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Enhancing EFL Speaking Proficiency through TalkPal AI and Automatic Speech Recognition

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ABSTRACT

Background: The integration of Artificial Intelligence (AI) into language education has created new opportunities to improve English as a Foreign Language (EFL) learners' speaking proficiency through interactive and personalized learning environments. One emerging platform is TalkPal AI, which incorporates Automatic Speech Recognition (ASR) technology to provide immediate feedback on learners' oral performance.

Purpose: This study aimed to investigate the effectiveness of TalkPal AI-assisted learning in enhancing EFL university students' speaking proficiency through Automatic Speech Recognition (ASR)-based learning.

Method: A quantitative approach employing a quasi-experimental nonequivalent control group design was used. The participants were 21 undergraduate students enrolled in the English Literature Study Program at Universitas Muhammadiyah Gorontalo, comprising an experimental group (n = 11) and a control group (n = 10). Students' speaking proficiency was assessed through pre-test and post-test speaking tasks using an analytic rubric covering pronunciation, fluency, grammar, vocabulary, and comprehension. The instrument demonstrated excellent inter-rater reliability (ICC = 0.987) and high rating consistency (Cronbach's α = 0.994). Data were analyzed using descriptive statistics, Shapiro–Wilk normality test, Levene's test, paired samples *t*-test, independent samples *t*-test, and Cohen's *d*.

Results and Discussion: Both groups showed significant improvement after instruction. However, the experimental group demonstrated a substantially greater improvement (mean difference = 42.09) than the control group (mean difference = 14.25). The independent samples *t*-test revealed a significant difference in post-test scores between the groups ($t = -14.470$, $p < .001$), with a very large effect size (Cohen's $d = 2.35$).

Conclusions and Implications: TalkPal AI-assisted learning supported by ASR technology was associated with significantly higher speaking proficiency than conventional instruction, indicating its potential to enhance technology-enhanced language learning in EFL speaking classrooms.

Keywords: *TalkPal AI; Automatic Speech Recognition; Artificial Intelligence; EFL Speaking Proficiency; Technology-Enhanced Language Learning.*

ABSTRAK

Latar Belakang: Integrasi *Artificial Intelligence* (AI) dalam pembelajaran bahasa membuka peluang untuk meningkatkan kemampuan berbicara mahasiswa *English as a Foreign Language* (EFL) melalui lingkungan belajar yang interaktif dan adaptif. Salah satu platform yang berkembang adalah TalkPal AI yang memanfaatkan teknologi *Automatic Speech Recognition* (ASR) untuk memberikan umpan balik secara langsung terhadap performa berbicara mahasiswa.
Tujuan: Penelitian ini bertujuan menganalisis efektivitas penggunaan TalkPal AI dalam meningkatkan kemampuan berbicara mahasiswa EFL.
Metode: Penelitian menggunakan pendekatan kuantitatif dengan desain kuasi-eksperimen *Nonequivalent Control Group Design*. Partisipan penelitian berjumlah 21 mahasiswa Program Studi Sastra Inggris Universitas Muhammadiyah Gorontalo yang terdiri atas kelompok eksperimen (n = 11) dan kelompok kontrol (n = 10). Kemampuan berbicara diukur melalui tes *pre-test* dan *post-test* menggunakan rubrik analitik yang mencakup *pronunciation, fluency, grammar, vocabulary,* dan *comprehension*. Instrumen menunjukkan reliabilitas antarpenilai yang sangat tinggi (ICC = 0,987) dan konsistensi penilaian yang sangat baik (Cronbach's α = 0,994). Analisis data dilakukan menggunakan statistik deskriptif, uji Shapiro–Wilk, uji Levene, *Paired Samples t-Test*, *Independent Samples t-Test*, dan Cohen's *d*.
Hasil dan Pembahasan: Kedua kelompok mengalami peningkatan kemampuan berbicara setelah pembelajaran. Namun, kelompok eksperimen menunjukkan peningkatan yang lebih besar (selisih rata-rata = 42,09) dibandingkan kelompok kontrol (selisih rata-rata = 14,25). Uji *Independent Samples t-Test* menunjukkan perbedaan yang signifikan pada skor *post-test* antara kedua kelompok ($t = -14{,}470$; $p < 0{,}001$) dengan ukuran efek yang sangat besar (Cohen's $d = 2{,}35$).
Kesimpulan dan Implikasi: Pembelajaran berbantuan TalkPal AI yang didukung teknologi ASR berkaitan dengan peningkatan kemampuan berbicara mahasiswa EFL yang lebih tinggi dibandingkan pembelajaran konvensional. Temuan ini menunjukkan bahwa TalkPal AI berpotensi menjadi alternatif yang efektif dalam mendukung pembelajaran bahasa berbantuan teknologi, khususnya untuk pengembangan keterampilan berbicara.

Kata Kunci *TalkPal AI; Pengenalan Ucapan Otomatis; Kecerdasan Buatan; Kemampuan Berbicara EFL,. Pembelajaran Bahasa Berbantuan Teknologi*

INTRODUCTION

The rapid advancement of artificial intelligence (AI) has significantly transformed the landscape of language education, particularly in the teaching and learning of English as a Foreign Language (EFL).[1] AI-powered technologies have created new opportunities for learners to engage in personalized, interactive, and autonomous language learning experiences. Among the four essential language skills, speaking is widely recognized as one of the most challenging competencies for EFL learners to develop due to limited opportunities for authentic communication, lack of immediate feedback, speaking anxiety, and insufficient exposure to target language environments. Consequently, researchers and educators have increasingly explored innovative technological solutions to facilitate speaking practice and improve learners' oral proficiency.[2]

Recent developments in speech processing technologies, particularly Automatic Speech Recognition (ASR), have demonstrated considerable potential in enhancing speaking instruction. ASR-based learning environments enable learners to receive immediate feedback on pronunciation, fluency, and speech accuracy, thereby supporting continuous self-improvement and autonomous

learning.[3] Furthermore, the emergence of AI-driven language learning platforms has expanded the possibilities of interactive speaking practice by providing learners with conversational partners that simulate real-life communication. One such platform is TalkPal AI, an AI-assisted language learning application that combines conversational interaction with speech recognition technology to support speaking development. Despite its growing popularity among language learners, empirical evidence regarding its effectiveness in improving EFL learners' speaking proficiency remains limited.[4]

The challenges associated with speaking proficiency continue to be a major concern in higher education contexts. Many EFL university students experience difficulties in expressing ideas fluently, producing accurate pronunciation, utilizing appropriate vocabulary, and maintaining grammatical accuracy during oral communication.[5] Traditional classroom instruction often provides limited opportunities for individualized speaking practice due to time constraints, large class sizes, and teacher-centered learning approaches. As a result, students frequently lack sufficient exposure to meaningful communicative practice and timely corrective feedback, which are essential for speaking development.[6]

Several previous studies have investigated the role of AI and speech recognition technologies in language learning. Khalkhmurzayeva et al. examined AI-enhanced pronunciation feedback systems and found that speech evaluation systems integrated with Dynamic Time Warping (DTW) improved pronunciation assessment accuracy and provided more effective feedback to learners. However, their study primarily focused on pronunciation evaluation rather than overall speaking proficiency. Similarly, Chen explored the use of Speech-to-Text Recognition (STR) technology for EFL oral training and reported significant improvements in students' speaking performance and motivation. Nevertheless, the study employed an action research design and did not specifically investigate AI-powered conversational learning platforms. Furthermore, Tsai investigated the effectiveness of learning materials based on Augmented Reality (AR) and Automatic Speech Recognition (ASR) technologies and found positive effects on students' listening and speaking performance. However, the focus of the study was on the integration of AR and ASR rather than AI conversational agents designed to facilitate interactive speaking practice.

Although previous studies have confirmed the positive impact of speech recognition technologies on language learning, several research gaps remain. First, existing studies have primarily focused on pronunciation assessment, speech recognition applications, or the integration of ASR with other technologies, while limited attention has been given to AI-powered conversational learning platforms such as TalkPal AI. Second, previous research has generally emphasized specific speaking components, including pronunciation and fluency, rather than examining speaking proficiency as a multidimensional construct encompassing pronunciation, fluency, vocabulary use, grammatical accuracy, and communicative effectiveness. Third, empirical studies employing a quasi-experimental design to evaluate the effectiveness of TalkPal AI-assisted learning in university EFL contexts remain scarce.[7] Finally, there is limited evidence regarding the implementation of TalkPal AI within higher education environments, particularly in contexts where English is learned as a foreign language.

To address these gaps, the present study introduces a novel perspective by examining the effectiveness of TalkPal AI-assisted learning through ASR-based interaction in enhancing EFL university students' speaking proficiency. Unlike previous studies that focused primarily on speech recognition systems or pronunciation feedback mechanisms, this study investigates TalkPal AI as an interactive conversational learning tool capable of providing real-time feedback and personalized speaking practice. The study also contributes to the growing body of literature on AI-assisted language learning by evaluating the pedagogical impact of an emerging AI platform within an authentic university EFL setting using a quasi-experimental approach.

The significance of this study lies in both its theoretical and practical contributions. Theoretically, it extends current understanding of how AI-assisted learning and ASR technologies can facilitate speaking development among EFL learners. Practically, the findings may provide valuable insights for educators, curriculum designers, and educational institutions seeking effective technological solutions to enhance speaking instruction and promote autonomous language learning. Additionally, the results may inform the integration of AI-powered learning tools into higher education language programs and contribute to the broader discussion on the role of artificial intelligence in language education.

Therefore, the main objective of this study is to investigate the effectiveness of TalkPal AI-assisted learning in enhancing EFL university students' speaking proficiency through Automatic Speech Recognition-based learning. Specifically, the study seeks to determine whether students who learn through TalkPal AI demonstrate significantly higher speaking proficiency than those who receive conventional instruction and to examine the extent to which AI-assisted speaking practice contributes to speaking development in EFL higher education contexts.

LITERATURE REVIEW

Speaking Proficiency in EFL Contexts

Speaking proficiency is widely regarded as one of the most important indicators of language competence in English as a Foreign Language (EFL) learning. It refers to an individual's ability to communicate ideas, thoughts, and information effectively and appropriately through spoken language.[8] Unlike receptive skills such as listening and reading, speaking requires learners to simultaneously employ linguistic knowledge, communicative strategies, and cognitive processing in real-time interactions. Therefore, speaking proficiency is often considered a complex and multidimensional construct that reflects learners' overall language competence.[9]

In EFL contexts, speaking plays a crucial role because it enables learners to participate in academic, professional, and social communication. The ability to communicate orally in English has become increasingly important in the era of globalization, where English serves as an international language for education, business, and intercultural interaction. Consequently, developing speaking proficiency has become one of the primary objectives of English language instruction in higher education. Students are expected not only to understand linguistic forms but also to use English effectively in authentic communicative situations.[10]

Speaking proficiency is commonly evaluated through several interrelated components. Pronunciation refers to the accurate production of speech sounds, stress, rhythm, and intonation patterns that contribute to comprehensible communication. Fluency reflects the ability to speak smoothly, naturally, and continuously with minimal hesitation.[11] Grammar involves the accurate use of linguistic structures and sentence patterns during oral communication. Vocabulary refers to the range and appropriateness of lexical items employed to express ideas effectively. Meanwhile, comprehension represents the ability to understand and respond appropriately to spoken interactions. These components collectively determine the overall quality of learners' speaking performance and are frequently used as assessment criteria in speaking evaluation.[12]

Despite its importance, speaking remains one of the most challenging language skills for EFL learners to master. Many university students experience difficulties in expressing ideas confidently and accurately in English due to limited opportunities for authentic communication, insufficient exposure to English-speaking environments, and anxiety associated with oral performance.[13] In addition, learners often struggle with pronunciation accuracy, limited vocabulary knowledge, grammatical errors, and a lack of fluency during spontaneous communication. These challenges may hinder students' willingness to participate in speaking activities and ultimately affect their overall speaking proficiency.

The challenges are particularly evident in EFL higher education settings, where classroom speaking practice is often constrained by limited instructional time, large class sizes, and teacher-centered learning approaches. As a result, students may not receive sufficient opportunities for individualized speaking practice and immediate corrective feedback, both of which are essential for speaking development. These limitations highlight the need for innovative instructional approaches and technology-assisted learning environments that can provide learners with greater opportunities to practice speaking, receive timely feedback, and develop their oral communication skills more effectively.

Technology-Enhanced Language Learning (TELL)

The rapid development of digital technology has significantly transformed educational practices across various disciplines, including language learning. Technological innovations have expanded access to learning resources, facilitated communication, and created more interactive learning environments.[14] In the field of English language education, technology has become an essential component in supporting teaching and learning processes, enabling learners to engage with authentic language materials and practice language skills beyond traditional classroom settings. As educational institutions increasingly integrate digital tools into instruction, technology-assisted learning has emerged as an important approach for improving language acquisition and learner engagement.[15]

Technology-Enhanced Language Learning (TELL) refers to the integration of technological tools and digital resources into language teaching and learning processes to facilitate language development. TELL encompasses a wide range of technologies, including computer-assisted language learning applications, mobile learning platforms, online learning environments, virtual reality, speech recognition systems, and artificial intelligence-based tools.[16] The primary objective of TELL is to create meaningful learning experiences that promote active participation, autonomous learning, and continuous interaction with the target language. Through technology-enhanced environments, learners can access learning materials anytime and anywhere, allowing them to engage in flexible and self-directed learning activities.

The growing adoption of artificial intelligence (AI) has further expanded the potential of TELL in language education. AI-powered technologies can analyze learner performance, provide personalized feedback, adapt learning materials to individual needs, and facilitate interactive communication experiences.[17] Unlike traditional educational technologies that primarily deliver content, AI systems can respond dynamically to learners' inputs and support individualized learning pathways. This capability enables language learners to receive immediate corrective feedback and engage in repeated practice, both of which are considered essential for language development.

Compared with traditional language instruction, technology-enhanced learning offers several pedagogical advantages. First, it provides learners with greater opportunities for practice and exposure to the target language beyond classroom limitations. Second, technology can deliver immediate feedback that helps learners identify and correct errors more efficiently. Third, digital learning environments support learner autonomy by allowing students to control the pace, frequency, and intensity of their learning activities.[18] Finally, technology-enhanced instruction often increases learners' motivation and engagement through interactive features and authentic communication opportunities. These advantages suggest that the integration of technology into language learning can contribute significantly to the development of language skills, particularly speaking proficiency, which requires continuous practice and timely feedback.

Given these benefits, TELL has become an increasingly influential framework in contemporary language education. The integration of advanced technologies, particularly artificial intelligence and speech recognition systems, offers promising opportunities to address challenges commonly faced by EFL learners. Consequently, investigating the effectiveness of AI-assisted

learning platforms within the TELL framework is essential for understanding how emerging technologies can support the development of speaking proficiency in higher education contexts.

Artificial Intelligence in EFL Learning

Artificial Intelligence (AI) has emerged as one of the most transformative technologies in contemporary education. In educational contexts, AI refers to computer systems and algorithms capable of performing tasks that typically require human intelligence, such as understanding language, recognizing speech, providing feedback, solving problems, and adapting learning experiences to individual learners.[19] The integration of AI into education has created new opportunities to improve teaching effectiveness, personalize learning experiences, and enhance student engagement. As digital technologies continue to evolve, AI has become increasingly prominent in language education due to its ability to support interactive and adaptive learning environments.

In English as a Foreign Language (EFL) learning, AI has been widely adopted to facilitate the development of various language skills, including listening, speaking, reading, and writing. AI-powered applications can analyze learners' performance, identify strengths and weaknesses, and provide customized learning recommendations. These capabilities enable learners to receive individualized support that may not always be available in traditional classroom settings. Consequently, AI has become an important tool for addressing common challenges faced by EFL learners, particularly those related to limited opportunities for language practice and feedback.[20]

One of the most significant applications of AI in language learning is its role as a conversational agent. AI-powered conversational systems can simulate human-like interactions, allowing learners to engage in meaningful dialogues and communicative activities. Through natural language processing and speech recognition technologies, conversational AI can understand learners' responses, generate appropriate replies, and maintain interactive conversations. This feature provides learners with opportunities to practice speaking in a low-anxiety environment where they can communicate freely without fear of negative evaluation. As a result, AI conversational agents can help learners develop confidence and improve their oral communication skills through repeated practice.

Another important advantage of AI-assisted learning is its capacity to support personalized learning. Traditional classroom instruction often follows a uniform approach that may not accommodate individual differences in learning pace, proficiency level, and learning preferences. In contrast, AI systems can adapt instructional content and learning activities based on learners' needs and performance. Personalized learning enables students to focus on specific areas requiring improvement, thereby increasing learning efficiency and promoting better learning outcomes. This adaptive capability is particularly beneficial in language learning, where learners frequently demonstrate diverse linguistic backgrounds and proficiency levels.

AI technologies also provide immediate feedback, which is considered a crucial factor in effective language learning. Feedback helps learners recognize errors, modify language use, and improve performance through continuous reflection and practice.[21] Unlike traditional learning environments, where feedback may be delayed due to classroom constraints, AI systems can provide real-time responses to learners' spoken or written input. Immediate corrective feedback enables learners to identify pronunciation errors, grammatical inaccuracies, vocabulary misuse, and communication breakdowns more efficiently, thereby facilitating faster language development.[22]

Furthermore, AI contributes to the promotion of autonomous learning by encouraging learners to take greater responsibility for their learning process. AI-powered applications allow students to access learning resources independently, practice language skills at their own pace, and monitor their progress through performance analytics.[23] This flexibility enables learners to

engage in self-directed learning beyond classroom hours and supports continuous language development. Autonomous learning is particularly important in EFL contexts, where exposure to authentic English communication may be limited and learners need additional opportunities for independent practice.

Given these advantages, AI has become an increasingly valuable component of modern language education. Its ability to function as a conversational partner, provide personalized instruction, deliver immediate feedback, and promote autonomous learning makes it a promising tool for enhancing language proficiency.[24] Therefore, investigating the effectiveness of AI-assisted platforms in supporting speaking development is essential for understanding their potential contribution to EFL learning in higher education settings.

Automatic Speech Recognition (ASR) Technology in Language Learning

Automatic Speech Recognition (ASR) is a technology that enables computer systems to recognize, process, and convert spoken language into written text automatically. By utilizing advanced algorithms, machine learning, and natural language processing techniques, ASR systems can analyze speech input and identify linguistic patterns to generate accurate textual representations of spoken utterances.[25] Initially developed for speech transcription and voice-command applications, ASR technology has increasingly been integrated into educational settings, particularly in language learning, due to its ability to provide real-time analysis of learners' spoken performance.

The operation of ASR technology generally involves several stages. First, the system captures learners' speech through a microphone and converts the audio signal into digital data. The speech input is then processed through acoustic and language models that identify phonemes, words, and sentence structures. Subsequently, the recognized speech is compared with target language patterns to determine its accuracy. Based on this analysis, the system generates feedback regarding pronunciation, fluency, and other aspects of oral performance.[26] Recent advancements in artificial intelligence and machine learning have significantly improved the accuracy and adaptability of ASR systems, allowing them to recognize diverse accents, speech rates, and speaking styles more effectively.

In language learning, ASR has become an increasingly valuable tool for developing speaking skills. The technology allows learners to engage in interactive speaking activities while receiving immediate feedback on their oral production. Unlike traditional classroom settings, where corrective feedback is often limited by time constraints and teacher availability, ASR enables continuous monitoring and evaluation of learners' spoken language. As a result, students can identify their weaknesses, make corrections, and improve their speaking performance through repeated practice.[27] This capability has made ASR particularly beneficial for EFL learners who require frequent opportunities to practice speaking outside the classroom environment.

One of the major advantages of ASR technology is its ability to provide immediate feedback. Timely feedback is widely recognized as a critical factor in effective language learning because it enables learners to recognize errors and make adjustments before incorrect language patterns become habitual. Through instant evaluation of spoken input, ASR systems facilitate continuous improvement and help learners develop greater awareness of their language use.

Another important benefit of ASR is pronunciation correction. Since pronunciation is often one of the most challenging aspects of speaking for EFL learners, ASR systems can assist students by identifying mispronounced words and highlighting areas requiring improvement. The technology provides learners with opportunities to compare their pronunciation with target language models and refine their articulation through repeated practice.[28] Consequently, ASR contributes to the development of clearer and more comprehensible speech.

ASR technology also supports self-paced learning. Learners can practice speaking independently without relying solely on classroom instruction or teacher supervision. This flexibility allows students to determine the frequency, duration, and intensity of their practice according to their individual learning needs.[29] Self-paced learning is particularly advantageous in EFL contexts, where exposure to authentic English communication is often limited. By enabling learners to practice anytime and anywhere, ASR promotes learner autonomy and encourages continuous language development beyond formal instructional settings.

Despite its advantages, ASR technology also has several limitations. The accuracy of speech recognition may be affected by factors such as strong accents, background noise, speech rate variations, and pronunciation errors. In some cases, ASR systems may incorrectly interpret learners' speech, resulting in inaccurate feedback. Furthermore, while ASR is effective in evaluating linguistic aspects such as pronunciation and fluency, it may be less capable of assessing higher-level communicative competencies, including pragmatic appropriateness, discourse management, and contextual language use.[30] Therefore, ASR should be viewed as a complementary learning tool rather than a complete substitute for human instruction and interaction.

Overall, ASR technology offers significant potential for enhancing speaking instruction by providing immediate feedback, pronunciation support, and opportunities for self-directed learning. These capabilities have contributed to the increasing adoption of ASR in AI-powered language learning platforms. One notable example is TalkPal AI, which integrates ASR technology with conversational artificial intelligence to facilitate interactive speaking practice and personalized feedback. Consequently, understanding the role of ASR is essential for examining how TalkPal AI may contribute to the development of EFL students' speaking proficiency.

TalkPal AI as an AI-Powered Speaking Learning Platform

TalkPal AI is an artificial intelligence-powered language learning platform designed to facilitate interactive and personalized language practice. The platform functions as a virtual language tutor that enables learners to engage in real-time communication through text and voice interactions.[31] By integrating conversational artificial intelligence and Automatic Speech Recognition (ASR) technology, TalkPal AI provides learners with opportunities to practice speaking in a flexible and autonomous learning environment.

One of the primary features of TalkPal AI is Conversational AI, which allows learners to participate in authentic conversations with an AI-powered language partner.[32] Through interactive communication, learners can express ideas, respond to questions, and engage in meaningful exchanges that resemble real-life communication. Such interaction provides valuable opportunities for developing speaking fluency and communicative competence.

Another important feature is ASR-based feedback, which automatically analyzes learners' spoken language and provides immediate feedback on pronunciation, fluency, and speech accuracy. Timely corrective feedback enables learners to identify linguistic errors and improve their oral production through repeated practice.[33] This feature supports the development of pronunciation accuracy and speaking confidence.

TalkPal AI also incorporates Dialogue Practice, which exposes learners to structured conversations based on everyday situations. Through repeated engagement with contextualized dialogues, learners can develop familiarity with common expressions, sentence patterns, and conversational strategies. Consequently, dialogue practice contributes to vocabulary development, grammatical accuracy, and communicative effectiveness.[34]

The platform further provides Roleplay Mode, allowing learners to simulate authentic communicative situations such as job interviews, restaurant interactions, travel conversations, and customer service encounters. Roleplay activities encourage learners to use language in context and

promote spontaneous speech production, thereby enhancing fluency, confidence, and pragmatic competence.[35]

In addition, Debate Mode enables learners to express opinions, defend arguments, and respond to opposing viewpoints on various topics. This feature promotes higher-order speaking skills by encouraging critical thinking, argumentation, and extended discourse production. As a result, learners are able to develop more sophisticated vocabulary usage, grammatical complexity, and communicative effectiveness.

Another distinctive characteristic of TalkPal AI is its Personalized Learning system. The platform adapts learning content and activities according to learners' goals, proficiency levels, learning preferences, and practice frequency. This adaptive learning environment allows learners to receive individualized learning experiences that match their specific needs, thereby increasing engagement and supporting continuous speaking development.[36]

Collectively, these features contribute to the development of speaking proficiency across its major dimensions, including pronunciation, fluency, grammar, vocabulary, and comprehension. By combining conversational practice, immediate ASR feedback, contextualized interaction, and personalized learning pathways, TalkPal AI provides an integrated environment that supports meaningful speaking practice and autonomous language learning for EFL students.

METHOD

This study used a quantitative approach with a quasi-experimental design (Nonequivalent Control Group Design).[37] This design was chosen to investigate the effectiveness of TalkPal AI-assisted learning through Automatic Speech Recognition (ASR) technology in enhancing EFL university students' speaking proficiency by comparing an experimental group and a control group.[38]

This design was chosen because the study was conducted in pre-formed classes (intact classes), so the researcher did not randomize individuals into experimental or control groups. Two classes with relatively comparable academic characteristics were selected purposively. One class was designated as the experimental group (n = 11) receiving TalkPal AI-assisted learning, while the other class became the control group (n = 10) receiving conventional speaking learning.[27]

Data were collected using an analytic speaking test administered as both a pre-test and a post-test. Students' speaking performances were assessed using an analytic scoring rubric consisting of five components: pronunciation, fluency, grammar, vocabulary, and comprehension. Each component was rated on a five-point scale and assigned an equal weight of 20%, with the total score converted to a 0–100 scale.

The speaking rubric was reviewed by experts in English language teaching and educational assessment to establish content validity. All speaking performances were audio-recorded and independently scored by two trained raters using the same assessment rubric. Inter-rater reliability was examined using the Intraclass Correlation Coefficient (ICC). The analysis yielded an ICC (Single Measures) of 0.987 (95% CI = 0.976–0.993, $p < .001$), indicating excellent agreement between the two raters. In addition, the reliability analysis produced a Cronbach's alpha coefficient of 0.994, indicating excellent internal consistency of the ratings.

The treatment was conducted over six weeks, comprising eight instructional meetings. Before the treatment, both groups completed a pre-test to determine their initial speaking proficiency. During the treatment phase, the experimental group practiced speaking using TalkPal AI, which integrates ASR technology to provide real-time feedback on pronunciation, fluency, and language accuracy. Meanwhile, the control group participated in conventional speaking activities

without AI-assisted support. At the end of the treatment, both groups completed a post-test to measure changes in speaking proficiency.[39]

The data were analyzed using SPSS through descriptive and inferential statistics. Descriptive statistics included means and standard deviations, while inferential analysis involved normality and homogeneity tests prior to hypothesis testing. A Paired Samples t-Test was used to examine improvements within each group, and an Independent Samples t-Test was conducted to compare the post-test speaking proficiency scores between the experimental and control groups. Because Levene's Test indicated unequal variances ($p < .05$), the results from the Equal Variances Not Assumed row were used for statistical interpretation.

RESULT AND DISCUSSION

This section presents the results of the statistical analyses conducted to examine the effectiveness of TalkPal AI-assisted learning in enhancing EFL students' speaking proficiency. The findings include descriptive statistics, normality and homogeneity tests, hypothesis testing, and effect size analysis. The results are subsequently discussed in relation to relevant theories and previous studies to provide a comprehensive understanding of the impact of TalkPal AI and Automatic Speech Recognition (ASR)-based learning on students' speaking development.

Descriptive statistics were calculated to provide an overview of students' speaking proficiency before and after the instructional intervention. As presented in Table 1, the two groups demonstrated relatively comparable speaking proficiency before the treatment. The control group obtained a mean pre-test score of 42.00 (SD = 4.16), whereas the experimental group achieved a slightly higher mean score of 44.91 (SD = 1.84). The difference between the two groups at the pre-test stage was relatively small, indicating that both intact classes had comparable initial speaking proficiency before the intervention.

Table 1. Descriptive Statistics of Students' Speaking Proficiency by Group

Group	N	Mean	SD	Median	Minimum	Maximum
Control Group (Pre-test)	10	42	4.16	43	36.5	47.5
Experimental Group (Pre-test)	11	44.91	1.84	45	41	47.5
Control Group (Post-test)	10	56.25	1.89	56.5	53.5	59.5
Experimental Group (Post-test)	11	87	6.76	89.5	74.5	94.5

Following the treatment, improvements were observed in both groups. The control group increased its mean score to **56.25** (SD = **1.89**), while the experimental group demonstrated a substantially greater improvement, achieving a mean post-test score of **87.00** (SD = **6.76**). The post-test results indicate that students who participated in TalkPal AI-assisted learning outperformed those who received conventional speaking instruction.

Furthermore, the descriptive statistics reveal that the experimental group achieved not only

a higher mean score but also a wider range of post-test scores (74.50–94.50) compared with the control group (53.50–59.50), suggesting that most students in the experimental group attained a considerably higher level of speaking proficiency after the intervention.

The descriptive findings indicate that both instructional approaches contributed to improvements in students' speaking proficiency. However, students who received TalkPal AI-assisted instruction consistently achieved substantially higher speaking scores than those who participated in conventional classroom instruction.

Before the intervention, the mean scores of the experimental and control groups differed by only 2.91 points (44.91 versus 42.00), suggesting that the two intact classes started from relatively comparable levels of speaking proficiency. After six weeks of instruction, the difference between the two groups increased markedly. The experimental group achieved a mean post-test score of 87.00, whereas the control group obtained 56.25, resulting in a difference of 30.75 points. This substantial improvement suggests that integrating TalkPal AI with Automatic Speech Recognition (ASR) technology provided additional learning benefits beyond those obtained through conventional speaking instruction.

The pedagogical features of TalkPal AI may explain the superior performance of the experimental group. The platform enables students to engage in repeated speaking practice while receiving immediate feedback on pronunciation accuracy, fluency, grammatical correctness, and vocabulary use. Such immediate and individualized feedback allows learners to recognize and correct their speaking errors during the learning process, thereby facilitating more effective language development.

These findings are consistent with the principles of technology-enhanced language learning, which emphasize that AI-assisted learning environments can promote active engagement, self-regulated learning, and continuous formative feedback. The availability of real-time corrective feedback through Automatic Speech Recognition may therefore explain the substantially higher speaking performance achieved by students in the experimental group.

Test of Normality

Prior to hypothesis testing, the normality of the data distribution was examined using the Shapiro–Wilk test, as each group consisted of fewer than 50 participants. The results are presented in Table 2.

Table 2. Tests of Normality for Pre-test and Post-test Scores

Group	Shapiro–Wilk Statistic	df	Sig.	Decision
Control Group (Pre-test)	0.898	10	0.208	Normally distributed
Experimental Group (Pre-test)	0.951	10	0.684	Normally distributed
Control Group (Post-test)	0.937	11	0.49	Normally distributed
Experimental Group (Post-test)	0.912	11	0.254	Normally distributed

The Shapiro–Wilk test indicated that all significance values exceeded the 0.05 threshold. The pre-test scores of the control and experimental groups produced significance values of 0.208 and 0.684, respectively. Likewise, the post-test scores of the control and experimental groups yielded

significance values of 0.490 and 0.254, respectively.

Since all significance values were greater than 0.05, the null hypothesis of normality was accepted. Therefore, the distributions of the pre-test and post-test scores in both groups were considered approximately normal. These findings indicate that the assumption of normality required for subsequent parametric analyses, including the Paired Samples t-Test and Independent Samples t-Test, was satisfied.

Based on the results of the Shapiro–Wilk test, there was no deviation from the normal distribution of data across all study groups. This indicates that the variation in students' speaking ability scores was still within the limits of normal distribution, so the use of parametric analysis to test the differences in scores before and after treatment and the differences between the experimental and control groups can be statistically justified.

Test of Homogeneity

The homogeneity of variance assumption was examined using Levene's Test prior to conducting the independent-samples comparison. The results are presented in Table 3.

Table 3. Test of Homogeneity of Variance

Test	Levene Statistic	df1	df2	Sig.	Decision
Based on Mean	14.471	1	19	0.001	Variances are not homogeneous
Based on Median	7.218	1	19	0.015	Variances are not homogeneous
Based on Median (Adjusted df)	7.218	1	11.139	0.021	Variances are not homogeneous
Based on Trimmed Mean	13.809	1	19	0.001	Variances are not homogeneous

The significance values obtained from Levene's Test were 0.001, 0.015, 0.021, and 0.001 for the four estimation methods, respectively. Since all significance values were below the 0.05 significance level, the assumption of equal variances between the experimental and control groups was not satisfied.

Accordingly, the independent-samples comparison was interpreted using the Equal Variances Not Assumed results (Welch's correction), which are more appropriate when the homogeneity assumption is violated.

The homogeneity test results showed that the variances between the experimental and control groups differed significantly. This indicates that the distribution of speaking ability scores in the two groups was not uniform after the treatment was administered. Therefore, using the Equal Variances Not Assumed result in the Independent Samples t-test is more appropriate than using the equal variance assumption.

Although the homogeneity assumption was not met, this did not preclude parametric analysis because the Welch's t-test procedure was designed to address differences in variance between groups while still producing robust estimates against violations of the homogeneity assumption.

Independent Samples t-Test

An Independent Samples t-Test was conducted to compare the post-test speaking proficiency of students in the experimental and control groups. Since Levene's Test indicated that the assumption of homogeneity of variance was violated (**p = .001**), the results from the **Equal Variances Not Assumed** row were used for interpretation.

Table 4. Independent Samples t-Test of Post-test Speaking Scores

Assumption	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper	Decision
Equal variances assumed	13.864	19	< 0.001	-30.75	2.218	35.392	-26.108	Significant
Equal variances not assumed	**14.47**	**11.694**	**< 0.001**	**-30.75**	**2.125**	**35.394**	**-26.106**	**Significant**

As presented in Table 4, the analysis revealed a statistically significant difference between the two groups, t(11.694) = -14.470, p < .001. The mean difference between the groups was -30.750 (SE = 2.125), with a 95% confidence interval ranging from -35.394 to -26.106.

These findings indicate that students who received TalkPal AI-assisted learning achieved significantly higher speaking proficiency than those who participated in conventional speaking instruction.

The results of the Independent Samples t-Test showed a significant difference between the experimental and control groups in post-test scores. The average difference of 30.75 points indicates that students learning using TalkPal AI achieved significantly greater improvement in their speaking skills than students who participated in conventional learning.

This finding indicates that the integration of Automatic Speech Recognition (ASR) in TalkPal AI positively contributes to the development of students' speaking skills. Through direct feedback on pronunciation, fluency, grammatical accuracy, and vocabulary usage, students have the opportunity to make continuous self-corrections during speaking practice. This allows for a more interactive, personalized learning process, and is oriented towards improving speaking performance.

Furthermore, the 95% confidence intervals, which were all below zero (-35.394 to -26.106), indicate that the differences between the two groups were consistent and not due to chance. Therefore, these results provide empirical evidence that TalkPal AI-assisted learning produces better speaking skills than conventional learning in the context of EFL students.

Paired Samples t-Test

A Paired Samples t-Test was conducted to determine whether students' speaking proficiency significantly improved within each group after the instructional intervention.

Table 5. Paired Samples t-Test for Pre-test and Post-test Scores

Comparison	Mean Difference	SD	SE	t	f	Sig. (2-tailed)	95% CI Lower	95% CI Upper	Decision
Control Group (Pre-test – Post-test)	-14.25	5.624	1.778	8.013	9	< 0.001	-18.273	-10.227	Significant
Experimental Group (Pre-test – Post-test)	-42.091	6.212	1.873	22.472	10	< 0.001	-46.264	-37.918	Significant

As presented in Table 5, both groups demonstrated statistically significant improvements between the pre-test and post-test. The control group showed a significant increase in speaking proficiency, $t(9) = -8.013$, $p < .001$, with a mean difference of -14.250 (95% CI = -18.273 to -10.227). Similarly, the experimental group demonstrated a much greater improvement, $t(10) = -22.472$, $p < .001$, with a mean difference of -42.091 (95% CI = -46.264 to -37.918).

Although both groups improved significantly after instruction, the magnitude of improvement in the experimental group was considerably larger than that observed in the control group. These findings suggest that students who received TalkPal AI-assisted learning achieved substantially greater gains in speaking proficiency than those who received conventional speaking instruction.

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The results of the Paired Samples t-Test showed that both conventional and TalkPal AI-assisted learning improved students' speaking skills. This was evident from the significance values for both groups, which were less than 0.05. Therefore, it can be concluded that speaking skills improved after the learning process in each group.

However, the magnitude of the improvement between the two groups differed significantly. The control group only experienced an average improvement of 14.25 points, while the experimental group experienced an improvement of 42.09 points. This significant difference in the magnitude of the improvement indicates that students learning using TalkPal AI experienced significantly greater learning benefits than those who participated in conventional speaking lessons.

The greater improvement in the experimental group can be explained by TalkPal AI's integration of Automatic Speech Recognition (ASR) technology. Through this technology, students receive direct feedback on pronunciation, fluency, grammar, vocabulary, and comprehension. Immediate, individualized feedback allows students to continuously correct errors throughout the speaking practice process, thus optimizing their speaking development.

Furthermore, the 95% confidence intervals for both groups did not cross zero, indicating statistically consistent improvement. However, the significantly larger t-value in the experimental group (-22.472) compared to the control group (-8.013) indicates a significantly greater magnitude of change in the experimental group. This finding corroborates the Independent Samples t-Test results, which showed a significant difference in post-test scores between the two groups. Overall, this provides evidence that the integration of TalkPal AI-based ASR contributes more effectively to improving EFL students' speaking skills than conventional learning.

CONCLUSION AND IMPLICATIONS

This study examined the effectiveness of TalkPal AI-assisted learning in improving EFL university students' speaking proficiency through the integration of Automatic Speech Recognition (ASR) technology. The findings showed that both the experimental and control groups demonstrated significant improvements in speaking proficiency following the instructional intervention. However, the experimental group achieved substantially greater improvement than the control group. The paired samples *t*-test confirmed significant gains within both groups, whereas the independent samples *t*-test revealed a statistically significant difference in post-test speaking proficiency between the experimental and control groups ($t = -14.470$, $p < .001$). Furthermore, the very large effect size (Cohen's $d = 2.35$) indicates that the difference between the two groups was not only statistically significant but also educationally meaningful.

The superior performance of the experimental group may be associated with the learning features provided by TalkPal AI, particularly its integration of conversational artificial intelligence and ASR technology. These features enable learners to engage in repeated speaking practice while receiving immediate feedback on pronunciation, fluency, grammar, vocabulary, and comprehension, thereby supporting more active, independent, and personalized learning experiences.

Despite these promising findings, the study has several limitations. The relatively small sample size, the use of intact classes within a single university, and the quasi-experimental design limit the generalizability of the findings to broader educational contexts. Future studies are therefore encouraged to involve larger and more diverse samples, employ longer intervention periods, and apply analytical approaches that better control for initial group differences. Further research may also explore the influence of AI-assisted speaking platforms on learner motivation, engagement, speaking anxiety, and long-term speaking development to provide a more comprehensive understanding of AI-supported language learning.

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