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Article

Integrating Technology into English Pronunciation Learning: A Combination of Both Synchronous and Asynchronous Activities

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Abstract
Integrating technology into teaching and learning has become an undeniable trend in English education. This study investigates the impact of the combination of asynchronous AI-based tool tasks with synchronous, interactive practices such as virtual exchanges and pronunciation workshops on EFL learners' pronunciation development. Conducted over a 12-week schedule, the research included 23 Vietnamese university students who acquired pronunciation via self-directed training using the ELSA Speak software and engaged in facilitated virtual exchange sessions and workshops. A pre-test/post-test design comprising mixed-method data through the test-retest results, the ELSA Speak app's dashboard, and focus group discussions was used. Quantitative data revealed significant development of some segmental (phonemes) and suprasegmental (intonation) aspects of pronunciation but not fluency. Besides the frequency of the ELSA Speak app usage, students' perceived English level seemed to have an impact on their pronunciation learning. Qualitative findings revealed that the students appreciated the interactivity and feedback of the app but also pointed out drawbacks such as cost, limited use, and the difficulty of ensuring regular use. The research accentuates the pedagogical potential of integrating AI-powered apps with real-time communicative practice. It suggests more focus on motivation, teaching, and accessibility to enhance learning gains to their maximum. Pedagogical implications for technology-mediated language learning research and instructional design are suggested to inform subsequent research.

Keywords
Pronunciation, ELSA Speak, virtual exchange, technology integration, AI-powered apps

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1 Introduction

Effective English pronunciation is essential to successful communication, determining how easily a message is understood. Seidlhofer (2001) considers pronunciation a central process in effective communication. Mispronunciation, even with correct grammar, can hinder the communication outcome (Gilakjani, 2012). Pronunciation is therefore at the heart of effective English use, particularly in international communication contexts. For Vietnamese learners, pronunciation is among their most significant concerns (Ha, 2005; Le, 2024). They are troubled by the difference between Vietnamese and English phonemic inventories, negatively impacting their confidence and the eventual outcome (Le, 2024). This issue is further complicated in Vietnam, where teaching practices emphasize grammar, reading comprehension, and written expression at the expense of pronunciation (Ngo, 2017).

In recent years, AI has been an effective tool to improve English learning outcomes, especially in pronunciation. AI tools can be particularly helpful for learners to practice pronunciation and speak more confidently outside the classroom (Simatupang & Heryono, 2025). Among the AI-based applications, ELSA Speak has been highly noted for its effectiveness in improving learners' pronunciation thanks to its instant feedback and personalized learning design features (Permatasari & Lubis, 2024; Rismawati et al., 2022). Although a number of studies agreed that AI-powered tools like ELSA Speak can be beneficial for students' independent learning (Kholis, 2021; Liu et al, 2019), most research focuses on AI in teacher-led classrooms, with limited attention to self-learning or real-world settings. Pronunciation improvement requires continual practice and corrections, which are not always possible in teacher-led classrooms due to time limitations and class size. In self-directed learning situations, AI can help students with their learning progress via instant feedback and correction (ELSA Speak, n.d.). However, there has been limited literature on how AI tools, ELSA Speak in particular, can help students improve their pronunciation through self-study. In addition, previous studies have paid little attention to the role of other factors, such as English level or their exposure to the language, etc., that may play in the learners' learning progress.

In brief, this study aims to examine the role of AI-powered self-study using the ELSA Speak app, integrated with interactive practices such as virtual exchange sessions and pronunciation workshops, in supporting students' pronunciation development. By observing a blended learning model implemented at Hanoi Open university, the research explores the effectiveness of combining autonomous learning with synchronous instructional support in fostering more confident, intelligible, and communicative English speakers. It also investigates the possible influence of other factors—such as the person's English proficiency and exposure to the language—on their pronunciation progress.

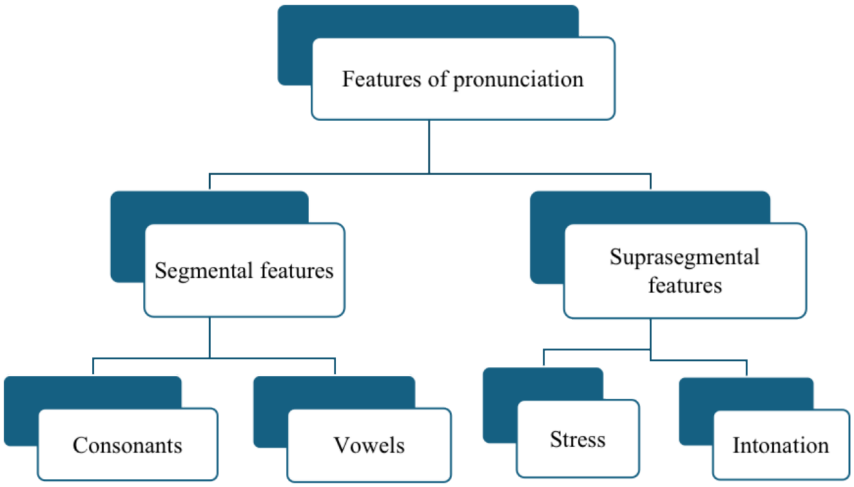
2 Literature Review

2.1 Features of pronunciation

Pronunciation plays a crucial role in communication, as it is the first layer through which speakers convey their messages and listeners decode linguistic signals (Pennington & Rogerson, 2019). Clear pronunciation ensures the message's clarity and reflects the speaker's emotions and attitudes. Conversely, unclear pronunciation can lead to communication breakdowns. For language learners, pronunciation impacts how others perceive their language competence, influencing social interactions and overall success (Pennington & Rogerson, 2019).

Pronunciation in English can be categorized into segmental and suprasegmental elements (Kelly, 2000). Segmental features refer to individual sounds, while suprasegmental aspects encompass intonation, stress, duration, and other characteristics that extend beyond single sounds (Figure 1).

Figure 1
Features of Pronunciation (adapted from Kelly, 2000)



Tanner and Landon (2009) suggested that focusing on keywords, stress, rhythm, and intonation, rather than the precise articulation of individual sounds, helps improve intelligibility, which means how easy it is for people to understand your pronunciation, over accuracy. Conversely, some scholars argue that segmental features, such as consonants and vowels, are more important for intelligibility and should receive more attention. Collins and Mees (2003, p. 209) identified six pronunciation features most influencing intelligibility, five of which relate to segmentals, with only one—word stress—pertaining to suprasegmentals. Recently, the debate has shifted toward an integrated approach, recognizing the importance of segmental and suprasegmental features. Celce-Murcia et al. (2010) noted that pronunciation instruction now adopts a balanced perspective, incorporating both aspects into curricula tailored to learners' needs.

Added to this, fluency, defined as the smoothness of spoken language (Thomson, 2015), is recognized as a key element of overall pronunciation proficiency (Saito & Plonsky, 2019). Chau et al. (2022) proposed that understanding the link between fluency and intelligibility could support clustering them—alongside comprehensibility and accentedness—under the broader category of global L2 pronunciation proficiency. While fluency may not directly impact intelligibility, it seems to affect the level of effort required by listeners to comprehend the speaker (Chau et al., 2022). Therefore, in this study, fluency is viewed as an element of pronunciation proficiency (Saito & Plonsky, 2019; Chau et al., 2022).

2.2 Factors that affect pronunciation learning

Despite its importance, studies show that less classroom time is devoted to pronunciation compared to other language skills (Lee et al., 2015; Saleh & Gilakjani, 2021). In addition, students' pronunciation learning can be affected by several factors. Brown (2008) mentions aptitude, motivation, and opportunity to use the language or exposure to the target language as the main factors. While aptitude seems to be out of the teacher's control, Moyer (2004) defines motivation as conscious effort, intentionality, and planning toward a goal. Moyer (2007) also finds a significant correlation between the degree of a foreign accent and the desire to improve it. Brown (2008) agrees that good pronunciation learners are strongly internally motivated. However, Plaitek et al. (2021) argue that motivation, attitude, and anxiety toward English lexis play lesser roles than the learners' prior knowledge of pronunciation, teacher recommendation, and English usage frequency. In her recent research, Wu (2024) finds out that ESL students' dialects have a certain influence on English pronunciation.

Despite the different thoughts, these studies have one thing in common—they all seem to have neglected the role of a student's input English level. Most mention the potential influence of English

proficiency on a learner's linguistic development through different practice modes without any attention to pronunciation. For example, Spring et al. (2019) noted that students with higher proficiency levels tend to show greater improvement in oral fluency. Nguyen et al. (2024) pointed out that a person's age plays a statistically significant role in their ability to learn a language, but did not specifically mention pronunciation. The lack of information regarding how English proficiency and exposure to the language may affect a student's pronunciation development begs for further empirical research in the area. Because motivation is often considered "extremely difficult to define and measure" (Szyszka, 2015), especially within the scope of this project, where students spent most of the time self-studying with the language app, the researchers decided not to examine it in this research.

2.3 Common pronunciation teaching techniques and strategies

When it comes to explicit pronunciation teaching in a conventional classroom, Kelly (2000) proposes some useful techniques. Firstly, drilling is the key practice for improving pronunciation and language retention, which typically starts with choral repetition to boost confidence, followed by individual practice for teachers to assess pronunciation. Next, minimal pairs (words that differ in only one phoneme, e.g., cat vs. cut, see vs. she, etc.) are used to focus on sounds that may cause students' difficulty. Another technique is teaching through spelling homophones, which helps students to recognize spelling variations, meanings, and subtle pronunciation differences, which is essential for mastering English pronunciation. Finally, tapes of students' spoken English are used to compare with those of native speakers to help them recognize where they need to improve.

Kirkova-Naskova (2019) suggests six common pronunciation teaching techniques, some of which are similar to those of Kelly (2000), including automatic repetition and imitation, perceptual training (ear training), phonetic instruction, and activities for raising phonological awareness and self-awareness of one's speech. However, she emphasizes the role of communicative activities and interdisciplinary techniques (e.g., using games such as bingo, cards, and Ludo or information gap tasks, group discussions, debates, and authentic materials like songs and articles) in preparing learners for real-life communication.

2.4 The use of ELSA Speak in pronunciation learning

To address the limited classroom time dedicated to pronunciation instruction, the integration of audio-visual and technological tools is recommended both in and outside the classroom. These tools can significantly enhance both teaching and learning, offering students more exposure to the target language. Pennington and Rogerson (2019) emphasize that pronunciation technology provides students with opportunities for self-paced learning, facilitating "*increased quantity, quality, and variety of access to language*" as well as "*improved quality and variety of analysis and feedback on speech*." Numerous studies have also shown that students who use computer-assisted pronunciation tools achieve better outcomes compared to those relying solely on traditional pronunciation tests (Saleh & Gilakjani, 2021).

One such tool is ELSA Speak, an innovative English language learning application founded in 2015. The primary feature of ELSA Speak is its ability to detect and correct pronunciation errors thanks to the speech recognition technology. By analyzing large amounts of speech data, the app provides personalized feedback to users, helping them "standardize" their pronunciation. ELSA Speak offers over 1.5 billion exercises based on real-life topics, tailoring lessons to meet each learner's unique needs and enabling them to self-study and progress at their own pace. Additionally, the app includes a custom-built teacher dashboard, which allows educators to manage lessons, monitor student progress, and adjust content as necessary (ELSA Speak, n.d.).

Many studies have explored the effectiveness of ELSA Speak. For example, Kholis (2021) conducted a study involving 18 students using the app. The study, which included pronunciation tests, observations, and one-on-one interviews, revealed significant improvements in students' pronunciation abilities. Post-

test results indicated greater pronunciation accuracy, and students also reported increased motivation to practice both inside and outside the classroom. Nguyen and Nguyen (2024) found that students valued the app's tailored pronunciation exercises, which met their learning needs. They liked its multimedia elements, such as animations, images, and sounds, which they thought were engaging and motivating. The app's speech recognition system also provided good feedback on pronunciation errors. In another study, Pham and Pham (2025) found the app's perceived usefulness, ease of use, and confirmation as key reasons for user satisfaction, with confirmation being singled out as the main reason for their positive feedback.

The studies did identify some challenges in using the app. One major issue is the repetitive nature of some exercises, which can lead to frustration and disengagement (Nguyen & Nguyen, 2024). Technical problems such as unstable internet connections, unclear audio recordings, and inaccuracies in voice recognition can impact effectiveness (Nguyen & Nguyen, 2024; Rebolledo & González, 2023). The app also lacks human interaction, which is crucial for students who thrive in dynamic, interactive learning environments. Like many AI-driven tools, ELSA Speak may struggle with understanding cultural nuances such as idioms, regional accents, and slang, which are essential for mastering natural speech. Finally, the app's success is also dependent on instructional support and alignment with course content from educators (Pham & Pham, 2025).

While most of the studies focus mainly on the effectiveness of ELSA Speak, there is a lack of concern with the possibility of extraneous variables during the research intervention. These variables—for instance, a student using another app alongside ELSA SPEAK or having frequent conversations with native English speakers—may affect test scores and, thus, the reliability and validity of the research outcomes. With this in mind, researchers must consider all potential influencing factors on learners' pronunciation progress.

While existing research finds ELSA Speak to be effective for short-term pronunciation improvement, further studies are needed to assess its long-term impact, particularly concerning real-life communication. We need to find out how ELSA Speak can be integrated into the classroom and real-life settings to maximize its effectiveness. Virtual Exchange (VE) activities may be one way to overcome this challenge. VE is a technology-based approach that enables learners from different cultures to meet and interact online, enhancing language skills, intercultural communication, and critical thinking. VE promotes speaking with international peers in a real-life setting and provides a great forum for students to practice their English and pronunciation. (O'Dowd & O'Rourke, 2019).

As such, we conducted a project that consisted of several activities: the students' self-paced pronunciation practice on the ELSA Speak App with real-life communicative activities, i.e., the VE meetings, incorporating synchronous pronunciation workshops. With this blended model, the study seeks to answer the following questions:

1 To what extent do the core intervention components (i.e., use of the ELSA Speak application, VE meetings, and pronunciation workshops) influence students' pronunciation development?
2 What other factors (i.e., students' exposure to the English language and their perceived English level) may be influencing students' pronunciation learning?
3 How do students perceive the effectiveness, usability, and limitations of the ELSA Speak app in the support of their learning process?

3 Research Methodology

3.1 Participants and setting

The research employed the convenience sampling method to recruit students from the Faculty of Tourism with the approval of Hanoi Open University, Vietnam. In particular, we posted an announcement on the faculty's Facebook page to attract potential applicants. Since self-study activities require a strong

commitment, applicants had to answer a short survey to indicate their reasons and expectations. They were also informed with the research's purpose and procedures and agreed to fill in a consent form before participating. All accepted participants were incentivized with an ELSA Pro account. The initial sample included 25 students, from first to fourth year, with mixed levels of English proficiency. However, two students withdrew for personal reasons after two weeks. The final sample consisted of 23 students.

To facilitate the pronunciation practices, we also included 13 international volunteers. Most are native English speakers, coming from the UK, the US, and Canada. Some are from the Philippines, where English is widely spoken. They range in age from 17 to 65 years old. Their occupations vary from ESL teachers to high school students. Most volunteers attended one VE session, while some participated in more with the Vietnamese students.

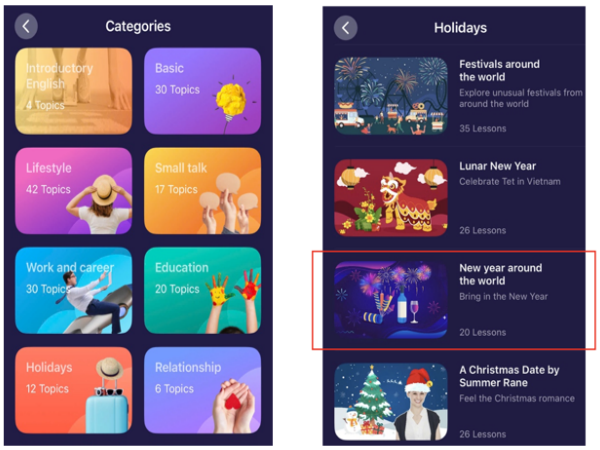
3.2 Research design and procedures

The research team employed a pre-test/post-test design without a control group. As an exploratory study, it aims to assess the development of students' pronunciation skills and identify potential contributing factors (i.e., other forms of English exposure and English proficiency) that could influence their learning. Consequently, a control and treatment group model was not considered essential for this research. Mixed methods of both qualitative and quantitative were used, as we believe that combining them provides a more comprehensive picture of the impact of AI technology and other complementary activities on the students' learning progress. The research was conducted through a two-phase procedure.

In the first phase, students were instructed to use the ELSA Speak app and explore its various features. A group chat was set up for all participants and researchers to share their real-time information. Before using the app, each student took a supervised entrance pronunciation test on it. After that, they participated in five weekly VE sessions with the international volunteers. Based on the observation of their performance in each VE meeting, the researchers designed the contents and drilling activities in the ad hoc pronunciation workshops, combining them with practice on the ELSA Speak app on relevant pronunciation topics. The topics for the VE meetings were selected from 203 topics for vocabulary and pronunciation practice suggested by ELSA Speak (Figure 2). After 12 weeks of attending the research project, students took a post-test to evaluate their pronunciation learning progress.

In the second phase, they took part in the group focus interviews to gather qualitative data. These interviews aimed to explore students' experiences and perceptions of the learning process, particularly their engagement with the app, VE sessions, and pronunciation workshops. The interviews also helped uncover the learners' perceived challenges, motivation, and suggestions for improving future implementations of similar pronunciation learning projects.

Figure 2
Examples of the "Study by topic" Feature on the ELSA Speak app



3.3 Data collection

The quantitative data were collected mainly through students' demographic information and ELSA Speak's dashboard, including frequency of use and assessment test results. The tests included a pre-test and a post-test.

The pre-test assesses students' initial pronunciation skills at the start of the project. It is available on ELSA's Assessment Test function and was taken by the students in front of one examiner to guarantee transparency and sound quality of the recordings. The test covers pronunciation (vowel and consonant sounds, hereby labeled "phonemes" for short), intonation, and fluency (see Figures 3 and 4 for further examples). And based on the results, the app created a personalized learning program to suit each student's needs. The post-test is a repeated version of the pre-test, taken at the end of the project to evaluate the students' pronunciation progress.

As they went through the project, students were constantly assessed by the ELSA app through lesson tests. These test results, however, were not used in the analysis because they reflected only the individual's performance and not necessarily the group's performance.

Figure 3
ELSA's Assessment Test Score

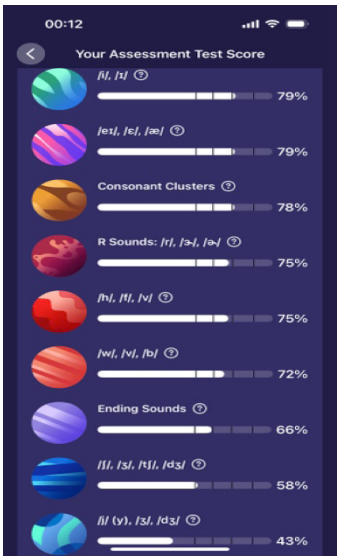
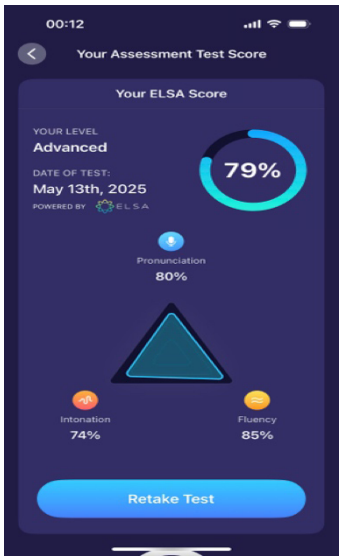


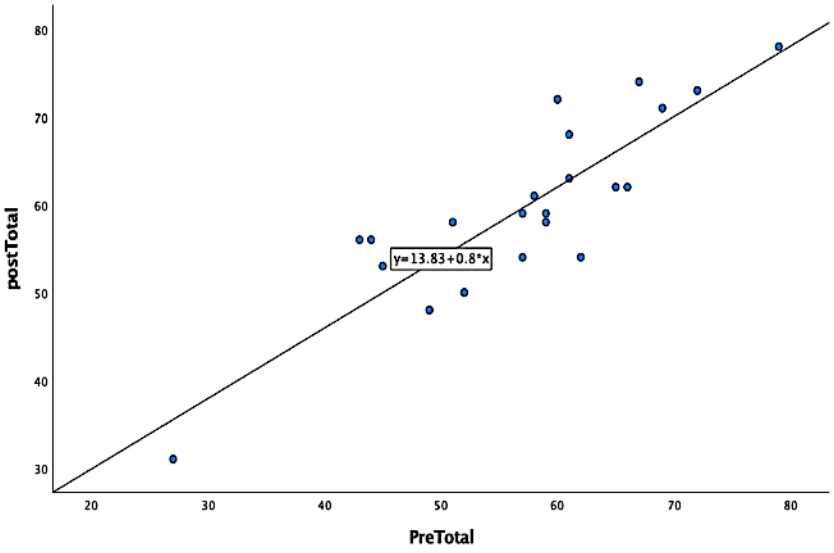
Figure 4
ELSA's Assessment Test Result Feedback



As for the test-retest consistency, the scatterplot shows that the data points are non-linear and reflect a monotonic relationship (Figure 5). Hereafter, Kendall's tau-b correlation test is conducted. According to Schober, Boer, and Schwarte (2018), the cut-off values for "strong" and "very strong" in Kendall's tau-b correlation are 0.49 and 0.71 respectively; therefore, the Kendall's value $\tau = 0.663$ implies a strong and near to "very strong" correlation between the pre-test and post-test scores, assuring the consistency of the test-retest research model.

Qualitative data were collected using several methods. First, one-on-one informal interviews were conducted throughout the project to find out any problems the students may have been encountering. The VE sessions also gave good insights into students' performance and areas they need to work on, as well as the level of interest and engagement. Finally, students took part in group focus interviews at the end of the project to provide feedback based on their perspectives, experiences, and attitudes towards the entire research process. These methods help triangulate and enrich the quantitative findings.

Figure 5
Scatterplot of the Pre-test/Post-test Scores



3.4 Data analysis

The quantitative data was analyzed using Excel, ELSA's dashboard statistics, and SPSS V27 software. Since the quantitative data does not meet the assumptions of parametric tests (due to a small sample size), non-parametric inferential tests were employed to increase the study's reliability and validity. More specifically, the Wilcoxon signed-rank test was used to explore if there is a significant difference between the students' pre-test and post-test scores.

To explore the potential influence of the core intervention components (i.e., *ELSA Speak app usage, VE meetings, and pronunciation workshops*) and other contributing variables (*learners' exposure to the English language and their perceived English level*) on the students' pronunciation skills, we ran the Kruskal-Wallis test, which is used to compare the mean values of a variable across three or more independent groups. As the primary objective was to assess overall group differences rather than identify specific pairwise comparisons, no post hoc tests were performed.

In terms of qualitative data analysis, the focus group interview data were analyzed following the thematic analysis. Thematic analysis is a systematic method for analyzing qualitative data by identifying patterns and themes. Braun and Clarke (2006) outline six key steps: familiarizing oneself with the data (1), generating initial codes (2), grouping codes into potential themes (3), reviewing and refining these themes (4), clearly defining and naming them (5), and finally, producing a coherent report supported by data excerpts to present the findings and their implications (6). These data were combined with quantitative analysis to triangulate the information when needed. The informal exchanges with the participants during the project and the observational notes of the students' performance during the VE meetings were used as referential data to help pinpoint issues and build the ad hoc pronunciation lessons in the workshops only, and hence were not put into the data analysis.

4 Research Findings

4.1 Demographic information of the participants

Table 4 provides important information about the participants. Most of them are female (19 out of 23), and just over half (12) are in their last year of studies (21 years old). The sample covers a small age range (18-21 years old), and all the participants have been studying English for roughly 10 years.

Table 1
Demographic Information of the Participants

Demographic information of the participants			
	Features	**Quantity (N=23)**	**Rate (%)**
Gender	Male	4	17.4%
	Female	19	82.6%
Age & Educational Background	First year (18 years old)	4	17.4%
	Second year (19 years old)	1	4.3%
	Third year (20 years old)	6	26.1%
	Fourth year (21 years old)	12	52.2%

4.2 Research question 1: Effects of ELSA Speak and complementary activities on pronunciation development

Table 2
Descriptive Statistics of the Pre-test/Post-test Scores

	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Pre-overall	23	27	79	57.17	11.142
Post-overall	23	31	78	59.74	10.266
Pre-phonemes	23	32	76	59.43	10.237
Post-phonemes	23	36	77	62.43	9.448
Pre-intonation	23	19	80	51.83	14.086
Post-intonation	23	24	85	56.09	13.648
Pre-fluency	23	21	87	53.48	16.629
Post-fluency	23	20	84	55.26	15.989
Valid N (listwise)	23				

In general, the pre-test and post-test scores show an improvement in the mean scores of both overall pronunciation skill and its attributes (i.e., phonemes, intonation, and fluency). Standard deviation is remarkably high in all categories, indicating a strong differentiation in students' English pronunciation proficiency, aligning with their varied perceived English levels (see Table 6).

To determine if there is a significant difference in the mean rank scores before and after the project, the research team used the Wilcoxon signed-rank test. The test results are shown below:

The results from the Wilcoxon signed-rank test show that *there is no difference* between the mean rank of the students' pre-test and post-test scores of overall pronunciation and fluency ($p = 0.059$ & 0.475, respectively). However, there is a *significant difference* between their pre-/post-test scores of phonemes and intonation ($p = 0.014$ & 0.022, respectively), proposing an influence of the project on the students' pronunciation learning. As a p-value ≤ 0.05 may merely provide the presence of a difference but not

necessarily reflect its practical significance, it should be accompanied by indications of effect size (Cohen, Manion & Morrison, 2007). In particular, the effect size of the Wilcoxon signed-rank test results between the pre-/post-test scores of phonemes and intonation is r = 0.364 and r = 0.339, respectively, identifying a medium-size effect. Therefore, although the overall pronunciation pre-/post-scores do not show a difference, it should be acknowledged that the project seems to influence the students' pronunciation learning, i.e., phonemes and intonation.

Table 3
Results of the Wilcoxon Signed-rank Test

	Test Statistics[a]			
	Post-overall – Pre-overall	**Post-phonemes – Pre-phonemes**	**Post-intonation – Pre-intonation**	**Post-fluency – Pre-fluency**
Z	-1.888[b]	-2.469[b]	-2.296[b]	-0.715[b]
Asymp. Sig. (2-tailed)	0.059	*0.014*	*0.022*	0.475
Effect size (r)		*0.364*	*0.339*	
a. Wilcoxon Signed Ranks Test				
b. Based on negative ranks.				

Although an impact on the students' phonemes and intonation learning is recognized, it is not possible to decide whether the use of ELSA Speak, VE meetings, and pronunciation workshops (Table 4) has an influence or not. To answer this question, we used the Kruskal-Wallis test, which compares the mean rank of three or more independent groups to detect any significant difference among them.

Table 4
Illustration of Intervention Components

		Number of students	**Percentage**
Time use of the ELSA Speak app (tracked from ELSA's dashboard)	0-5 minutes/day	8	35%
	6-10 minutes/day	12	52%
	11-15 minutes/day	3	13%
Number of VE meetings they attended	0	7	30,6%
	1	3	13%
	2	3	13%
	3	6	26,1%
	4	3	13%
	5	1	4,3%
Number of pronunciation workshops they attended	0	10	43,5%
	1	0	0%
	2	5	21,8%
	3	6	26,1%
	4	2	8,6%
	5	0	0%

The Kruskal-Wallis test results are illustrated below:

Table 5
Results of the Kruskal-Wallis Test

Test Statistics[a,b]		
	Post-phonemes	Post-intonation
Time use of ELSA Speak		
Kruskal-Wallis H	6.913	1.015
df	2	2
Asymp. Sig.	*0.032*	0.602
Effect Size (η^2)	*0.246*	
VE meetings		
Kruskal-Wallis H	10.917	5.861
df	5	5
Asymp. Sig.	0.053	0.320
Pronunciation workshops		
Kruskal-Wallis H	6.591	4.779
df	3	3
Asymp. Sig.	0.086	0.189
a. Kruskal Wallis Test		
b. Grouping Variable: Time use of ELSA Speak		

According to Table 5, there is *no significance* in the mean rank comparison of the Intonation post-test scores among the groups of varied amounts of using ELSA Speak, VE meetings, and pronunciation workshops. Only the groups of time use of ELSA Speak differ significantly when it comes to the phonemes' post-test scores. Following this result, a large effect size ($\eta^2 = 0.246$) is reported, identifying a practical significance of the results.

Interview data also show that the students regarded the improvement in the pronunciation of phonemes they made with the frequent practice on ELSA Speak.

> *I learned how to pronounce common words that I thought were correct, but when I used the app (ELSA), I realized they were wrong. For example, the word "vehicle", I read it 5-6 times to get it right. Usually, the first time I read it wrong, but the next time I recognized the wrong sounds and improved.* (Interview data)

On the other hand, when mentioning "intonation", most of the students referred to it as "*speaking naturally*", or "*better accent*", revealing their lack of background knowledge of what intonation is about, and how important it is in communication. All that they learned was "*repeating after the AI voice and trying to imitate the intonation of the sample sentences on ELSA Speak"* without acknowledging the reason for using it.

It is also noteworthy that the overall frequency of using ELSA Speak is rather low. In general, most students used the app only 6-10 minutes per day (12 out of 23), while eight of them did it for 0-5 minutes or less per day. Only three practiced more than 10 minutes per day.

While quantitative data did not show the influence of the VE meetings and the pronunciation workshops on students' pronunciation development, it is worth noting that the participation of the students in these activities was not frequent. This can be attributed to several reasons. Firstly, at the beginning of the project, students were informed that these two supplementary activities were not

compulsory for them to join, so some of them did not see the need to attend. Secondly, some students were either too busy to attend or were too shy to speak English, so they did not participate in the VE meetings:

> *I have never talked with foreigners before. My English is not good enough, so I'm afraid that they won't understand what I say. I'm not ready for it yet.* (Interview data)

Contrasting the quantitative analysis results, the qualitative data suggested that these activities (VE meetings) could be perceived as contributing factors, as many students appreciated the opportunities to meet others and practice their English, particularly their pronunciation, and to expand their cultural knowledge:

> *The project was very interesting and useful; the activities were diverse and complemented each other very well".* (Interview data)

Moreover, most students who attended the pronunciation workshops recognized their value in raising awareness of key pronunciation features:

> *I like the workshops because I can learn new and interesting knowledge of pronunciation that our textbooks or online documents do not have. After attending the workshop, I have more motivation to study.* (Interview data)

In general, despite the low frequency of participation, some students said they noticed significant improvements in their listening and speaking skills, as well as confidence in communicating in English, after attending such interactive activities. These positive responses suggest that, when supported by clear instructions and consistent student engagement, the combination of technology-based practice and real-life interaction holds strong potential for enhancing overall language learning outcomes, particularly pronunciation.

4.3 Research question 2: Effects of the other factors on pronunciation development

Although the statistical test results have confirmed the likely positive impact of the ELSA Speak app on the students' pronunciation development, it is unable to conclude whether it is the only influential factor or not. Some other variables to consider herein are the other types of exposure to the English language during the project and the learners' perceived English level (see Table 6).

Table 6
Illustration of Other Variables

Other types of English exposure	never	10	43,5%
	sometimes	8	35%
	often	0	0%
	very often	5	21,8%
Perceived level of English	beginner (1)	1	4.3%
	pre-intermediate (2)	3	13%
	intermediate (3)	10	43.5%
	upper-intermediate (4)	9	39.2%

First, while attending the project, some students did part-time jobs in the tourism industry, such as tour assistants and salespeople etc., which allowed them more opportunities to speak English than others.

Nearly half of the students did not have any contact with foreigners, while five claimed that they talked with expatriates "very often", and the remaining eight said that they "sometimes" spoke English with people from other countries. The interview data also show that, except for this, they did not have any other exposure to speaking English.

Next, most of the students perceived themselves as having intermediate (10 out of 23) or upper-intermediate (9 out of 23) English proficiency levels. Only one was at the beginner level. These differences in proficiency levels urge our researchers to find out if they play a significant role in the students' pronunciation and learning process.

To answer research question 2, Kruskal-Wallis tests were used to identify if there is any significant difference across the groups. Since the phonemes' post-test score is the only element that is influenced (research question 1), it is hereby imported as a dependent variable. The test results are shown in the following table:

Table 7
Results of the Kruskal-Wallis Test

	Post-phonemes	**η2 (effect size)**
English level		
Kruskal-Wallis H	8.742	
df	3	
Asymp. Sig.	*0.033*	*0.302*
Other types of English exposure		
Kruskal-Wallis H	1.630	
df	2	
Asymp. Sig.	0.443	

Table 7 indicates that there is *no significant difference* across the groups of English exposure. However, the p-values of the English level groups are 0.033, meaning that there is a *significant difference* between these two groups. With a large effect size ($\eta^2 = 0.302$), it can be concluded that students' English level seems to influence the students' learning of phonemes.

4.4 Research question 3: Students' perceptions of the ELSA Speak app's effectiveness, usability, and limitations

As a result of the thematic analysis, three major constructs emerged: *students' reasons for participation*, *self-reflection on language development*, and *evaluation of the three learning modes*. They reflected on improvements in pronunciation, listening, speaking, intonation, vocabulary, and confidence. Regarding the pronunciation workshops, students acknowledged their usefulness and expressed a desire for more content and practice. For the VE meetings, students valued the opportunity to engage in real English conversations and recognized the positive influence on their language progress. Students also praised the ELSA Speak app for its usefulness and ease of use and indicated an intention to continue using it.

In particular, the qualitative results revealed that all the students acknowledged the *usefulness* and *ease of use* of the ELSA Speak app. The app's diverse features and personalized lessons made it accessible for most students.

> *Using the app is not complicated at all; the app has a built-in roadmap, and you can just study it.* (Interview data)

When interviewed, most students said using the ELSA application helped improve their pronunciation, individual sounds, and word stress. They said they were made more aware of the importance of intonation when speaking, but thought it was a difficult skill that required a lot of practice to acquire. Only a few students felt their intonation improved. Notably, these were all students with relatively good proficiency and high-test scores compared to the rest.

> *Although not very much, my pronunciation has improved thanks to the app; for example, my voice tone is more natural and deeper; I pronounce the endings -s and -es more clearly; and I express my emotions more clearly when speaking English*. (Interview data)

On the other hand, there were occasional issues with unclear recordings or background noise, affecting the app's accuracy. Some students also found the app's assessments "*picky*," requiring multiple recordings and attempts to meet criteria, which could be frustrating. One student mentioned:

> *The app was too strict, so I felt discouraged and didn't use it as much as before.* (Interview data)

Additionally, learning to pronounce correctly is not always easy and may take a while and persistent practice to succeed. This can be particularly challenging when applied to real-world communication:

> *I remember how to pronounce the words with correct stress and final sounds while using the app, but when talking with the foreigners (in the VE meetings), I was so nervous and tried to focus mostly on the contents, so I totally forgot those pronunciation rules.* (Interview data)

Although students found ELSA Speak generally effective, their usage was limited by personal commitments like work and study. This perhaps shows a lack of priority placed by some of the students on the process of learning English, specifically pronunciation.

> *At first, I used (ELSA) regularly, but then due to my busy study schedule and work, I did not have time to maintain the same study habits as before.* (Interview data)

Interestingly, when asked about their intention to continue using paid English learning apps such as ELSA Speak, most students (14 out of 23) said they would do so. But 9 said they would stop. The main reason was cost, as most of them were only willing to pay a relatively small amount for learning English on paid apps.

5 Discussion

The study's findings confirm the significant role of technology applications such as ELSA Speak in enhancing students' English pronunciation skills. In particular, the students' pronunciation skills showed certain improvements, though not too significant, and they were highly satisfied with the use of ELSA Speak in the learning process, which was consistent with previous studies (Nguyen & Nguyen, 2023; Nguyen & Nguyen, 2024; Kholis, 2021; Pham & Pham, 2025). This was due to several reasons. First, most of them appreciated the app's content variety, which gives them a lot of selections from the menu design for not only helping learners distinguish between sounds of consonants and vowels but also practicing with intonation. Also, thanks to the speech recognition, instant feedback, and mistake correction features, ELSA Speak allowed students to instantly redo and correct their mistakes. This has been widely acknowledged in many other studies on the application of ELSA Speak to language learning (Nguyen & Nguyen, 2023; Rismawati et al., 2022; Kholis, 2021). Students also acknowledged the app's ease of use with user-friendly design, as cited also in the studies of Nguyen and Nguyen (2024), Pham and Pham (2025), and Kholis (2021).

The study also recognized some challenges while using the app, as noted by previous research, like technical issues caused by background noise that may affect the feedback's accuracy. Besides, the fact that the app is based so much on native speakers' accentedness, with little flexibility when it comes to assessing a student's attempt, can frustrate many learners. But the biggest barrier appeared to be the cost one must pay to optimize the app's features, as the free version provides very limited access. This is a challenge to many students who do not have a stable income.

While previous studies have often treated pronunciation as a unified skill (e.g., Derwing & Munro, 2005; Kholis, 2021; Nguyen & Nguyen, 2024; Pham & Pham, 2025), the present findings take a multidimensional approach by viewing it from three distinct constructs: vowel and consonant phonemes, intonation, and fluency. This analytical model allows a more nuanced understanding of learners' pronunciation development, moving beyond the holistic perspectives commonly found in earlier research.

While the students' pronunciation of phonemes and intonation was helped by the project activities, their fluency did not show any significant improvement. Only the pronunciation of such segmental features as phonemes was improved from the use of ELSA Speak, which may be due to the explicit segmental pronunciation instructions provided by the app. Fluency and intonation, on the other hand, receive little or no instruction. This outcome was like that of Chau et al. (2022), who also found there was little gain in perceived fluency for the learners, indicating that fluency is a difficult aspect for the students to achieve. In terms of intonation—perhaps the biggest challenge for Vietnamese students of English—Ngo (2017) listed two main reasons: the neglect of specific intonation teaching in the classroom and a great difference between Vietnamese learners and native English speakers' intonations. So, without intensive and explicit coaching, students can hardly improve their intonation from self-learning apps.

The study also found a correlation between a student's English level and their pronunciation learning. This supports the viewpoints of Kholis (2021) that teachers cannot neglect their students' English competence in pronunciation development. Spring et al. (2019) and Nguyen et al. (2024) agreed, citing that effective pronunciation is an integral component of linguistic competence.

It should be noted that while most students showed interest and commitment while attending the various project activities (i.e., VE meetings and pronunciation lessons), many did not participate because they were noncompulsory. This may also explain the generally low engagement of the students and why it may be a challenge for them to maintain motivation and sustain in a self-learning situation. Future studies should consider making these activities compulsory to ensure a more complete outcome.

Although the VE exchanges and pronunciation workshops did not play a major part in students' pronunciation learning, they were considered meaningful by the students for providing them with an interactive environment to practice their English as well as to exchange cultures. Apart from the development in language learning (e.g., pronunciation, vocabulary, listening, and speaking skills), the VE sessions also help to raise students' confidence in speaking English, showing consistency with previous studies on virtual exchange effectiveness (Nguyen et al., 2024; O'Dowd & Lewis, 2016). The integration of the ELSA app practice and pronunciation workshops into the VE meetings should be considered a potential model of language learning in which students can integrate vocabulary and pronunciation rules into real-life communication. However, as Ellis (2015) notes, language development is complex, and further research is needed to understand how combining VE with language learning apps can optimize pronunciation skills.

6 Limitations and Implications for Further Studies

Although the findings of this research help to consolidate the pivotal role of technology and other supportive learning modes in pronunciation learning, some limitations need to be underlined.

Firstly, the study utilizes a pre-test/post-test design with no control group, which restricts the potential for drawing direct causal assumptions regarding the efficacy of the ELSA Speak app. By not having a comparison group, any improvement in pronunciation among participants can be due to extraneous variables such as testing effects, maturation, or increased test format familiarity (Creswell & Creswell, 2018). Hence, we would like to acknowledge this as a limitation and suggest that future studies should have both control and experimental groups to be able to differentiate the effect of different learning practices on students' pronunciation skills.

Secondly, constraints on instructional coverage in the app need to be taken into consideration. While ELSA Speak offers diverse pronunciation practice, it does not offer direct instruction on intonation and fluency, which are key elements of overall pronunciation proficiency (Derwing & Munro, 2015). Although certain practices involve stress patterns, the assessment test of the app does not examine this aspect, and such practices could contribute to an incomplete measurement of learners' pronunciation skills.

Finally, while findings indicate that the ELSA Speak app and English proficiency can influence pronunciation development, the study was not set up to determine causal effects. The small sample size (N = 23) can also limit the generalizability of the findings due to a higher chance of sampling bias and lower statistical power. Interpretations must thus be tentative and exploratory. Therefore, it is necessary to acknowledge the research's context-bound findings. To have a better interpretation of the findings, more research with a larger sample size is recommended.

The acknowledged limitations of the current study implicate the need for future studies using larger, more diverse samples and experimental designs with control groups to establish causality. Further work should aim to investigate the individual effects of app-based pronunciation tools and proficiency levels on specific pronunciation features. Moreover, future research should incorporate more holistic assessment measures that account for prosodic features like intonation and fluency, which are critical to overall communicative effectiveness (Saito et al., 2015). Furthermore, although the technology-based practice of pronunciation has been recognized for certain benefits, it is pivotal for students to raise awareness of the importance of pronunciation in developing their oral language skills (Tran, 2024) so that they can be motivated to learn and master their pronunciation (Tran, 2024). Therefore, intensive, explicit instructions should be given to students to optimize the use of technology in language learning. Finally, besides conventional pronunciation teaching and more modern, technology-based practice, teachers can consider integrating real-life communications with foreigners to give students more chances to hone their speaking and pronunciation skills.

7 Conclusion

In today's fast-changing world, integrating technology into learning, particularly in learning English, is becoming indispensable, easing oral presentations by offering a supportive environment without any judgement (Huang, 2024). Various applications powered by artificial intelligence, such as ELSA Speak, now enable learners to personalize their educational journey, helping them find suitable learning methods based on their abilities and interests, hence speeding up the learning process compared to traditional methods. While overall pronunciation improvements were observed and students expressed high satisfaction with ELSA Speak, largely due to its varied content, instant feedback, and user-friendly design, the extent of improvement varied across specific pronunciation attributes. Phoneme pronunciation showed the most significant gains, likely due to the app's explicit instruction in this area. However, the overall impact was moderate. No noticeable change was observed in students' fluency before and after using the app.

The study also revealed that students had positive feedback regarding the project, with all participants expressing satisfaction with activities such as learning with the ELSA Speak app, engaging in online

communication with native speakers, and attending pronunciation lessons. Most students reported improvements in listening, speaking, pronunciation, and confidence when speaking English. The app's ease of use and effectiveness were also highlighted. However, some students expressed that they were not ready to invest in paid applications or felt that the cost of such apps should be lower.

In addition, the research identified a challenge in maintaining students' motivation for self-study. The time dedicated to using the app was limited and inconsistent, often disrupted by personal reasons. This suggests that many students have not yet developed a discipline for a self-study routine. These findings and limitations will serve as a foundation for future studies exploring the effects of external factors, such as learning frequency and communication activities, on language skills and self-study habits.

Despite not directly influencing pronunciation improvement in this study, the integrated virtual exchange (VE) meetings and pronunciation workshops were highly valued by students for fostering an interactive environment, boosting confidence, and providing opportunities for real-life communication and cultural exposure. This suggests a strong potential for a blended learning model where AI-tool practice, workshops, and VE are combined to create a holistic language learning experience, allowing students to apply app-learned skills in authentic contexts. However, further research with a larger sample size and more targeted interventions for fluency and intonation, possibly incorporating compulsory participation, is necessary to fully understand and optimize the complexity of these factors in enhancing pronunciation and overall linguistic competence.

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