sustained engagement patterns with ELSA, identify which specific features contribute most to learning outcomes, and examine its applicability across diverse proficiency levels and learning environments.

Keywords: ELSA; Mobile-Based AI; Pronunciation Development; Self-Directed Learning; Practical Utility.

1 This article is the result of students learning experience using ELSA's AI to improve English pronunciation collaboration between King Saud University and La Tansa Mashiro University.

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Fomento de la pronunciación inglesa en el aprendizaje autónomo de los estudiantes mediante inteligencia artificial basada en dispositivos móviles

Resumen

Este estudio explora el potencial de ELSA (English Language Speech Assistant), una aplicación de inteligencia artificial móvil, para apoyar el desarrollo de la pronunciación en inglés entre estudiantes universitarios en aprendizaje autodirigido. Mediante un diseño experimental con pretest y postest, 28 estudiantes universitarios de segundo año utilizaron las funciones de pronunciación de ELSA durante el período de intervención. Los resultados revelaron un aumento en las puntuaciones medias de pronunciación, de 55.54 (DE = 13.077) a 80.18 (DE = 10.583) ($t(27) = -15.36$, $p < 0.001$, d de Cohen = 2.90). Estos hallazgos muestran la utilidad práctica de ELSA para apoyar la mejora autónoma de la pronunciación. La accesibilidad de la aplicación, su retroalimentación inmediata y su estructura autodidacta demuestran su viabilidad como herramienta complementaria en la enseñanza del inglés. Las mejoras observadas destacan la utilidad de las aplicaciones móviles basadas en IA para abordar necesidades de pronunciación en educación superior. Investigaciones futuras podrían explorar patrones de uso sostenido, identificar funciones específicas más contributivas y examinar su aplicabilidad en distintos niveles de competencia y entornos educativos.

Palabras clave: ELSA; inteligencia artificial móvil; desarrollo de la pronunciación; aprendizaje autodirigido; utilidad práctica.

Introduction

Pronunciation is crucial in English language teaching, influencing intelligibility alongside grammar and vocabulary. Ghafar (2023) suggests focusing on communication patterns rather than just phonetic elements, which will help make their instructions easier to understand for all types of learners. Algethami and Kamli (2025) stress that teaching pronunciation requires planning, appropriate techniques, and technological support to foster student independence. This highlights the need for pedagogical expertise and tools that promote learner autonomy. According to Jamila and Zubairi (2022) and Jennings (2023), students should take responsibility for their learning to develop independence. Incorporating technology like speech recognition software and AI-based apps allows for personalized practice (Dai and Wu, 2021; Evers and Chen, 2020; Liu et al., 2025). Studies explore how Automatic Speech Recognition (ASR) can support Foreign Language learning through immediate feedback (Bashori et al., 2020; 2022; 2024). ASR systems like My Pronunciation Coach (Cucchiarini et al., 2012), I Love Indonesia (Bashori et al., 2024), GREET (Penning de Vries et al., 2020), Rosetta Stone (), Elsa Speak (), Speechace (), and English Central () provide valuable feedback, even if not 100% accurate, enhancing pronunciation after short practice (Li and Ning, 2025; Liu et al., 2025). Technology-enhanced learning has been utilized in pronunciation instruction, particularly for speech development (Pham and Pham, 2025; Yenkimaleki et al., 2021). Recent research from several non-native English countries indicates that students often experience anxiety and difficulties with English pronunciation (Bui et al., 2025; Hoang, 2025; Li et al., 2025). In Indonesia, many learners struggle with consonant sound pairs like /ŋ/ and /n/, which are often mispronounced due to their absence in Sundanese (Muntasir et al., 2025; Rosswanna et al., 2025). Despite the importance of pronunciation, many Indonesian classrooms face challenges in pronunciation instruction, partly due to limited opportunities for autonomous learning, which may affect students' readiness for self-directed activities (Alisoy, 2025; Darcy et al., 2020). These issues are particularly significant in Indonesia, where English is a foreign language for most students, highlighting the need for innovative approaches to enhance pronunciation skills. This study aims to examine how mobile-based artificial intelligence can help Indonesian university students improve their English pronunciation during independent learning. It utilizes automatic speech recognition (ASR) from the affordable ELSA application, facilitating autonomous learning via smartphones. This study explores how mobile-based AI applications can support English Language Learners (ELLs) in developing their pronunciation skills. Despite the importance of pronunciation in language teaching, the impact of AI-based tools on Indonesian ELLs remains under-researched, indicating a necessary gap to address.

Accordingly, the primary purpose of this study is to highlight the usability of a mobile-based artificial intelligence application (ELSA) in supporting English pronunciation development within an autonomous learning context. Rather than examining students' subjective learning experiences or autonomous behaviors in isolation, this study focuses on how ELSA's core features such as automatic speech recognition, immediate corrective feedback, native-speaker modeling, and self-paced practice function as practical and accessible support mechanisms for pronunciation learning among Indonesian university students.

Literature Review

The Role of Pronunciation in EFL Teaching and Learning

Pronunciation instruction is a crucial aspect of EFL teaching, directly impacting learners' communication skills. In many EFL contexts, explicit pronunciation instruction, when combined with other language skills, can enhance learners' comprehensibility and confidence (Celce-Murcia, Brinton, & Goodwin, 2010). However, it is often underemphasized due to teacher confidence issues and insufficient training. Mora and Mora-Plaza (2023) advocate for integrating pronunciation instruction with communicative language teaching, suggesting that task-based pronunciation teaching could bridge this gap by combining structured tasks with individualized feedback. This highlights the need for innovative resources to support both teachers and learners in developing pronunciation skills.

Intelligibility vs. Native-like Pronunciation: Goals and Challenges

There is ongoing debate in English language teaching regarding whether pronunciation instruction should aim for native-like accuracy or intelligibility. Many researchers argue that intelligibility, being understood by listeners, is a more realistic goal for most learners, especially in international contexts where English serves as a lingua franca (Levis, 2005; Levis, 2022). English is spoken in various dialects, and communication does not require a native-like accent (Matsuda & Matsuda, 2010).

The discussion around the Intelligibility and Nativeness Principles has gained attention as global communication expands. The Intelligibility Principle prioritizes being understood overachieving a native-like accent, which is often unrealistic for many learners (Levis, 2022). Recent studies indicate a shift toward prioritizing intelligibility, evident in China's curriculum changes away from traditional native-like ideals (Wang & Wen, 2023). Scholars warn that the Nativeness Principle can create unnecessary pressure, leading to anxiety and inhibiting authentic language use (Kouam, 2024). Research shows consensus among educators that intelligibility should be the primary goal of pronunciation instruction, while exposure to native input remains beneficial (Algethami & Kamli, 2025). Similar trends are noted in Europe, where English as a lingua franca emphasizes clarity over accent mimicry (Tergujeff, 2022).

In EFL contexts like Indonesia, this distinction has significant implications. Intelligibility enables learners to communicate in diverse international settings, while striving for native-like pronunciation may cause frustration and undermine confidence. A balanced pedagogical approach is necessary, one that prioritizes intelligibility as the main goal while acknowledging learners' aspirations for native-like speech, guiding them toward achievable and contextually relevant pronunciation targets. This perspective aligns with current debates and situates pronunciation goals within a framework of equity and realistic outcomes in English language learning.

Teaching Challenges and Strategies: The Role of Non-Native Teachers and Noticing

In addition to setting appropriate goals for pronunciation instruction, the role of non-native English teachers and autonomous learning strategies are crucial. Research indicates that non-native teachers face unique challenges but also provide valuable insights and empathy (Sifakis & Sougari, 2005). Noticing is a meta-cognitive strategy where learners identify gaps between their pronunciation and the target, helping transform explicit knowledge into implicit knowledge (Ögeyik, 2017; Véliz-Campos, 2018). Methods like the Noticing-Reformulation Task (NRT) can help students recognize and correct their mistakes, leading to clearer speech (Mallapiang, 2015). As teachers and learners seek ways to improve pronunciation, technology presents new opportunities for both classroom and autonomous learning.

Technology and Autonomous Learning in Pronunciation Development

The process of learning pronunciation relies on students' ability to self-regulate and compare their results with other EFL speakers. Thus, educational strategies that promote autonomous learning warrant exploration. Jamila and Zubairi (2022) note that fostering learner autonomy leads to more reflective activities, enhanced awareness, and independent thinking (Stringer, 2024).

The rapid advancement of technology, particularly artificial intelligence, has transformed language education. AI-powered applications and computer-assisted pronunciation training (CAPT) systems provide personalized, self-paced practice and instant feedback, which are key features for pronunciation development (Stockwell, 2013; Ahmadi, 2018). These tools enhance learner motivation and engagement while fostering autonomy, allowing students to take control of their learning (Saran, Seferoglu, & Cagiltay, 2012). Research indicates that such systems significantly improve pronunciation accuracy and communicative competence (Wang and Munro, 2004). In EFL contexts, where classroom time and teacher expertise may be limited, these technologies provide valuable support for both teachers and learners.

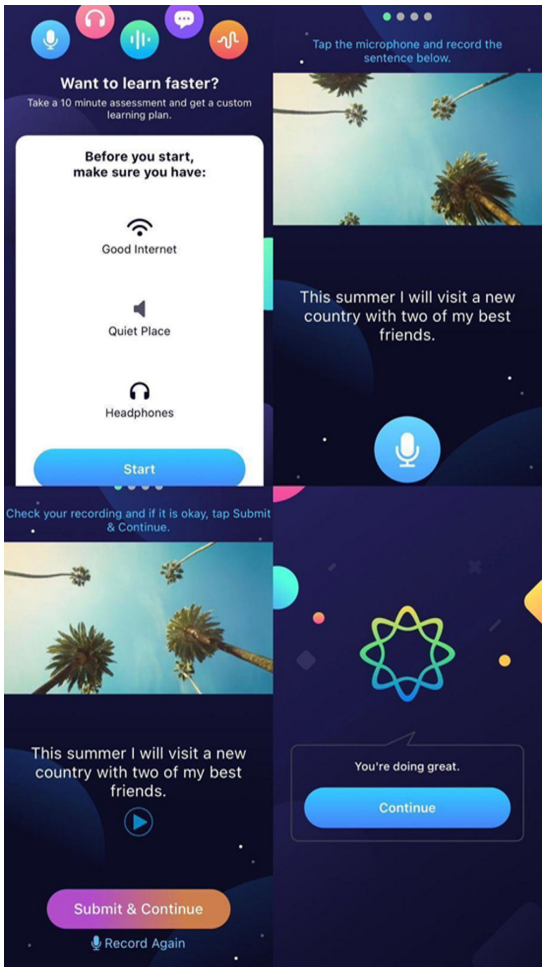
Ghafar (2023) identifies inconsistent instructional approaches as a key challenge in learning pronunciation. Consistent AI tools can address this and enhance self-control in autonomous settings. Kholis & Salamanja (2023) note that autonomous learning involves cognitive and metacognitive resources that shape educational activities. Yoshida (2018) stresses the importance of user-friendly technology tools for pronunciation teaching, highlighting the

need for immediate feedback and practice opportunities. Additionally, teachers play a crucial role in guiding students in using these resources.

ELSA Speak Application

The ELSA Speak application helps students identify pronunciation mistakes and promotes autonomous learning (Pham and Pham, 2025; Simanjuntak et al., 2023). This AI-powered app uses speech recognition technology to support English pronunciation and is compatible with Android and iOS devices, requiring a paid account for full access. It features various activities for different skill levels and topics, allowing users to learn anytime with an internet connection (Juhasz, 2025). Users can listen to pronunciation models, practice words, sentences, or dialogues, record their speech, and receive immediate feedback with personalized suggestions and progress reports (Wei, 2025). This study utilized the ELSA AI pronunciation test, a modified read-aloud test assessed via the app's scoring feature. Students select a pronunciation level, beginner, intermediate, advanced, or native, before testing, which is divided into several questions requiring voice recordings (Baldissera & Tumolo, 2020).

Figure 1. *Assessment test score in ELSA Application.*



Source: Authors' screenshot captured directly from the ELSA Speak application during the research procedure (2024). No generative AI was used to create or modify the screenshot.

In ELSA Speak, students can re-record their voice if unsure about a sentence by selecting the "Record Again" icon or choose "Submit & Continue" if they feel confident (see Figure 1). After completing the test, ELSA provides

an evaluation and score. This study employs a technology-based evaluation using Assistant Speech Recognition (ASR) on ELSA AI. According to Perez (2025), ELSA's speech recognition system assesses users' pronunciation by comparing it to native speakers, helping students identify weaknesses and make immediate adjustments. To receive feedback, students must read predefined sentences. The app then uses the ASR feature to provide a score and evaluation, with pronunciation scored on a percentage scale (0%-100%) compared to native speakers (Baldissera & Tumolo, 2020).

Figure 2. *ELSA Evaluation Score.*

Source: Authors' screenshot captured directly from the ELSA Speak application during the research procedure (2024). No generative AI was used to create or modify the screenshot.

Figure 2 shows that a lower intermediate score of 65% indicates students frequently confuse or mispronounce certain vowels (e.g., /i, I/, /e, ex/, /a: a/) and consonants (e.g., /f, h/, /t, d/, /k, g/), leading to miscommunication. Their fluency is primarily syllable-timed, with occasional stress-timing, and sentence stress is often misplaced, causing confusion. While rising and falling intonation patterns are sometimes used correctly, they frequently hinder understanding. Students receive feedback highlighting evaluated sounds in green, yellow, or red based on accuracy (see Figure 3).

Figure 3. *Pronunciation Evaluation Feedback Provided by the ELSA Speak Application.*

Source: Authors' screenshot captured directly from the ELSA Speak application during the research procedure (2024). No generative AI was used to create or modify the screenshot.

AI resources are accessible to learners worldwide, enabling equal benefits regardless of location. These tools facilitate faster progress in pronunciation compared to traditional methods. Huang, Zhang, and Zhang (2023) explore various AI-assisted learning platforms that provide personalized experiences and feedback. Their findings highlight reported benefits such as learning outcomes, motivation for learning a second language (L2), and self-regulated learning practices, including students' ability to set goals, track progress, and adapt strategies.

Research Design

This study investigated the application of mobile-based AI to enhance students' English pronunciation skills in an autonomous learning context. A quantitative one-group pre-test and post-test experimental design was employed to examine measurable changes in pronunciation performance following repeated use of the ELSA mobile-based AI application. This design was selected to evaluate the functional effectiveness and usability of ELSA in supporting pronunciation development rather than to explore learners' perceptions in depth.

Participants

The study involved 28 second-year university students enrolled in an English language program in Indonesia. Each participant had at least six years of English study, qualifying them as intermediate learners per university placement tests. The group comprised fifteen male and thirteen female students. Before the intervention, a preliminary survey was conducted to assess their prior experience with AI technologies in education. This online survey, administered via Google Forms, included five multiple-choice and short-answer questions about familiarity, usage frequency, and

confidence in using AI tools for language learning. Results indicated that most students had limited exposure to AI in education, with few expressing confidences in using these technologies to support their English learning.

Study Focus

This study examined the usability of a mobile-based AI application in supporting English pronunciation learning during autonomous practice. ELSA's speech recognition, feedback system, native-speaker models, and flexible smartphone access were evaluated based on students' pronunciation score improvements from pre-test to post-test consisting of three stages:

1. Applying the experimental session.

2. Conducting a pre-test to assess the dependent variable.

3. Performing a post-test to evaluate the dependent variable again.

English pronunciation assessments and field notes documented the influence of mobile-based AI.

The pronunciation test featured 10 sentences related to students' hobbies and was designed to assess their pronunciation over 35 minutes, aiming to evaluate their mastery progression. Students articulated sentences recorded with the speech analyzer function of ELSA AI, providing immediate feedback. Field notes documented the use of mobile-based AI throughout the process. Pre-test results established a baseline for students' proficiency in English pronunciation prior to the intervention, with progress observed over six sessions. A post-test will be administered following the treatment described in the methods section. Data from this test will be collected through observation to assess the outcomes of each intervention.

Following data collection, the researchers employed SPSS 29 to analyze the data and ascertain the efficacy of the session based on competency scores established at the university level. The data analysis method used was hypothesis testing. If the p-value is below 0.05 ($\alpha = 0.05$, 95% confidence level) and the computed t-value exceeds the critical t-value, the null hypothesis (H_0) is rejected in favor of the alternative hypothesis (H_a). This indicates a statistically significant positive impact of mobile-based AI instruction on students' English pronunciation competency.

A normality test is conducted to assess data distribution, using the Shapiro-Wilk test (Sugiyono, 2019). Homogeneity testing is essential in statistical research to ensure that data stems from populations with uniform variance. Nuryadi et al. (2017) noted that the homogeneity test confirms whether two or more sample data sets originate from populations with the same variance.

Findings

Validity and Reliability Test

The calculations aimed to check the validity and reliability of the pronunciation test questions were initially elucidated. The researcher chose 10 sentences regarding students' hobbies, all of which demonstrated strong validity based on the validity test findings. Table 1 displays the validity scores computed using SPSS 29.

The validation results of the sentences utilized in the English pronunciation test, as shown in Table 1, demonstrated that sentences 1 through 10 were valid since the Corrected Item-Total Correlation exceeded the r-table value of 0.396.

Furthermore, when the validity procedure is assessed, the reliability of the valid test is reviewed as a part of the calculations. The ten sentences were deemed credible if the Cronbach's Alpha value was above 0.60. The subsequent outcome was derived from the reliability analysis conducted using SPSS version 29.

Table 1. *Result of the Valid Test.*

	Item-Total Statistics			
	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Sentences 1	52.52	105.427	0.741	0.919
Sentences 2	52.96	108.457	0.626	0.924
Sentences 3	53.36	99.157	0.738	0.919
Sentences 4	53.20	101.250	0.748	0.918
Sentences 5	53.68	100.643	0.637	0.926
Sentences 6	53.40	103.500	0.793	0.916
Sentences 7	53.16	103.140	0.720	0.919
Sentences 8	53.64	103.823	0.719	0.919
Sentences 9	53.84	100.473	0.833	0.913
Sentences 10	53.04	107.790	0.687	0.921

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

Table 2. *Results of the Reliability Test*

Reliability Statistics	
Cronbach's Alpha	**N of Items**
0.927	10

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

The reliability calculation generated a result of 0.927, exceeding the minimum value of 0.60. This indicated that the 10 sentences were reliable, as shown in the data section in Table 2. Consequently, based on the validity and reliability findings, all ten sentences were approved to be valid and reliable as a part of the English speech assessment for the research participants.

Pre-Test

The pre-test was administered by the researchers on Wednesday, 3 July 2024, to 28 second-year university students. It aimed to assess students' baseline English pronunciation skills before the intervention. The assessment consisted of a pronunciation test with 10 sentences based on students' hobbies, designed to evaluate various pronunciation features such as stress, intonation, and individual sounds. The total duration of the test was 35 minutes. The session was held in a computer laboratory, where each participant was provided with a desktop computer and a headset with a microphone for high-quality audio recording. Before the test, students received a brief orientation from the researchers, explaining the test objectives, procedures, and instructions on using the ELSA Speak application, the AI tool for pronunciation test. Students logged in with their individual accounts and completed the read-aloud tasks provided within the app. Researchers were present to provide technical support and ensure the smooth administration. All students completed the pre-test, and the results are displayed in Table 3.

he students' scores are presented in Table 4. A total of 28 students registered for the pre-test, consisting of 15 male and 13 female participants. The subsequent data were utilized in SPSS 29 to compute the mean, minimum, maximum, and standard deviation.

Table 3. *The Result of Pre-test.*

No	Reg No	Gender	Score
1	22421002	M	40
2	22421003	M	30
3	22421004	M	45
4	22421005	M	40
5	22421006	M	45
6	22421007	M	45
7	22421008	M	50
8	22421009	M	70
9	22421010	M	55
10	22421011	M	60
11	22421012	M	60
12	22421013	M	50
13	22421014	M	60
14	22421016	M	75
15	22421017	M	70
16	20421018	F	45
17	22421019	F	55
18	22421020	F	90
19	22421021	F	60
20	20421022	F	50
21	22421023	F	60
22	22421024	F	60
23	22421025	F	55
24	22421027	F	55
25	22421028	F	55
26	22421029	F	40
27	22421030	F	80
28	22421031	F	55

Source: Authors' research data collected during the pre-test.

Table 4. *Descriptive Statistics of Pre-Test.*

Descriptive Statistics						
	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Pre-Test	28	30	90	1555	55.54	13.077

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

The pre-test score totaled 1,555, with a mean of 55.54. The maximum pre-test score was 90, while the minimum was 30. The researcher found that 17 pupils had bad scores, 9 students were at a fair level, 1 student was in a good position, and 1 had an excellent position. According to the pre-test score statistics, the English pronunciation proficiency of nearly all students remained comparatively low.

Intervention

The intervention was divided into six sessions. Students used the mobile-based ELSA AI feature for English pronunciation enhancement and data analysis to improve their mastery of pronunciation.

Students practiced a set of ten sentences related to hobbies, including:

- "I am learning psychology."
- "He has a unique pseudonym."
- "I am going to an island."
- "The girl is truculent in the classroom."
- "She loves him sincerely."

Each session focused on different aspects of pronunciation:

Session 1: Students listened to native speaker models of the sentences and repeated them, focusing on overall pronunciation and rhythm.

Session 2: Students used the ELSA app's dictionary feature to practice pronouncing difficult words, recording their attempts and reflecting on challenges.

Session 3: The focus shifted to vowel sounds. Students used the "learning set" feature in ELSA to practice vowels and then read the sentences aloud, concentrating on accurate vowel pronunciation.

Session 4: Students practiced reading their own sentences, with the ELSA app highlighting specific words and awarding points for correct pronunciation, emphasizing intonation and stress patterns.

Session 5: The "Speech Analyzer" tool in ELSA provided detailed feedback on pronunciation, identifying mispronounced words and offering a percentage score comparing their speech to a native speaker's model.

Session 6: Students worked in pairs using the speech analyzer to demonstrate their proficiency, receiving feedback from peers and the teacher to build confidence and encourage collaborative learning.

After each session, students recorded their pronunciation scores and feedback from the ELSA app in a table. This process helped them track words or sounds they struggled with, allowing them to focus on improving those areas in future practice.

The Treatment Session

The treatment sessions were conducted six times between July 10 and 19, 2024, during regular pronunciation classes at the university. These sessions aimed to enhance students' understanding of pronunciation and promote independent learning through the ELSA Speak application. Each session guided students through various pronunciation activities, fostering autonomy.

At the start of each session, researchers provided clear explanations and step-by-step instructions for the tasks. To encourage confidence and self-reliance, students used their smartphones and compatible headphones for clear audio during speaking and listening tasks, simulating real-world, self-directed learning environments. At the end of the treatment period, an evaluation was conducted to gather student feedback on the learning experience and assess their perceptions of the treatment's usability.

The first session occurred on Wednesday, July 10, 2024. The instructor directed the students to select a difficult word to say within ten sentences about their hobbies and to write why the chosen word was difficult to pronounce on the data table. Students then used the dictionary tool to hear native speakers pronounce English terms. All sessions

were conducted face-to-face to assess students' abilities. In this session, students learned the pronunciation of English words by listening to native speakers' voices in ELSA.

On Thursday, July 11, 2024, the second session was administered. The instructor informed the students that the objective was to practice English pronunciation via ELSA. The students were invited to use the ELSA application and began practicing with the "Dictionary" feature. The students were instructed to record their voices while articulating words from the tabulated information (see Table 5). The session required students to practice English vocabulary pronunciation using ELSA dictionary tool.

Table 5. *English Pronunciation Assessment.*

No	Sentences	Category	Score	Error	Vowels	Consonants
1.	I am learning psychology /ɑɪ æm lɛːrniŋ saɪ'kalədʒi/	Almost Correct	72 (Score obtained from ELSA)	1. learning /lɛːrni/ 2. psychology /seɪ'kələdi/	2. ɑ	ŋ, dʒ
2.	He has a unique pseudonym /Hi hæz ə ju'nik sudənɪm/	Almost Correct	70 (Score obtained from ELSA)	1. unique /ju'nɪk/ 2. pseudony m /sɛdɪnəm/	1. i 2. u, ə, ɪ	
3.	I am going to an island /ɑɪ æm goʊ.iŋ tə ən ɑɪlənd/	Excellent	83 (Score obtained from ELSA)	1. to /t/ 2. island /ɑɪlən/	ə	2. d
4.	The girl truculent in the classroom /ðʌ gɛːrl trʌkjələnt in ðʌ klæsrʊm/	Excellent	88 (Score obtained from ELSA)	1. girl /gɛːr/ 2. truculent /trʌkələnt/ 3. classroom /klæsrʊm/	3. ʊ	1. l 2. j, k
5.	She loves him sincerly /ʃi lʌvz hɪm sɪn'sərli/	Excellent	97 (Score obtained from ELSA)	1. sincerly /sɪn'sərli/		3. ʃ

Source: Adapted from Simanjuntak et al. (2023) and supplemented with authors' research data obtained through the ELSA Speak application.

The third session was conducted on Friday, July 12, 2024. The instructor directed the students to use the "learning set feature" to accurately pronounce vowels read words from hobby materials created by the students. As a result, students began to acquire English pronunciation like native speakers' accents, reducing challenges caused by their mother tongue The instructor provided feedback on English pronunciation sentences using the data tabulation sheet.

Table 6. *Example of ELSA Application Sentence with Bolded Words and Points.*

Sentence	Bolded Word(s)	Student Pronunciation Score	Points Earned
I am learning psychology.	psychology	85%	10
He has a unique pseudonym.	pseudonym	90%	10
I am going to an island.	island	80%	8
The girl is truculent in the classroom.	truculent	75%	7
She loves him sincerely.	sincerely	95%	10

Source: Authors' research data based on pronunciation scores generated by the ELSA Speak application during the intervention.

The fourth session was administered on Wednesday, July 17, 2024. Its purpose was to instruct students to read words from sentences they had composed earlier and record their voices using the study set feature. In the ELSA application, certain words are bolded, and students earned points for each bolded word. The outcome indicated that

the students could concentrate on the smallest phonetic elements of English, enabling them to articulate sentences with proper intonation. The points accumulated by students were incorporated into the data tabulation.

The fifth session was organized on Thursday, July 18, 2024. Its objective was to utilize the "Speech Analyzer" tool on ELSA AI to enhance confidence and proficiency in clear English communication. After using the Speech Analyzer, students received pronunciation evaluations from ELSA AI, which included identified mispronunciations and a percentage score indicating their speech performance compared to that of a native speaker. The outcome was that students could identify the elements contributing to their pronunciation errors in English.

The sixth session was conducted on Friday, July 19, 2024. In this concluding exercise, the instructor explained the principles of selecting peers for a practice session using the speech analyzer to demonstrate their proficiency in articulating the English sentences they had constructed in previous sessions. After completing a conversation exercise themed on hobbies, the teacher provided feedback in a tabulated format. As a result, this sixth session provided students with opportunities to practice articulating themselves clearly and accurately in English in front of their peers. The outcomes of the analyzed six sessions using the ELSA application can be encapsulated as follows: auditory exposure to AI imitating native speech, acquisition of proper intonation in word pronunciation, mastery of English pronunciation with a native accent, articulation of vowels, understanding the origins of errors in English pronunciation, and confident pronunciation of sentences in English. Students engaged with mobile-based ELSA AI throughout all six sessions, with varying activities from the first to the final session.

Post-Test

After the treatment period, a post-test was administered on July 24, 2024, to evaluate students' progress and determine final pronunciation scores. The same group of 28 second-year university students who completed the pre-test participated. To ensure valid comparison, the post-test followed the same procedures and format as the pre-test. Students used the ELSA Speak mobile-based AI application on their devices to complete similar read-aloud pronunciation tasks. This ensured that improvements were attributed to the treatment rather than variations in testing conditions. The goal was to identify significant changes in students' pronunciation skills by comparing pre- and post-test scores, assessing the intervention's usability. All students completed the post-test, and the results were as follows.

Table 7 delineates the scores attained by the 28 students in the post-test, consisting of 15 males and 13 females. The data were processed in SPSS to compute the mean, minimum, maximum, and standard deviation.

Table 8 shows that the total post-test scores of the students amounted to 2,245, with a mean of 80.18. The highest score was 95 and the lowest was 60. None of the students had low scores; seven were at a fair level, seven were in a good position, and fourteen achieved excellent grades. The data indicate that students' proficiency in English pronunciation improved after the repeated pronunciation sessions using the ELSA AI application.

Significant Usability of Mobile-Based AI for Students' English Pronunciation Competence

An analysis of the pre-test and post-test scores indicated that the English pronunciation skills of second-year university students improved following instruction via mobile-based AI, reflected by the rise in average scores from the pre-test to the post-test.

The researchers employed the Shapiro-Wilk test to assess data normality, determining if the study data had a normal distribution. If normality was confirmed, a paired sample t-test was conducted, along with a linearity test to evaluate the distribution of the research data.

Normality Test

A normality test was employed to verify that the data sample originated from a normal distribution. The data collected in this study, including students' pre-test and post-test scores, were analyzed using SPSS version 29. The results, determined by the Shapiro-Wilk test, are displayed in Table 9.

Table 7. *The Results of Post-Test.*

No	Reg No	Gender	Score
1	22421002	M	70
2	22421003	M	60
3	22421004	M	80
4	22421005	M	60
5	22421006	M	65
6	22421007	M	65
7	22421008	M	80
8	22421009	M	90
9	22421010	M	80
10	22421011	M	80
11	22421012	M	90
12	22421013	M	80
13	22421014	M	80
14	22421016	M	90
15	22421017	M	90
16	20421018	F	70
17	22421019	F	90
18	22421020	F	95
19	22421021	F	90
20	20421022	F	80
21	22421023	F	70
22	22421024	F	90
23	22421025	F	70
24	22421027	F	80
25	22421028	F	95
26	22421029	F	80
27	22421030	F	95
28	22421031	F	80

Source: Authors' research data collected during the post-test.

Table 8. *Descriptive Statistics of Post-Test.*

Descriptive Statistics						
	N	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**
Post-Test	28	60	95	2245	80.18	10.583

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

Table 9. *The Result of Shapiro-Wilk Normality Test*

Tests of Normality						
	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test	0.292	7	0.072	0.889	7	0.269
Post-Test	0.276	3	0.072	0.942	3	0.537

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

The standard for educational significance was 0.05 (α = 5%). As shown in Table 9, the significance level was 0.537. Since this value was higher than 0.05, the result indicated that the data was normally distributed.

Homogeneity of Variances

The purpose of the homogeneity test was to determine if two or more sample data sets from a population displayed equivalent variance. The data distribution was considered homogeneous if the significance value for deviation from homogeneity (sig) exceeded 0.05. Conversely, if the significance value was less than 0.05, the data was categorized as non-homogeneous. This result is evidenced by the consistency of variances in Table 10.

Table 10. *The Result of Homogeneity of Variances.*

Tests of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**Sig.**
Pronunciation Test	Based on Mean	0.520	1	54	0.474
	Based on Median	0.463	1	54	0.499
	Based on Median and with adjusted df	0.463	1	50.332	0.499
	Based on trimmed mean	0.392	1	54	0.534

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

The homogeneity of variances table indicated a significance value of 0.534, which is larger than 0.05. The evidence demonstrated that the variants of student learning outcomes data were homogeneous when employing ELSA mobile-based artificial intelligence for decision-making in the context of a homogeneity test.

T-Test

To assess the pre-test and post-test data, the researchers employed a paired sample t-test. The significance value (sig) of the paired t-test was compared to the α value (0.05) to determine the outcome. If the significance value exceeded α (0.05), the null hypothesis (H_0) was accepted; if it was less than α (0.05), (H_0) was rejected and (H_1) was accepted. The findings from the data analysis conducted with SPSS 29 are presented in Table 11.

As shown in Table 11, the paired-samples t-test revealed a statistically significant difference between students' pre-test and post-test pronunciation scores, $t(27) = -15.358$, $p < .001$. Therefore, the null hypothesis (H_0) was rejected, indicating a significant improvement in students' English pronunciation performance following the use of the ELSA mobile-based AI application. These findings demonstrated a statistically significant disparity in students' English pronunciation abilities before and after using the ELSA Mobile-Based Artificial Intelligence. The results indicate that mobile-based AI supports and enhances students' pronunciation skills, particularly in helping them practice English as a foreign language and engage in autonomous learning. This aligns with the research question: "In what ways can mobile-based artificial intelligence services support students' pronunciation development during autonomous learning?" Overall, ELSA was found to be a useful and practical tool for improving students' pronunciation skills at the university level.

Table 11. *The Result of T-test*

Paired Samples Test								
		Paired Differences						**Sig. (2-tailed)**
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	
Pair 1	Pre-test - Post-test	-24.643	8.491	1.605	-27.935	-21.351	-15.358	<,001

Source: Authors' analysis of the research data using IBM SPSS Statistics 29.

Discussion

Indonesian university EFL students face notable challenges with English pronunciation, influenced by limited exposure to accurate pronunciation models from non-native English teachers, interference from their first language, and reliance on conventional teaching methods. An initial assessment in which students articulated ten sentences about hobbies revealed an average score of 55.54, highlighting the extent of these pronunciation challenges. To address this situation, the researchers introduced the ELSA mobile-based AI application to support autonomous pronunciation practice among students.

Following regular engagement with ELSA, students' average assessment score rose to 80.18, illustrating the practical value of integrating mobile-based AI into pronunciation learning routines. The application enabled students to access English pronunciation models from native speakers, thereby enriching the pedagogical resources available to them. This study demonstrates how mobile-based AI can serve as a valuable supplementary tool in contexts where direct access to native-speaker models is limited.

Mobile-based AI offers several practical advantages for pronunciation learning, particularly through flexible access, immediate feedback, and exposure to native-speaker models. These features support students' pronunciation practice beyond classroom limitations while enhancing confidence and learning efficiency. The application aimed to improve learners' intelligibility rather than develop a native-like accent, aligning with research that identifies intelligibility as the primary requirement for effective communication in international contexts (Levis, 2022; Levis, 2005). Exposure to diverse English varieties may further enhance learners' adaptability across different linguistic settings.

This study illustrates the practical benefits of mobile-based AI for enhancing students' English pronunciation, particularly in fostering autonomous learning. The application proved useful for second-year university students in Indonesia, allowing them to engage in pronunciation practice at their convenience, regardless of time or location. According to Trang (2019), many students appreciate using mobile-based AI to improve their pronunciation of unfamiliar words, finding the flexibility particularly valuable. These findings align with observations from prior research by Hidayah et al. (2024), Shafiee Rad & Roohani (2024), and Sufi and Shalmani (2018), all of which have documented the pedagogical value of AI-based pronunciation tools in similar contexts.

Shafiee Rad (2024) and Zou et al. (2023) have similarly documented the practical benefits of mobile-based AI in English pronunciation learning. In the present study, ELSA's diagnostic capabilities identified specific pronunciation difficulties linked to interference from the local language, Sundanese, providing targeted feedback that students found helpful. Tools like ELSA represent a meaningful development in language education, offering personalized feedback and supporting increased learner autonomy. However, it remains essential to balance technology with human interaction and to consider issues of accessibility and teacher training (Stockwell, 2013; Ahmadi, 2018; Junaidi, 2020).

The use of mobile-based AI shows considerable promise for supporting English pronunciation development, as it provides engaging themes and features that assist students in improving their pronunciation during autonomous learning. This study, along with previous research, illustrates how mobile-based AI can positively contribute to students' pronunciation learning experiences. Thus, incorporating mobile-based AI tools into English pronunciation instruction appears both beneficial and feasible for fostering autonomous learning among university students.

Beyond the immediate observations, it is important to reflect on the broader role of AI in language education. These tools can be especially valuable in contexts where access to native speakers or expert pronunciation instruction is limited. However, the integration of AI also raises important considerations. While AI can supplement traditional instruction, it should not replace essential human elements such as encouragement, cultural context, and nuanced feedback that account for individual learning styles and needs. Additionally, issues of accessibility, digital literacy, and the need for teacher training must be addressed to ensure equitable benefits for all students. As AI continues to evolve, ongoing research and thoughtful integration into curricula will be vital to maximize its constructive role in language education.

Several methodological limitations should be considered. The sample size of 28 students is relatively small, which means the observations should be interpreted with appropriate caution. Larger studies would help to further establish the patterns observed here. Additionally, this research focused specifically on Indonesian university students, so the findings may not directly transfer to learners in other linguistic or educational contexts. Future research could explore how mobile-based AI tools function for students in different settings, examine long-term retention of pronunciation improvements, and investigate integration approaches for combining these tools with classroom instruction.

Conclusion and Future Research

The study analysis demonstrates the practical value of mobile-based AI tools in supporting English pronunciation development among Indonesian university students in autonomous learning environments, as reflected in ELSA's accessible, flexible practice supported by immediate feedback, native-speaker models, and personalized learning. These features proved particularly useful in contexts where direct access to native-speaker instruction is limited, enabling students to practice independently and build confidence in their pronunciation skills.

The observations from this study contribute to growing evidence of the pedagogical potential of AI-based tools in language education. Mobile-based AI offers practical advantages as a supplement to traditional instruction, fostering learner independence and providing opportunities for pronunciation practice beyond classroom constraints.

Future research should explore how mobile-based AI supports students across various proficiency levels and examine its integration with traditional teaching methods in diverse educational contexts. Important considerations include long-term retention of pronunciation skills, accessibility, digital literacy requirements, and teacher training needs. As AI technologies evolve, thoughtful integration into language curricula, balanced with essential human instruction, will be crucial for maximizing their constructive role in language education. This study demonstrates that tools like ELSA offer practical, accessible means of supporting pronunciation development and merit continued exploration as valuable resources in English language teaching.

Contributor roles: Hessah Saleh Aldayel: Methodology, Conceptualization, Supervision, Writing- Reviewing and Editing. **Hikmah Pravitasari**: Software, Data curation, Writing-Original draft preparation, Visualization, Validation.

Use of Artificial Intelligence

Generative artificial intelligence (ChatGPT) was used solely to assist with language editing and refinement during the revision of this manuscript. It was not used to generate, collect, analyze, or interpret the research data or to produce the research findings. All substantive content, interpretations, statistical results, and final revisions were reviewed and verified by the authors, who take full responsibility for the content of the manuscript.

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