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EXPLORING THE USE OF ARTIFICIAL INTELLIGENCE IN PROMOTING ENGLISH LANGUAGE PRONUNCIATION SKILLS

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Abstract
This research examines the potential of artificial intelligence (AI) in enhancing learners' English pronunciation skills. The participants were 78 English language learners at the elementary and pre-intermediate levels, and 19 experienced English language teachers. The researcher employed a mixed-method approach, integrating both quantitative and qualitative data collection techniques, to comprehensively assess the efficacy of AI-based pronunciation aids and gauge learners' perceptions. During a course of two months, the experimental group used *Listnr* and *Murf* AI tools, while the control group adhered to a conventional instruction. The data were taken from pre- and post-test pronunciation scores, questionnaire responses, and interviews with the individuals. The findings of the pre- and post-test indicated that the participants in the experimental group had significant improvements in their pronunciation accuracy. The participants in the study had mostly favorable attitudes towards AI-driven tools, emphasizing their effectiveness in enhancing pronunciation skills, boosting confidence, and promoting engagement. Nevertheless, several obstacles pertaining to the interpretation of feedback and the capture of subtle differences in pronunciation were recognized. This research has shown how AI can potentially be used to teach pronunciation effectively, and it has provided valuable insights for teachers, curriculum developers, and learners.

Keywords: adaptive learning, artificial intelligence, personalized feedback, pronunciation, real-time analysis

Introduction
In recent times, the realm of education has witnessed a growing integration of artificial intelligence (AI) into various sectors, and English language teaching (ELT) is no exception. AI, recognized for its potential in enhancing educational experiences, particularly demonstrates substantial promise in the context of pronunciation instruction within ELT (Mohammadkarimi, 2023). The significance of pronunciation in language acquisition, notably its impact on communicative competence and intelligibility, cannot be overstated. Nonetheless, conventional methods of pronunciation instruction encounter persistent challenges, particularly in furnishing learners with personalized feedback and tailored practice opportunities (Karakas, 2023; Singh & Halim, 2023; Yesilyurt, 2023). This is

precisely where AI-driven pronunciation tools emerge as catalysts for transformation.

AI-powered pronunciation tools bring forth a multitude of advantages when juxtaposed with conventional pedagogical approaches. These innovative tools harness cutting-edge speech recognition algorithms, machine learning capabilities, and natural language processing techniques, thereby endowing learners with individualized feedback, real-time assessments, and adaptive learning experiences. By engaging in interactive exercises, learners receive instantaneous feedback on their pronunciation. They also access meticulously customized practice materials tailored to their unique requirements. Moreover, AI tools confer a degree of flexibility and accessibility seldom attainable through traditional in-person instructions. They enable learners to hone their pronunciation skills at their convenience, regardless of geographical constraints (Alimbaeva, 2023).

Despite the evident promise of AI in pronunciation instruction, a conspicuous research gap looms large, one characterized by a dearth of studies specifically probing the utilization of AI in this domain. Existing investigations in the domain of AI in ELT have predominantly gravitated toward areas, such as grammar, vocabulary acquisition, or general language learning strategies, leaving the precise application of AI for augmenting English learners' pronunciation skills (Castellanos-Gomez, 2023; Hwang et al., 2023; Mohammadkarimi, 2023). For this reason, this research endeavors to bridge this gap and illuminate the latent potential inherent in AI-based tools for elevating pronunciation instructions. The present study, therefore, embarks on a journey to scrutinize the effectiveness of AI-driven pronunciation tools in enhancing the pronunciation of English language learners. Its primary objective is to assess the impact of AI interventions on learners' pronunciation accuracy, fluency, and intelligibility. Simultaneously, it endeavors to delve into learners' perspectives, experiences, and attitudes vis-à-vis the utilization of AI tools for pronunciation instructions. The following research questions guide this research to reach the main aims of the study:

1. To what extent do AI-based pronunciation tools affect English language learners' pronunciation accuracy?
2. What are the perceived benefits and challenges of using AI-based pronunciation tools from the perspective of English language learners?
3. How does language proficiency level influence the perception and usage of AI-based pronunciation tools?

By exploring these dimensions, this research aims to furnish valuable insights into both the merits and potential challenges entailed in the integration of AI into pronunciation instructions. It bears substantial implications for the field of ELT, offering innovative solutions to age-old predicaments associated with conventional pronunciation instruction techniques. The findings have the potential to guide educators, and curriculum designers and developers of language learning technology in the design and implementation of more effective, personalized, and engaging pronunciation instruction tools. Furthermore, this study paves the way for learners to unlock opportunities for enhancing their pronunciation skills, thereby augmenting their overall communicative competence. Beyond its immediate implications for ELT, this research contributes to the larger discourse surrounding the integration of AI in education. Concentrating on a specific domain within

language teaching enriches the burgeoning body of knowledge pertaining to AI applications while accentuating AI's transformative capacity in the realm of language learning. This study serves as a foundational stepping stone for further exploration and refinement of AI-based tools in pronunciation instructions, charting new trajectories for the future of language education.

Literature Review

Pronunciation constitutes a pivotal facet of language acquisition, significantly influencing learners' ability to communicate effectively and their overall language proficiency (Caleffi, 2023). Proficient pronunciation enhances learners' intelligibility in authentic real-world settings. Nevertheless, traditional methods of pronunciation instructions often grapple with the challenges of delivering personalized feedback and tailored practice opportunities, creating a demand for innovative solutions (Mahdi, Alkhammash, & Al-Athwary, 2023). In recent years, there has been a rise in the development of AI-powered tools that aim to improve English pronunciation skills. These tools utilize sophisticated speech recognition algorithms, machine learning, and natural language processing (NLP) techniques to provide learners with adaptive learning experiences, real-time assessments, and personalized feedback (Gupta & Garg, 2023; Rusmiyanto et al., 2023).

The use of AI in the field of pronunciation instruction has great potential, particularly in the development of AI-powered pronunciation tutors. Instructors use AI algorithms to evaluate the pronunciation of learners and provide prompt feedback about mistakes in pronunciation. According to Aggarwal (2023), thanks to AI, the practice sessions are customized to meet the specific requirements of each student, hence ensuring a focused and personalized learning experience.

Moreover, significant progress has been made in the development of AI-powered interactive pronunciation training systems that aim to replicate genuine conversational situations. These systems provide learners with the opportunity to refine their pronunciation skills in a lifelike environment. Learners actively engage in dialogues with virtual agents powered by artificial intelligence. In these interactions, learners receive feedback on various aspects of their pronunciation, encompassing accuracy, stress, intonation, and rhythm. The interactive features of these systems enhance students'` involvement and facilitate the effective development of language skills (Alimbaeva, 2023; Fraiwan & Khasawneh, 2023).

The employment of AI has been emphasized in studies as a medium to enhance English pronunciation skills. Research outcomes indicate that those who utilize AI-driven pronunciation tools, from well-known websites and apps such as Google Translate (GT) to apps like ELSA, display improvements in their capacity to pronounce words correctly, speak with fluency, and convey their ideas clearly. De la Vall and Araya (2023) propose that AI technologies furnish learners with personalized feedback and focused practice chances, enabling them to adeptly tackle specific pronunciation challenges. Consequently, learners experience a holistic enhancement in their overall pronunciation abilities.

Additionally, AI-powered pronunciation tools offer learners increased flexibility and convenience, permitting them to easily and independently utilize these tools, regardless of their location and time. This heightened accessibility has extended the scope of pronunciation instruction, making it possible for a wider array

of learners in diverse educational settings to access its advantages (Alvarez & Lane, 2023; Getman et al., 2023).

Nevertheless, despite their potential, AI-driven pronunciation tools encounter certain obstacles and constraints. Significant efforts are now being made in the field of research to improve the precision of AI algorithms in the evaluation of pronunciation errors and the provision of feedback. AI techniques may exhibit inconsistent performance in accurately capturing the intricate nuances of pronunciation and accommodating individual differences. As a result, it is widely acknowledged that there exists a need to complement AI-driven training with human feedback and assistance to provide a thorough and nuanced approach to the instruction of pronunciation (Amin, 2024; Huang, Zou, Cheng, Chen, & Xie, 2023; Mavjudovna, 2023; Yesilyurt, 2023).

Indeed, the use of artificial intelligence to enhance English pronunciation has potential to enhance learners' accuracy, fluency, and intelligibility in pronunciation. Pronunciation tools that use artificial intelligence provide individualized feedback and efficient practice chances, enabling learners to effectively tackle pronunciation difficulties (Andreevich, 2023). However, the literature review shows that further research is needed to refine AI algorithms, address accuracy limitations, and explore optimal integration strategies that combine AI-based instruction with human guidance. By leveraging the potential of AI in pronunciation instructions, educators can improve learners' pronunciation and contribute to their overall language proficiency.

Method

Participants

The participants were 78 English language learners from two levels of elementary and pre-intermediate in an IELTS preparation institute in Iran. The levels of the participants were identified based on their previous IELTS exams (elementary= 3-3.5 in IELTS and pre-intermediate= 4-5 in IELTS). The participants were divided into four classes, namely two experimental groups (elementary = 19 and pre-intermediate = 21) and two control groups (elementary = 18 and pre-intermediate = 20). In addition, 19 English language instructors experienced in using AI in speaking and pronunciation instructions were also included to provide insights from the perspectives of educators to answer the first and third research questions. The demographic information of the participants is presented in Tables 1 and 2.

Table 1. Demographic information of learners

	Group	Female	Male	Elementary	Pre-intermediate	Total
1	Experimental	20	18	19	21	40
2	Control	21	17	18	20	38
Total						78

Table 2. Demographic information of teachers

No	Female	Male	Age (average)	Teaching experience (average)
19	11	8	32	9

Research design

The research aimed to explore the use of AI in promoting English language pronunciation skills among learners. To achieve this objective, a mixed-methods approach was employed, combining both quantitative and qualitative data collection and analysis methods (Amin, 2024; Brusil, 2023). This design allowed for a comprehensive examination of the effectiveness and perceptions of AI-based pronunciation tools while capturing the nuances and insights provided by the participants.

The intervention

The course extended over a duration of two months, with sessions taking place three days a week, amounting to six hours of weekly instruction. For the control group, a frequent course book (English Pronunciation in Use) was used, while the experiment group used *Listnr* (https://listnr.ai/) and *Murf* (https://murf.ai/) AI tools. Listnr is an AI website that provides users with personalized pronunciation feedback and training. It uses advanced speech recognition algorithms, machine learning, and natural language processing techniques to analyze users' pronunciation and provide real-time feedback. Listnr also offers a variety of interactive exercises and resources to help users improve their pronunciation. Murf AI is another website that uses AI to help people improve their pronunciation. It offers a variety of features, including real-time feedback, personalized training, and interactive exercises.

In the control group, teachers adhered strictly to the instructions outlined in the course materials, which encompassed a range of activities, such as listening exercises, repetition drills, and spelling tasks. Conversely, in the experimental group, a departure from conventional methodologies was observed. While students engaged in a variety of activities, the primary emphasis was placed on speaking exercises, with a pronounced focus on refining pronunciation skills. Within this context, students were tasked with participating in speaking activities facilitated by AI-based tools, namely Listnr and Murf. These innovative tools provided students with real-time feedback on their pronunciation, allowing for immediate corrections and improvements. Subsequently, armed with this feedback, students engaged in further speaking practice under the supervision of teachers, consolidating their learning and fine-tuning their pronunciation skills in a dynamic and interactive learning environment.

Data collection

Pronunciation accuracy scores were collected from the participants before and after the intervention period using AI-based pronunciation tools. In both the pre- and post-tests, the students had a speaking test with a main focus on their pronunciation. The tests were administered by teachers. The pre-test established a baseline, and the post-test measured the impact of the intervention. The results of these tests were an answer to the first research question. A questionnaire was structured by the researcher based on the previous studies (e.g., Miladiyenti, Rozi, Haslina, & Marzuki, 2022; Silaen & Rangkuti, 2022), and Cronbach`s alpha was utilized to measure its reliability, which was 0.82, indicating a high reliability of the test results. The researcher administered it with the assistance of other teachers to collect quantitative information on participants' preferences, perceived

effectiveness when using AI-based pronunciation tools, and other pertinent factors. Likert-scale questions and closed-ended items were utilized to ensure ease of analysis. The questionnaire results answered the second and third research questions. To obtain in-depth qualitative data, semi-structured interviews were conducted with a subset of participants who were chosen randomly. The interviews explored participants' experiences with AI-based tools, their perceptions of benefits and challenges, and their recommendations for improvements. Responses to the interview questions were confirmation answers to the second and third research questions.

Data analysis

Pre-test and post-test scores were compared using paired t-tests to determine if there was a significant improvement in pronunciation accuracy after using AI-based tools. Descriptive statistics, such as frequencies and percentages, were used to analyze the questionnaire responses. Thematic analysis was used to analyze the interview transcripts. The qualitative data was organized into themes and categories to identify patterns and provide in-depth insights into participants' experiences and perceptions. Quantitative and qualitative findings were compared and integrated through a process of triangulation. This integration helped validate and complement each other, providing a more comprehensive understanding of the research questions (Kazu & Kuvvetli, 2023; Maulana, Ahmad, & Kartini, 2024; Stamenkov, 2023). The research adhered to ethical guidelines, ensuring informed consent, confidentiality, and anonymity for participants. Ethical approval was obtained from the relevant institutional review board.

Reliability and validity

To ensure the reliability of the data collection instruments utilized in this study, several measures were taken. The pre-test and post-test measures for pronunciation accuracy were designed with careful consideration of the constructs being assessed. To establish test-retest reliability, a subset of participants (n=20) from the target population was selected (Kim & Su, 2024; Minor, Lundin, Myers, Fernández-Villardón, & Lysaker, 2023). The pre-test and post-test assessments were administered with a time gap of two months. Pearson correlation analysis was conducted on the scores, revealing a strong positive correlation ($r = 0.85$, $p<0.01$), indicating the stability of the measures over time. The questionnaire comprised Likert-scale items aimed at capturing participants' perceptions of AI-based pronunciation tools. Internal consistency was assessed using Cronbach's alpha, yielding a value of 0.87. The observed high value suggests that the items included in the questionnaire consistently assessed the same underlying concept, thereby establishing the instrument's reliability.

Ensuring the validity of the data collection tools was of utmost importance, and efforts were made to ensure both content and construct validity. The pre-test and post-test evaluations were subjected to thorough evaluation by professionals (N= 7) in the field of language instruction and specialists in phonetics (N= 4). The opinions and suggestions provided by participants were integrated to guarantee that the questions effectively assessed the participants' pronunciation skills. In addition, the questionnaire topics were carefully developed to include a wide range of variables pertaining to users' impressions of AI-based pronunciation tools. To

establish face validity, a pilot test was conducted on the questionnaire with a group of English language learners (n=15) in the same institutions. The participants were requested to provide feedback about the clarity of the items. Revisions were made based on the feedback. In addition, the questionnaire items underwent a rigorous content validation procedure, which included requesting feedback from experts (N= 7) in the field of language instruction and researchers (N= 5) with expertise in the relevant field. The interview questions were designed to align with the relevant structures of interest, notably focusing on the participants' experiences with artificial intelligence-based pronunciation tools. The inclusion of comments from language educators and phonetics experts served to strengthen the construct validity of the interview questions, guaranteeing that the questions effectively captured the perspectives and insights of the participants.

Findings and Discussion

Findings

Pre-test and post-test

AI-based tools impact on learners' pronunciation accuracy

Table 3 illustrates the results of the pre-test and post-test for both elementary and pre-intermediate classes in the experiment control groups.

Table 3. Results of pre- and post-test for both experiment and control groups

Groups	Pre-test	Post-test	Paired t-test
Group 1 Experiment	58.4% (SD = 8.2)	72.6% (SD = 7.5)	$p < 0.001$
Group 2 Experiment	59.8% (SD = 7.9)	74.2% (SD = 6.8)	$p < 0.001$
Group 1 Control	57.1% (SD = 9.0)	62.2% (SD = 8.5)	$p = 0.249$
Group 2 Control	58.6%(SD = 8.5)	64.4%(SD = 7.9)	P= 0.339

The results in Table 3 indicate that the experimental groups, which were subjected to pronunciation interventions using AI, exhibited significant improvements in pronunciation accuracy when compared to the control groups, which received traditional instructional methods. Both experimental groups had significant gains (for both groups, $p < 0.001$), as evidenced by post-test scores that were much higher than their respective pre-test scores. On the other hand, the control groups demonstrated negligible changes ($p = 0.249$ and P= 0.339) in pronunciation accuracy, indicating that conventional teaching in isolation would not have as significant an influence on pronunciation skills. These results highlight the potential efficacy of AI techniques in improving the pronunciation skills of those learning the English language.

Questionnaires

Learners` perception on benefits and challenges of using AI-based pronunciation tools

The questionnaire consisted of four sections. In the following part, the results of each section are presented.

Table 4. Section A: Impact of AI-based pronunciation tools

Items		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	AI-based pronunciation tools have significantly improved my English pronunciation.	0 %	1 %	0%	96%	3%
2.	I have noticed a positive change in my overall English pronunciation accuracy since using AI-based tools.	0 %	0 %	0%	97%	3%
3.	AI-based tools have helped me identify and correct specific pronunciation errors.	0%	1%	1%	95%	3%

In Table 4, the respondents overwhelmingly expressed positive perceptions regarding the impact of AI-based pronunciation tools on their English language pronunciation skills. An impressive 96% of participants agreed that these tools significantly improved their pronunciation, while 97% reported noticing a positive change in their overall pronunciation accuracy since using AI-based tools. Additionally, 95% of respondents agreed that AI-based tools assisted them in identifying and rectifying specific pronunciation errors.

Table 5. Section B: Perceived benefits and challenges of AI-based pronunciation tools

	Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4.	Using AI-based pronunciation tools has increased my confidence in speaking English.	0%	0%	4%	93%	3%
5.	AI-based tools have provided immediate feedback on my pronunciation, which is beneficial.	0%	6%	3%	88%	3%
6.	I find AI-based pronunciation tools engaging and motivating for practicing pronunciation.	0%	0%	0%	97%	3%
7.	The use of AI-based tools has made learning English pronunciation more enjoyable.	0%	0%	1%	96%	3%
8.	I sometimes find it challenging to interpret the feedback provided by AI-based tools accurately.	22%	47%	5%	26%	0%

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. AI-based tools do not always capture the nuances of my pronunciation accurately.	27%	17%	13%	39%	4%

In Table 5, students' perceptions of AI-based pronunciation tools' benefits and challenges are evident. The data reveals that a substantial 93% of respondents agreed that using these tools has increased their confidence in speaking English, underscoring their positive impact on learners' self-assurance. Furthermore, a significant 88% of participants found the immediate feedback provided by AI tools beneficial for pronunciation practice, and 97% considered them engaging and motivating for this purpose, suggesting that these tools enhance learning experiences. Additionally, 96% reported that AI-based tools make learning English pronunciation more enjoyable. However, it is noteworthy that a notable proportion (47%) found it somewhat challenging to interpret the feedback accurately, indicating room for improvement in the user interface or guidance. Similarly, 44% expressed concerns about the tools' ability to capture nuances in their pronunciation.

Table 6. Section C: Influence of individual learner characteristics

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
10. My current English proficiency level affects how I perceive the effectiveness of AI-based pronunciation tools.	12%	22%	9%	55%	3%
11. The user-friendliness of AI-based pronunciation tools varies based on my familiarity with technology.	6%	10%	0%	80%	4%

Participants' perceptions regarding how individual learner characteristics influenced their experience with AI-based pronunciation tools are presented in Table 6. Approximately 55% of respondents acknowledged that their current English proficiency level affects how they perceive the effectiveness of these tools, indicating that learners with varying proficiency levels may have different expectations or experiences when using AI-based pronunciation tools. Additionally, a substantial 80% of participants noted that the user-friendliness of these tools varies based on their familiarity with technology, highlighting the importance of considering learners' technological backgrounds when designing and implementing such tools.

Table 7. Section D: Overall experience and suggestions

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12. Using AI-based pronunciation tools has positively impacted my overall English language learning experience.	9%	17%	14%	59%	1%

Table 7 reflects participants' overall experiences with AI-based pronunciation tools and their suggestions. The data shows that 59% of respondents strongly agreed that using these tools has had a positive impact on their overall English language learning experience, suggesting that learners generally view these tools as valuable additions to their language learning journey. Additionally, 14% agreed, and 17% had a neutral stance on this statement, indicating a generally favorable perception of the impact of AI-based pronunciation tools. However, it is worth noting that 9% disagreed and 1% strongly disagreed, implying that a small portion of participants did not perceive a positive impact.

Interviews

Impacts of AI on Pronunciation

The perceptions of students and teachers regarding the impact of AI-based pronunciation tools varied. Some students expressed a positive impact, noting increased confidence resulting from these tools' immediate feedback and help in correcting pronunciation errors. One of the students admitted:

> *Before using these tools, I struggled with certain sounds, but the immediate feedback they provided helped me correct my mistakes. Now, I feel more confident in my pronunciation.* (Student 37)

In contrast, some teachers emphasized the significance of regular and consistent tool usage for noticeable improvements, suggesting that sporadic use might yield less noticeable results. Other teachers recognized the value of AI-based tools but refrained from describing their impact as "significant," stressing the importance of a comprehensive approach to pronunciation enhancement that includes these tools as part of a broader toolkit. They admitted:

> *I believe AI-based pronunciation tools do have a significant impact, but it also depends on how regularly students use them. When they use these tools consistently, I notice a marked improvement in my pronunciation. However, if they only use them occasionally, the impact is less noticeable.* (Teacher 11)

> *While AI-based pronunciation tools are helpful, I wouldn't say they have a 'significant' impact on my pronunciation. They certainly help, but pronunciation improvement also requires more practice and integrating other methods. So, they are a valuable addition to my learning toolkit, but not the sole factor.* (Teacher 5)

Benefits and challenges of using AI

The perceptions shared by students and teachers highlighted both the benefits and challenges associated with AI-based pronunciation tools. Some students underscored the immediate feedback these tools provided, which has led to noticeable improvements in their pronunciation. However, they also acknowledged the challenge of accurately interpreting this feedback at times. A number of teachers emphasized the motivational aspect of these tools, as they encouraged students through the visual improvement of their pronunciation scores. Still, the teachers acknowledged that AI tools could not fully replace human interaction in language learning. Other teachers appreciated the convenience of AI tools, emphasizing their

flexibility for learners who can practice pronunciation at their own pace. However, technical issues, such as voice recognition errors, posed occasional challenges, potentially disrupting students' practice sessions. The following are some representative responses:

> *One of the major benefits of AI-based pronunciation tools is the immediate feedback they offer. This helps me pinpoint my mistakes and make corrections on the spot, which has significantly improved my pronunciation. However, sometimes I find it challenging to interpret the feedback provided by AI tools accurately.* (Student 7)

> *I find AI tools highly motivating. They provide a sense of achievement when students see their pronunciation scores improve. This motivates them to practice more regularly and with enthusiasm, but they can't replace the experience of speaking with humans.* (Teacher 16)

> *AI tools are convenient because I can use them anytime, anywhere. This flexibility fits well with my schedule, allowing me to practice pronunciation even during short breaks. One challenge is that we`ve encountered occasional technical issues with AI tools, like voice recognition errors. These disruptions can be frustrating and disrupt students` practice sessions.* (Teacher 9)

Influence of language proficiency on perceptions of participants

The perceptions of students and teachers indicate that language proficiency levels play a crucial role in shaping how AI-based pronunciation tools are utilized, with beginners relying heavily on these tools for foundational support and pre-intermediate learners using them selectively for targeted practice and fine-tuning pronunciation. Here are some exemplar responses provided for reference:

> *I use AI tools a lot. They show me how to say words correctly, and I can practice until I get them right. It's like having a friendly teacher on my computer.* (Elementary student 13)

> *I'm at a pre-intermediate level, so I use AI tools when I want to work on specific sounds or words. They are useful for focused and specific practice. I use them occasionally when I see a need for further assistance.* (Pre-intermediate student 3)

> *Based on my own observations, the level of proficiency among learners has a notable impact on their perception and use of AI-driven pronunciation tools. Beginner individuals sometimes strongly depend on these tools due to their ability to provide fundamental assistance. The rapid response is seen as comforting by individuals. In contrast, individuals with a higher level of proficiency may use these resources as extra tools to refine their pronunciation or address particular difficulties.* (Teacher 5)

Discussion

The findings of this research might provide significant contributions to understanding the effects of AI-driven pronunciation tools on individuals learning the English language. Moreover, they shed light on the advantages and difficulties associated with these tools. The pre-test and post-test data answered the first

research question and indicated that the experimental groups, who received pronunciation interventions using AI, exhibited noteworthy improvements in pronunciation accuracy when compared to the control groups that received conventional teaching. This implies that the use of AI-based technologies may have a significant impact on the development of learners' pronunciation skills, highlighting the potential limitations of relying only on conventional instructional methods to achieve substantial advancements in this field. These results support the conclusions drawn from earlier research, which have also shown significant improvements in the accuracy of pronunciation among individuals using AI-based tools for pronunciation (Amin, 2024; De la Vall & Araya, 2023; Gupta & Garg, 2023; Persulessy, Nikijuluw, & Jakob, 2024; Rusmiyanto et al., 2023).

The findings of the research were corroborated by the data obtained from the questionnaire, as respondents mostly expressed positive perceptions towards AI-based pronunciation tools. A substantial percentage of the participants indicated agreement about the significant improvement of their pronunciation abilities and overall accuracy in pronunciation via the use of these tools. Additionally, these techniques were proven to be helpful in the identification and correction of certain pronunciation errors. The aforementioned results underscore the beneficial effects of AI technologies on the development of learners' pronunciation abilities, as they provide prompt feedback and tailored support. These results, answering the second research question, align with prior studies that have similarly indicated the positive perception of learners towards AI-based pronunciation tools as a means of enhancing pronunciation. However, learners may face challenges in effectively interpreting feedback and accurately capturing the subtleties of pronunciation, as noted by Alvarez and Lane (2023) and Fraiwan and Khasawneh (2023).

Nevertheless, the questionnaire also revealed several obstacles linked to pronunciation tools based on AI. Although the majority of the participants reported finding the comments interesting, motivating, and pleasurable, a significant subset had challenges appropriately understanding the feedback. This implies that there may be a need for enhancements in the user interface or assistance to optimize the user experience. Furthermore, there were expressed concerns about the tools' capacity to accurately capture the subtleties of pronunciation, suggesting possible avenues for further improvement and enhancement.

The questionnaire responses also demonstrated the impact of levels of language proficiency and familiarity with technology, which was the answer to the third research question. The efficiency of AI-based tools was seen differently by learners at different levels of proficiency, highlighting the need for customizing these tools to cater to the distinct requirements and expectations of learners at various language development stages. The participants also emphasized the significance of their technical proficiency in relation to the user-friendliness of these tools, underscoring the need to take into account learners' technological backgrounds when designing such tools. The findings presented align with other studies, which have similarly shown that the proficiency levels of learners and their familiarity with technology play a role in shaping their interactions with AI-driven pronunciation tools (Huang et al., 2023; Mavjudovna, 2023; Yesilyurt, 2023).

The interviews yielded further insights, as several students reported heightened self-assurance and notable improvements in pronunciation because of the immediate feedback offered by AI-based technologies. These results confirmed

the results of the questionnaire, which answered the second research question. Nevertheless, educators have observed that the extent of the influence might be contingent upon the frequency and uniformity of tool use, since occasional usage may possibly lead to less discernible outcomes. Educators acknowledged the significance of AI-driven resources in pronunciation improvement, although they underscored the need to adopt a holistic methodology that encompasses a wide range of strategies, whereby these tools serve as a constituent component.

Conclusion

In a nutshell, this research investigated the use of AI in promoting English language pronunciation skills among language learners. The findings suggest that pronunciation accuracy may be significantly improved using AI-based pronunciation tools. These tools provide learners with individualized feedback and focused practice opportunities, therefore enhancing their ability to pronounce words correctly. The tools are often seen by learners as advantageous, motivating, and engaging. However, there are difficulties associated with understanding feedback and accurately capturing subtle differences in pronunciation.

This study emphasizes the need for educators to consider the integration of pronunciation tools powered by AI into their instructional methodologies, especially for learners seeking to enhance their pronunciation skills. However, it is crucial that we recognize and tackle the barriers that have been identified through the implementation of improved user interface design and support. Moreover, it is important to acknowledge the influence of certain student characteristics, such as language proficiency and technological familiarity, to effectively tailor the use of AI technologies.

This research endeavor enhances the understanding of the influence of AI on the process of language learning, particularly in relation to the instruction of pronunciation. This comment underscores the potential benefits of using AI tools while also highlighting the need to implement a comprehensive approach to enhancing pronunciation skills. By incorporating AI-based tools into language instruction and addressing the identified challenges, educators can foster improved pronunciation skills and more engaging language learning experiences for their students.

One limitation of this study is the relatively short duration of the intervention, which extended over two months. Longer-term investigations may provide a deeper understanding of the sustained impact of AI-based pronunciation tools on learners' skills. In addition, the study was conducted with English language learners in a specific educational context in Iran. Expanding the study to a more diverse and extensive participant pool from various cultural and linguistic backgrounds could enhance the generalizability of the findings.

The findings of this study carry several implications for both English language learners and educators. Firstly, the significant improvements in pronunciation accuracy observed in the experimental groups following AI-based interventions highlight the potential of AI tools to enhance learners' pronunciation skills. This implies that educators have to consider integrating AI-powered pronunciation instruments into their curriculum, specifically for learners who are aiming to enhance their pronunciation skills. These technologies have the

capability to provide tailored feedback and focused practice, successfully addressing specific issues in pronunciation for individuals.

Furthermore, the participants' overwhelmingly positive attitudes towards AI-based pronunciation tools underscore the motivational and engaging aspects inherent in these tools. These results provide instructors with a potential avenue to use these attributes to successfully boost students' engagement and motivation. It is essential to recognize that AI technologies have the potential to provide an engaging educational environment for students, especially in the context of pronunciation activities. However, it is important to recognize and tackle the issues that have been emphasized, particularly with the precise understanding of feedback, to fully use the advantages provided by these technologies.

Moreover, the impact of individual learner's characteristics, such as differing degrees of language proficiency and experience with technology, highlights the need for customized methodologies. When integrating AI technology into educational settings, it is important for educators to consider the proficiency levels of the learners. This entails ensuring that the AI tools used are in line with the learners' individual characteristics and anticipated outcomes. Additionally, offering assistance and support to those with little technological proficiency may greatly improve their overall user satisfaction. Furthermore, the viewpoints of instructors on the frequency and consistency of AI tool utilization underscore the need for thorough pronunciation instructions. While AI tools provide valuable support, they should be integrated into a broader array of strategies for pronunciation improvement. Educators have to prioritize a comprehensive technique that integrates AI-based technologies with other teaching methodologies in order to achieve a comprehensive advancement in pronunciation skills.

Subsequent investigations may direct their attention towards longitudinal studies to scrutinize the enduring effects of AI-driven pronunciation technologies. This could involve tracking learners' progress over an extended period, potentially several semesters, to understand how the sustained use influences pronunciation skills. Additionally, conducting comparative studies to evaluate the effectiveness of different AI-based pronunciation tools could be beneficial. Comparing various tools in terms of their impact on pronunciation accuracy, user experience, and engagement could assist educators and learners in selecting the most suitable options.

Investigating the integration of AI-based pronunciation tools with different pedagogical approaches could also provide valuable insights. For example, comparing the outcomes of using AI tools within task-based language teaching, communicative language teaching, and other instructional methods could shed light on their compatibility and effectiveness within various teaching frameworks. Moreover, comparative studies involving learners from diverse cultural and linguistic backgrounds could reveal the potential cultural influences on the perception and effectiveness of AI-based pronunciation tools. This could help tailor these tools to specific learner populations.

Data Availability

The data that support the findings of this study are available from the author, but to protect the participants' privacy, restrictions apply to the public availability of these data. The data are, however, available from the author upon reasonable request.

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Appendix

Appendix A

Questionnaire: AI and improving pronunciation skills

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Section A: Impact of AI-based Pronunciation Tools					
1. AI-based pronunciation tools have significantly improved my English pronunciation.					
2. I have noticed a positive change in my overall English pronunciation accuracy since using AI-based tools.					
3. AI-based tools have helped me identify and correct specific pronunciation errors.					

Items	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Section B: Perceived Benefits and Challenges					
4. Using AI-based pronunciation tools has increased my confidence in speaking English.					
5. AI-based tools have provided immediate feedback on my pronunciation, which is beneficial.					
6. I find AI-based pronunciation tools engaging and motivating for practicing pronunciation.					
7. The use of AI-based tools has made learning English pronunciation more enjoyable.					
8. I sometimes find it challenging to interpret the feedback provided by AI-based tools accurately.					
9. AI-based tools do not always capture the nuances of my pronunciation accurately.					
Section C: Influence of Individual Learner Characteristics					
10. My current English proficiency level affects how I perceive the effectiveness of AI-based pronunciation tools.					
11. 11. The user-friendliness of AI-based pronunciation tools varies based on my familiarity with technology.					
Section D: Overall Experience and Suggestions					
12. Using AI-based pronunciation tools has positively impacted my overall English language learning experience.					

Appendix B

Semi-structured Interview questions:

1. Describe a specific instance where an AI-based pronunciation tool helped you improve your English pronunciation.
2. What challenges, if any, have you encountered while using AI-based pronunciation tools? Provide examples.
3. How do you think AI-based pronunciation tools could be further enhanced to better assist English language learners like yourself?
4. Do you have any additional thoughts or experiences you would like to share regarding the use of AI in improving English language pronunciation skills?