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A Systematic Review on Artificial Intelligence Applications for Enhancing EFL Students' Pronunciation Skill

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Abstract

This systematic literature review examines the impact of AI applications, including ELAi app, ELSA Speak, and Lyra Virtual Assistant, on the pronunciation skills of English as a Foreign Language (EFL) students. By analyzing ten relevant articles published between 2018 and 2023, this review identifies the unique features and effects of these AI tools. ELAi app emphasizes spontaneous speech and topic development, offering comprehensive feedback. ELSA Speak accurately detects pronunciation errors and provides a wide range of lessons. Lyra Virtual Assistant acts as a conversational companion, supporting speaking abilities. The findings reveal that these AI applications have a positive influence on EFL students' pronunciation development, as evidenced by empirical research. Further recommendations for future research in the integration of AI in EFL education is enhancing personalization through AI tools that adapt to individual students' learning styles and needs. In summary, utilizing AI technology can empower EFL students to improve their pronunciation proficiency and enhance their overall English language learning experience.

Keywords: Artificial Intelligence; EFL, Pronunciation, Systematic Review

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INTRODUCTION

In the context of English as a Foreign Language (EFL) education, pronunciation is an important aspect in English learning process especially in speaking context that is often found challenging for EFL students. One of the main difficulties comes from the fact that English pronunciation is rather complicated because there are many sounds, diphthongs and intonation patterns that can be unknown for non-native speakers (Utami & Lintangsari, 2021). Moreover, the person's limited exposure to native speakers and the restricted practice opportunities will worsen the condition. In addition to that, individual differences in accent, dialect, and cultural backgrounds are also vital factors that shape the way students learn and use English sounds. Overcoming such difficulties, AI is an important part of the learning process which provides

the personalized feedback, interactive exercises and immersive experiences that are specific to the needs of each learner. For instance, according to Noviyanti (2020) AI-powered speech recognition software can analyze students' accent areas and suggest correcting feedback, while AI-implemented chatbots can have dialogues with students in conversational manner which is almost a real situation. Furthermore, students can be immersed in AI-generated voice clips which increases engagement and effectively academic performance in a more practical way when it comes to pronunciation.

Becoming aware of the fact that EFL students experience certain difficulties in the process of the pronunciation learning, researcher decides to form a systematic literature review on several Ai applications that can be effective in increasing EFL student's pronunciation ability. The related studies reveal that AI-powered tools are greatly identified as a substantial resource for EFL students but still there's very few researches on what components and tools are meant for the improvement of the pronunciation skills of EFL learners. This study focuses in seeing pronunciation as extremely essential skill to learn English as a foreign language and many students face difficulty in learning the pronunciation with the right accent and intonation and how Ai applications components and features can be affective to help students overcome those problem. The aim of this systematic review is to identify the main characteristics and effectiveness of the AI powered apps such as ELAi, ELSA Speak, and Virtual Assistant app which increase the fluency of the EFL learners.

Based on the literature review matrix it showed that ten papers on the topic of the efficacy of the ELAi app, Elsa speaks app, and Lyra Virtual Assistant app were chosen for in depth analysis. The outcomes demonstrate that these AI-powered tools are capable of bringing a big difference in students' speech production. The app has been recognized as a tool that provides detailed feedback for students' spontaneous speech and pronunciation skills by means of speech recognition technology which offers feedback on learners' pronunciation at every stage (Lehmann et al., 2020). This adaptive feedback includes corrections for words which are mispronounced, suggestions and explanations so as to better equip the learners in articulating correctly. The ELSA speaks app has been regarded as an efficient tool for increasing students' pronunciation skills because various studies prove its effectiveness in this field (Zakiyyah et al, 2022). Likewise, it was seen by Junaidi (2020) that the app, Lyra Virtual Assistant, is a valuable aid in boosting students' pronunciation. These AI based apps have the ability to help EFL students improve their pronunciation skills. They can help students develop the rhythm, stress, pitch and intonation. A study done by Qiao and Zhao (2023) showed that AI-based instruction can create significant impact on students' pronunciation ability that suggest platform like Lyra virtual assistant have a positive impact in enhancing students' pronunciation skills. Voice assistant like Lyra virtual assistant can give significant impact on students' performance, however the abundance of limitation of studies on Lyra virtual assistant might become the problem at proving the point.

This systematic literature review discusses the ELAi app, ELSA Speak, and Lyra Virtual Assistant application in terms of their features and effectiveness in improving EFL students' pronunciation ability. This paper will focus on previous research finding from 2018 to 2023 that is concerning AI application in EFL students' pronunciation development. Three potential applications that are chosen from ten potential articles (ELAi app, ELSA Speak, Lyra

Virtual Assistant) will be the primary source of this paper for achieving the aims of this paper namely: 1) to figure out the features of ELAi, Elsa Speak, and Lyra apps in developing EFL students' pronunciation skill, and 2) to discover the effect of ELAi, Elsa Speak, and Lyra apps in enhancing EFL students' pronunciation skill. Based on two interpreted goals, the research questions for this systematic literature review are:

1. What are the features of ELAi, Elsa Speak, and Lyra apps in developing EFL students' pronunciation skills?
2. What is the effect of ELAi, Elsa Speak, and Lyra apps in developing EFL students' pronunciation skills?

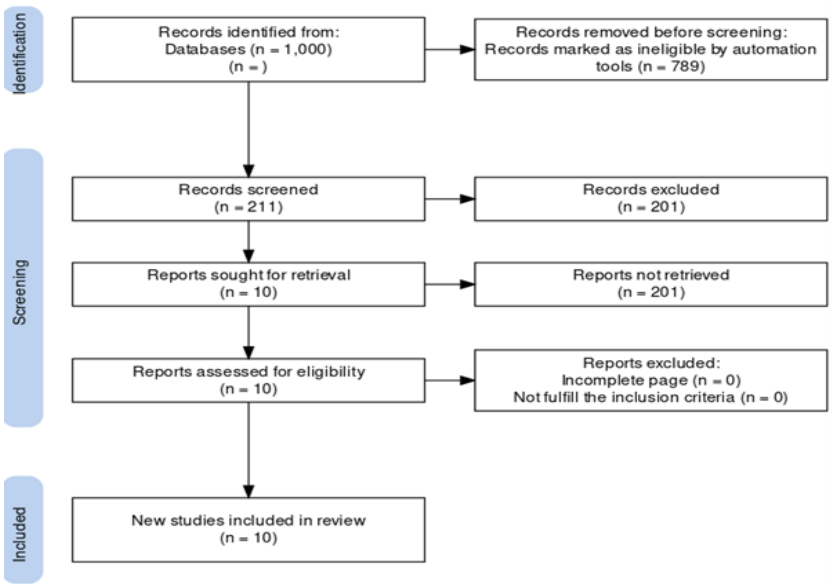
METHOD

The investigation on AI applications for EFL students' pronunciation enhancement was implemented by choosing articles in publication years: 2018-2024. To select the relevant information regarding the topic of AI applications for EFL students' pronunciation development, a systematic review method was applied. This paper also used PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to break down the process of finding articles and eliminate them in order to fit the topic interest. PRISMA model was implemented on behalf of finding the qualified indicator, the process of finding the articles, the articles' details, and the result of the articles.

Data Collection Technique

This paper used Harzing's Publish or Perish tool that was connected to Google Scholar as the primary source of the database. Google Scholar was implemented by inserting the keyword of topic interests. The keywords that were mentioned are "AI technology in EFL pronunciation" and "The use of AI in pronunciation development" with the setting of publication years: 2018-2024. In the process of recruiting the data, PRISMA guidance was implemented by following three steps. Those three steps were identification, screening, and data included. It started by having 1000 data from the database. To avoid irrelevant data from joining the SLR, the process of inclusion and exclusion was commenced.

Figure 1. PRISMA Diagram



To select the relevant articles, authors establish inclusion and exclusion criteria as follows:

Table 1. Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
AI Application in EFL Students' pronunciation skill enhancement	Not using AI applications in EFL students' pronunciation skill enhancement
Must revolve around thestudent's pronunciation skill or speaking.	The development of Reading, listening, and writing skills.
Empirical research	Non-empirical
Publication years in 2018-2023	Below publication years of 2018-2013
EFL students and teachers' context	Non-EFL students and teachers' context
English language	Non-English language

Data Analysis

The data selection is done by taking out articles that do not fit the study and keeping ten articles that discuss the use of AI applications in EFL students' pronunciation enhancement. From that data selection, ten main articles are selected and several other articles to support the main narrative. These articles are used to answer two of this study's research questions. Ten articles that are selected are all being reviewed in order to gather information that is important for this systematic literature review. From ten article that are gathered, all discussed about the impact of AI-based instruction application that are formed in different applications. The focus of this study is to discuss three selected applications from those ten articles, namely ELAi app, Elsa Speak app and Lyra Virtual Assistant app.

The purpose of this study not only to study those three applications but as well as answering two important research questions (1) What are the features of ELAi, Elsa Speak, and Lyra apps in developing EFL students' pronunciation skills? (2) What is the effect of ELAi, Elsa Speak, and Lyra apps in enhancing EFL students' pronunciation skills? that will build up the discussion of this systematic literature review. Author has provided several articles outside the selected articles to support the information of these three ai-based instruction applications. From there author can create a discussion by answering these two research questions.

The studies that were conducted on ELAi, Elsa Speak, and Lyra Virtual Assistant applications come from varied researchers, subjects and places. This study uses manual selection data with the help of PRISMA in the exclusion and inclusion process. In addition, this study's data findings are entirely grounded in the google scholar database by inserting keywords and years of published articles. This systematic literature review only reviews what the previous study found about three applications in relation to EFL students' pronunciation development. This systematic literature review will not create any findings outside of previous studies.

FINDINGS AND DISCUSSIONS

The researcher selected ten articles related to the use of AI applications in enhancing

pronunciation skills. In Table 2, ten articles are gathered as they fit with the criteria of AI applications in developing pronunciation topics. From ten published studies it is known that three of those articles are focused on certain applications in developing pronunciation skills and seven of those articles are more focused on AI applications in general. The final result of ten reviewed articles shows that only three AI applications that give a significant effect on students' pronunciation development.

The significant effect that ELAi, Elsa Speak, and Lyra Virtual Assistant are giving more potential changes to student's performance. Based on the previous study it is known that both ELAi and Elsa Speak applications study were conducted in China and Lyra Virtual Assistant applications were conducted in Indonesia. These three applications focused on improving EFL Students' pronunciation skills which are related to the topic that is being studied. According to research findings, the implementation of these applications has mostly occurred at junior high, senior high, and university levels. There are 10 articles that are selected to support this study and most of them are related to AI Applications and their related with EFL Students' Pronunciation skill development.

Table 2. An overview of selected articles

No	Authors	Findings	Methods	Future study
1	Humardhiana (2022)	AI apps have been shown to assist beginner newsreaders in improving their English pronunciation. After practicing for seven days, the beginner newsreaders demonstrated improvement in all evaluated aspects of pronunciation, including Accuracy, Key Words, Chunking and Pausing, Intonation, as well as Sounds and Vocal Features.	Classroom action research method	Future researchers are advised to conduct similar studies focusing on one or two specific English sounds and assessing them in multiple cycles.
2	Pennington et al (2019)	CAPT technology is the opportunity to provide automated feedback and the use of speech technologies can be particularly beneficial for giving feedback on pronunciation.	Systematic review method	More research is needed on the effectiveness of CAPT, particularly, the longer-term benefits, as well as more detailed, critical reviews of popular commercial software.
3	Ghafar et al (2023)	AI helps students to achieve more by giving varied information and give immediate feedback proven by applications that fulfill students' needs.	Library study research	Investigate the needs of teachers require-ments for using AI in the learning process.
4	Utami & Santosa (2023)	Previously reviewed articles stated Using VoiceThread could help students develop their English-speaking ability. The use of VoiceThread is more common abroad precisely in Iran and Russia.	Systematic method	Explore other Aspects than English speaking skills and conduct more research about the different stages of EFL and teachers of English language context

5	Lehman et al (2020)	The results showed that from the use of the ELAi app users didn't utilize the detailed feedback provided by the app and spent the majority of their time searching for prompts, completing new responses, and viewing shallow-level feedback.	Experiment-al research	Examine the relevant level of age on apply- ing the ELAi app for example applying ELAi app to English for young learners.
6	Shazly (2021)	AI applications in FL classrooms have the potential to positively Infl-uence FL learning outcomes. Therefore, educators, designers, and FL stakeholders should intelligently incorporate these applications to maximize learning benefits. This study adds to the existing body of knowledge on FLA acquisition by investigating the practical aspect of using AI to enhance speaking skills in FLA, supported by empirical evidence.	The pretest–posttest model generated both qualitative and quantitative data.	To improve future research, it would be helpful to involve more participants and collect qualitative data through weekly diaries that encourage reflection on specific prompts.
7	Zou et al (2020)	92 % of students agreed that social network-based was useful. The interactive and collaborative activities support studentsin developing. However, several students had problems with reading instruction and failed at doing so.	Mixed method	To apply social network-based interaction in lower levels of education, especially the secondary level.
8	Zou et al (2023)	On quantitative data analysis, 43.4 % of students believed that AI has a significant impact on their performance and 21.2 % did not and the rest had different opinions. Qualitative data analysis showed from the results of the interview students didn't know much about AI-ELL technology and some students couldn't identify their mistakes in the process.	Mixed method	Examine further knowledge gaps to match the relevance of Chinese student needs.
9	Zakiyyah et al (2022)	From 15 pronunciation applications, it is concluded that Elsa Speak is the most effective application because it provides so many advantages where it is free to	Descriptive qualitative method	It is expected that Elsa's speech should be applied at a higher educational level as a tool to improve pronunciation skills.

		download, can detect 90% accuracy of pronunciation mistakes, and has 1.200 lessons and an adaptive dictionary.		
10	Junaidi (2020)	The data distribution in the pre-test was normal and the difference in date in the pre-test was not significant. The result of the posttest showed that data distribution was normal and the data difference was slightly significant.	Quasi-experimental	The significant development of using Lyra virtual assistant in secondary school is expected to be used at the primary level too.

The systematic literature review aimed at finding the answers of formed research questions, namely 1) What are the features of ELAi, Elsa Speak, and Lyra apps in enhancing EFL students' pronunciation skills? And 2) What is the effect of ELAi, Elsa Speak, and Lyra apps in enhancing EFL students' pronunciation skills? From the PRISMA method it was found that Elai, Elsa speak, and Lyra applications have varied features that can affectively help students achieving their goals on enhancing their pronunciation skills.

English Language Artificial Intelligence (ELAi) app uses an automated speech recognition that can point out students' mistakes automatically that focuses on spontaneous speech delivery, detailed feedback, and topic development (Lehman et al., 2020). Several discoveries have shown that applying automatic speech recognition learning system can notably improve students' pronunciation ability, however when its accuracy it is not at 100 percent (Bashori et al., 2024). In terms of students' perspective ASR gives student personal in doing their speaking practice by giving feedbacks without the pressure of peers and teachers presence, in this sense it can also be said that ASR can reduce students' learning anxiety (Elimat & AbuSeileek, 2014). Despite of its enfeeblement ASR can somehow manage to improve students' pronunciation ability by providing detailed feedbacks and topic development as well as giving students personal learning space for practicing pronunciation. ELAi app is designed to improve pronunciation skills by using speech recognition that gives adaptive feedback for learner's pronunciation progress (Widyasari & Maghfiroh, 2023). This adaptive feedback is given in the form of corrections from mispronounced words, suggestions and explanations.

The findings show that ELAi application provides several AI features that can easily use by students, such as simple prompts, fast respond, and detailed-feedbacks. It focuses on improving student's pronunciation skill by doing spontaneous speech that later will be evaluated by the app. According to Lehman et al. (2020), User responses were evaluated with an automated speech recognition tool that used acoustic and language models to allow for the extraction of acoustic characteristics and creation of a response transcript. This method takes the average pronunciation level of standard speech as the basis of pronunciation error judgment, and judges the pronunciation and application of words such as speed, pronunciation, semantics, etc. (Liu & Quan, 2022). This system will later transcript a response in the formed of detailed-feedbacks that allow students to see what they did wrong. Another research done by Ai (2015) shows that detailed-feedback from AI system can be in the form of phoneme

substitution or distortion are detected with high accuracy, and at the same time, corrective feedback with multimedia support, which demonstrates how exactly error phonemes should be pronounced, is also generated. Not only ELAi application gives student fast and responsive detailed-feedbacks but it also provides topic-development in the term of multimedia support recommended by AI system that later on can be studied to improve pronunciation skill.

Ultimately, ElAi application has the potential to improve pronunciation skill by providing automated speech analysis, it uses spontaneous speech concept where students will speak spontaneously with their current pronunciation that will be evaluated afterwards by providing detailed-feedbacks and topic development. The effectiveness of ELAi application is also being questioned in this systematic literature review which proven effective since the features specifically automated speech recognition really help students improve their pronunciation skill. Study done by Cai et al. (2023) found that automated speech recognition can be affective system for practicing pronunciation in a way that it provides individualized feedback for mispronounced words. Another study showed the same result which said that ELAi application with the support of automated speech recognition can significantly increase students' pronunciation ability compared to without using automated speech recognition system (Sun, 2023). However according to Lehman et al. (2020) from previous articles that the use of the ELAi application showed that the app users did not utilize the detailed feedback provided by the app and spent the majority of their time searching for prompts, completing new responses, and viewing shallow- level feedback. It is further proven another study that stated the effectiveness of ElAi application on impacting students' pronunciation skill is still below par, with an effect size of 0.37 (Zou et al., 2023). Although ELAi speak is considered fast and efficient in term of providing real time feedbacks and topic development, it is also showed that ELAi speak cannot help increase student's performance in the bigger scale of score. Author also found that there need to be more studies conducted with ELAi application in order to develop the application according to what learners need.

Compared to ELAi application in terms of application features Elsa Speak has more advanced features that support pronunciation enhancement. Elsa Speak uses automated speech recognition feature to review pronunciation accuracy that will automatically give detailed-feedbacks (Becker, 2019). Becker further explains that Elsa Speak also offers features such as a "Word Bank," "ELSA Pronunciation Score," and "Assessment." "Word Bank" offers a progress summary in three sections: "Word Sound," "Word Stress," and "Conversation." Word sound specifies feedback about individual phonemes and word stress assesses syllable stress. The second progress feature, EPS, is a collection of scores from ELSA activities. The third progress feature, "Assessment," allows users to record 13 sentences and then gives feedback on segmental issues such as consonant clusters, aspiration sounds, and schwa. As for compatibility feature Elsa application can be downloaded both in play store for android users and apple store for IOS users. These features can certainly help users to practice their pronunciation, in fact several studies had proven that Elsa speak application is effective and increases student's ability in pronunciation.

One study from Anggraini (2022) discovered that ELSA speak application was considered effective in term of enhancing students' English pronunciation where the study used a pre-experimental research design. Furthermore, the study involved students at UPT SMP

Negeri 1 Sungguminasa and the results showed that ELSA application leveled up students' post-test score by (83.49) from (77.20) in pre-test. Different scale of effectiveness was also found in different previous study on Elsa speak application. The result of that study unfolded that elsa speak was notable in increasing students' pronunciation skill, it was supported by the result of post-treatment score which was 76.46 and pre-treatment score was 46.03 which indicated that elsa speak application left an excellent effect on student's pronunciation performance (Marjun & Sintang, 2022). Zakiyyah et al. (2022) in the other hand also believed from 15 pronunciation applications it is concluded that Elsa Speak is the most effective application because it provides so many advantages where it is free to download, can detect 90% accuracy of pronunciation mistakes and has 1.200 lessons and an adaptive dictionary. He further found that Elsa Speak is the most advantageous one because it provides the most material and a more advanced mistakes checker that has a significant effect on students' pronunciation skills.

Unlike Elsa speak, Lyra virtual assistant focuses on assisting users and answering questions. Junaidi (2020) expressed that the LVA employs natural language processing to control the user's device, provide recommendations, and respond to questions from users on a range of subjects. LVA stands out from other AIs because it can serve as the user's "talking friend" and has a variety of useful features like searching for YouTube videos, telling jokes, finding directions, managing a diary, setting alarms, and more. It makes LVA being user-friendly and appropriate for secondary school students. These features allow students to practice pronunciation with their own personalized learning space. As stated by Shemshack and Spector (2020) personalized learning spaces allow students to get customized approach in teaching and learning according to users' needs, interests, and situations. With personalized learning space that lyra virtual assistant application gives, it will empower student's motivation, engagement, understanding and overall learning effectiveness. In terms of its effectiveness, Lyra virtual assistant features give so many advantages in improving pronunciation skill, not only in personal use but also in large scale use. The study by Terzopoulos and Satratzemi (2020) found that voice assistants in application such lyra virtual assistant can be used as language partners for pronunciation training and it suggests that voice assistants can provide valuable learning paradigms such as conversational role play and pronunciation practice.

Based on the ten selected articles, it was found that ELAi and Elsa Speak provide more advanced features, including automated speech recognition, and detailed-feedback, that however have various effectiveness, according to multiple authors. For example, Elsa Speak was highlighted for its advanced features in some articles, such as personalized curriculum and assessment tools, which proved its effectiveness in several sources. At the same time, other applications, such as Lyra Virtual Assistant, offer approach accompanied by teacher's guidance and help students perform a variety of tasks with additional features such as personalized learning spaces, which were emphasized. While ELAi, and Elsa Speak have demonstrated a positive impact in regards to improving EFL learners' pronunciation skills, learners still need human guidance to ensure their pronunciation accuracy. AI helps with precise comments and speech recognition in an automated way, and yet it does not completely replace a teacher or a dictionary, which ensures the correct pronunciation produced by the learners. Thus, this AI is

mostly likely to support traditional approaches rather than replace them completely.

CONCLUSION

This systematic literature review explored the features and effectiveness of three AI applications namely ELAi app, ELSA Speak, and Lyra Virtual Assistant for improving English Language Skills among EFL students. Based on the documents that were published over the period of 2018 to 2023; the researchers identified that these applications provide features like voice recognized systems, detailed responses, personalized curriculum and personalized learning spaces. Both ELAi and Elsa Speak were pointed out to be more effective because of their innovative capabilities and the fact they improve pronunciation by different students found many praises. Meanwhile, Lyra Virtual Assistant differs with a different strategy, which rather focuses on individual classes along with other specific features marked for teacher's guidance. AI assisted apps may help EFL students who speak with accent to improve their pronunciation proficiency and make the overall English language learning a better experience. The degree of effectiveness may be different for each app. Moreover, it is essential to conduct more research on the life span of these strategies and whether or not they can be used to achieve maximum results in different educational settings.

REFERENCES

Ai, R. (2015). Automatic pronunciation error detection and feedback generation for CALL applications. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 9192, 175–186. https://doi.org/10.1007/978-3-319-20609-7_17

Anggraini, A. (2022). Improving students' pronunciation skill using Elsa Speak application. *Journey: Journal of English Language and Pedagogy*, *5*(1), 135–141. https://doi.org/10.33503/journey.v5i1.1840

Bashori, M., van Hout, R., Strik, H., & Cucchiarini, C. (2024). I Can Speak: Improving English pronunciation through automatic speech recognition-based language learning systems. *Innovation in Language Learning and Teaching*, 1–19. https://doi.org/10.1080/17501229.2024.2315101

Becker, K., & Edalatishams, I. (2019). ELSA Speak – Accent Reduction [Review]. In J. Levis, C. Nagle, & E. Todey (Eds.), *Proceedings of the 10th Pronunciation in Second Language Learning and Teaching Conference*, Ames, IA, September 2018 (pp. 434-438). Ames, IA: Iowa State University.

Cai, Y. (2023). The application of automatic speech recognition technology in English as foreign language pronunciation learning. Atlantis Press SARL. https://doi.org/10.2991/978-2-38476-068-8_44

Elimat, A. K., & AbuSeileek, A. F. (2014). Automatic speech recognition technology as an effective means for teaching pronunciation. *The JALT CALL Journal*, *10*(1), 21–47. https://doi.org/10.29140/jaltcall.v10n1.166

Ghafar, Z. N., Salh, H. F., Abdulrahim, M. A., Farxha, S. S., &. (2023). The role of artificial intelligence technology on English language learning: A literature review. *Canadian*

Journal of Language and Literature Studies, 3(2). https://doi.org/10.53103/cjlls.v3i2.87

Humardhiana, A. (2022). Ai-powered apps to enhance novice Bewsreaders' English Pronunciation. *ELT Echo: The Journal of English Language Teaching in Foreign Language Context, 7*(2), 214-223. https://doi.org/10.24235/eltecho.v7i2.12503

Junaidi, Hamuddin, B., Julita, K., Rahman, F., & Derin,T. (2020). Artificial Intelligence in EFL Context: Rising Students' Speaking Performance with Lyra Virtual Assistance. *International Journal of Advanced Science and Technology*, *29*(05), 6735 - 6741.

Lehman, B., Gu, L., Zhao, J., Tsuprun, E., Kurzum, C., Schiano, M., Liu, Y., & Tanner Jackson, G. (2020). Use of adaptive feedback in an app for English language spontaneous speech. *Artificial Intelligence in Education: 21st International Conference*, 309–320. https://doi.org/10.1007/978-3-030-52237-7_25

Liu, Y., & Quan, Q. (2022). AI recognition method of pronunciation errors in oral English speech with the help of big data for personalized learning. *Journal of Information & Knowledge Management, 21*(Supp02), 2240028. https://doi.org/10.1142/S0219649222400287

Marjun, A., Sa, L., & Kapuas Sintang, U. (2022). The effect of using Elsa Speak application for students' pronunciation at SMK Kesehatan f Kapuas Raya Sintang. *Edumedia: Jurnal Keguruan dan Ilmu Pendidikan, 6*(2), 41-46 https://doi.org/10.51826/edumedia.v6i2.665

Noviyanti, S. D. (2020). Artificial intelligence (AI)-based pronunciation checker: An alternative for independent learning in pandemic situation. *ELT Echo: The Journal of English Language Teaching in Foreign Language Context*, *5*(2), 162-169. https://doi.org/10.24235/eltecho.v5i2.7246

Pennington, M.C., Rogerson-Revell, P. (2019). Using technology for pronunciation teaching, learning, and assessment. In Research and practice in applied linguistics. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-137-47677-7_5

Qiao, H., & Zhao, A. (2023). Artificial intelligence-based language learning: illuminating the impact on speaking skills and self-regulation in Chinese EFL context. *Frontiers in Psychology, 14*(November). https://doi.org/10.3389/fpsyg.2023.1255594

Shazly, R. El. (2021). Effects of artificial intelligence on English speaking anxiety and speaking performance: A case study. *Expert Systems.* https://doi.org/10.1111/exsy.12667

Shemshack, A., & Spector, J. M. (2020). A systematic literature review of personalized learning terms. *Smart Learning Environments, 7*(1), 33. https://doi.org/10.1186/s40561-020-00140-9

Sun, W. (2023). The impact of automatic speech recognition technology on second language pronunciation and speaking skills of EFL learners: a mixed methods investigation. *Frontiers in Psychology, 14*(August). https://doi.org/10.3389/fpsyg.2023.1210187

Terzopoulos, G., & Satratzemi, M. (2020). Voice assistants and smart speakers in everyday life and in education. *Informatics in Education, 19*(3), 473–490. https://doi.org/10.15388/infedu.2020.21

Utami, I. A., & Lintangsari, A. P. (2021). English phonology for language learners: Exploring learners' preferences. *International Journal of Humanity Studies (IJHS), 4*(2), 247–255. https://doi.org/10.24071/ijhs.v4i2.3234

Utami, N., & Santosa, M. (2023). Using VoiceThread to develop the speaking skills of EFL learners: A systematic literature review. *Jurnal Inovasi dan Teknologi Pembelajaran, 10*(1), 83-91. https://doi.org/10.17977/um031v10i12023p083

Zakiyyah, F., Setyaji, A., & Ardini, S. N. (2022). The analysis of pronunciation application based on the concept of artificial intelligence. *Conference on Language, 2(1), 559-569.*

Zou, B., Guan, X., Shao, Y., & Chen, P. (2023). Supporting speaking practice by social network-based interaction in artificial intelligence (AI)-assisted language learning. *Sustainability, 15*(4), 2872. https://doi.org/10.3390/su15042872

Zou, B., Liviero, S., Hao, M., & Wei, C. (2020). Artificial intelligence technology for EAP Speaking Skills: Student Perceptions of Opportunities and Challenges. *In New language learning and teaching environment (pp. 433–463).* Springer. https://doi.org/10.1007/978-3-030-34212-8_17