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THE IMPACT OF EXTENDED MOBILE-ASSISTED LANGUAGE LEARNING USING DUOLINGO AND WHATSAPP ON EFL SPEAKING ACCURACY AND FLUENCY: A COMPARISON ACROSS ADOLESCENT AND ADULT LEARNERS

Agus Mulyadi[1], Slamet Asari[*]
[1, 2]English Education Department, Universitas Muhammadiyah Gresik, East Java, Indonesia

Corresponding author's email: asari70@umg.ac.id

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Abstract: This study explores the impact of extended Mobile-Assisted Language Learning (MALL) instruction using Duolingo and WhatsApp on EFL learners' speaking accuracy and fluency across diverse age groups. While existing studies have explored MALL in language learning, there is a gap in research on its impact on speaking accuracy and fluency, especially with the use of Duolingo and WhatsApp across different age groups. The purpose of this study is to evaluate the effectiveness of extended MALL instruction in improving EFL learners' speaking skills, with a focus on accuracy and fluency. A quasi-experimental mixed-methods design was used, with 40 participants divided into an experimental group and a control group. Quantitative data were collected through pre-test and post-test speaking assessments, while qualitative data were gathered through questionnaires and semi-structured interviews. Data were analyzed using SPSS, including descriptive statistics, paired sample t-tests, independent sample t-tests, and effect size analysis. The results showed that the experimental group experienced statistically significant improvement in both speaking accuracy and fluency ($p < 0.001$), with large effect sizes ($d = 1.85$ for accuracy and $d = 1.72$ for fluency), whereas the control group showed no statistically significant improvement ($p > 0.05$). Significant differences were found between the two groups, confirming the effectiveness of the MALL intervention. Additionally, adolescents showed greater improvements in fluency, while adult learners demonstrated stronger improvements in accuracy. The study concludes that extended and integrated MALL instruction using Duolingo and WhatsApp provides a balanced and effective approach to developing speaking skills in EFL contexts. It highlights the importance of combining structured and communicative tools for optimal language learning outcomes.
Keywords: *Mobile-Assisted Language Learning; Duolingo; WhatsApp; speaking accuracy; speaking fluency; EFL learners.*

INTRODUCTION

Mobile-Assisted Language Learning (MALL) has emerged as a pivotal approach in language education by leveraging modern technology to create flexible, accessible, and interactive learning environments that positively influence EFL learners' speaking proficiency (Apoko et al., 2023; Irzawati & Unamo, 2023; Benlaghrissi & Ouahidi, 2024). It allows students to learn anytime and anywhere using mobile devices, making the learning process more flexible and accessible compared to traditional classroom settings. This flexibility is particularly important in modern education, where learners are expected to be more independent and actively engaged in their own learning process. By using mobile technology, students are not only exposed to language input in the classroom but also outside the classroom, which increases their opportunities to practice and improve their language skills. Such continuous exposure is essential in language learning because it supports retention and reinforces previously learned material.

Recent studies have increasingly demonstrated

that Mobile-Assisted Language Learning (MALL) significantly enhances learners' speaking performance and engagement, particularly when supported by interactive and sustained learning environments (Sabiri et al., 2022).

Speaking proficiency, particularly in terms of accuracy and fluency, remains one of the most challenging aspects of EFL learning. This study is grounded in several major theories of second language acquisition. Krashen's Input Hypothesis emphasizes the importance of comprehensible input slightly beyond a learner's current proficiency level (i+1) as the key to language development, as confirmed by recent research showing that AI-generated graded reading materials significantly improve oral proficiency in EFL learners. Long's Interaction Hypothesis highlights the role of interaction in facilitating acquisition through negotiation of meaning, clarification requests, and feedback, which remains a foundational framework in contemporary SLA research (Huang, Lu, & Ou, 2024). Swain's Output Hypothesis stresses the importance of language production and feedback in developing communicative competence, as learners notice gaps in their linguistic knowledge while producing the target language, a concept that continues to influence research in collaborative dialogue and metalinguistic reflection (Gong, 2023). Speaking accuracy relates to the correct use of grammar, vocabulary, and pronunciation, whereas fluency refers to the ability to produce speech smoothly and confidently (Pham, 2025). Many learners struggle to develop both aspects due to limited exposure to real communication and insufficient opportunities for sustained practice. In this context, extended use of MALL offers a potential solution. Mobile applications like Through gamification and structured practice, Duolingo promotes learners' accuracy, whereas WhatsApp fosters speaking fluency by enabling interactive and collaborative communication in real-time (Jia, 2025; Putri & Degeng, 2024; Benlaghrissi & Ouahidi, 2024). When used together over time, these platforms can contribute to a more balanced development of speaking skills.

In addition, the integration of mobile technology into language learning is closely related to the broader concept of Computer-Assisted Language Learning (CALL), where technology plays a central role in facilitating learning. In this context, MALL can be seen as an extension of CALL that emphasizes mobility, accessibility, and real-time interaction. The use of mobile devices enables learners to access various learning resources, including applications, videos, and communication platforms, which can support different aspects of language development. Furthermore, mobile learning environments provide opportunities for personalized learning, allowing students to learn at their own pace and according to their individual needs. This personalization is considered beneficial because learners have different learning styles and preferences, and mobile technology can accommodate these differences effectively (Trianasari et al., 2025).

Among various mobile applications, Duolingo and WhatsApp are widely used in language learning contexts. Duolingo provides structured learning activities that focus on vocabulary and grammar through repetition, immediate feedback, and gamified features. These features help learners stay motivated and engaged, as they can track their progress and receive instant responses to their answers. Recent research highlights the importance of combining structured applications and communicative platforms in MALL environments, where applications like Duolingo supports accuracy via repetition and feedback, and WhatsApp enhances speaking fluency by providing opportunities for meaningful, real-time communication (Shadiev et al., 2024; Apoko et al., 2023; Sesa & Margana, 2025). On the other hand, WhatsApp offers a more communicative environment where learners can interact with others using text, voice messages, and multimedia. This interaction allows students to use language in more authentic contexts, which is important for developing communicative competence and confidence in speaking (Khan et al., 2024).

Unlike previous studies that examined single platforms or short-term interventions. This current study covers those missing parts or gap. It attempts to provide language learners to use language communicatively, effectively, and contextually. This balance is important because language learning does not only involve understanding grammatical rules but also using the language effectively in real-life situations.

Recent studies have increasingly confirmed that MALL significantly enhances EFL learners' speaking performance and engagement, particularly when combining structured practice platforms like Duolingo with communicative tools such as WhatsApp or AI-enabled chatbots (Shadiev et al., 2024; Ma et al., 2025; Shortt et al., 2023). However, most previous studies focused only on short-term interventions and single-platform applications, leaving limited

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understanding of the combined effect of extended six-week use of Duolingo and WhatsApp on speaking accuracy and fluency across adolescent and adult EFL learners, leaving a gap in understanding the extended and integrated use of multiple platforms across different learner groups.

In many cases, learners who focus only on grammar may struggle to communicate fluently, while those who focus only on communication may produce inaccurate language. Therefore, integrating structured learning with communicative activities can help learners develop both accuracy and fluency in a more balanced way. This integrated approach is increasingly recommended in language teaching as it addresses the limitations of using a single method (Thị & Ngọc, 2023).

Speaking is one of the most important yet challenging skills in language learning. It requires learners to produce language in real time, which involves both linguistic knowledge and cognitive processing. Accuracy in speaking refers to the correct use of grammar, vocabulary, and pronunciation, while fluency refers to the ability to speak smoothly and with minimal hesitation. Many learners find it difficult to achieve both aspects at the same time, especially in EFL contexts where opportunities for authentic communication are limited. Traditional classroom activities often emphasize controlled practice, which may help improve accuracy but does not provide enough opportunities for spontaneous communication. As a result, learners may know the rules of the language but struggle to use them in real conversations.

In this situation, MALL can provide additional support for speaking development by offering more opportunities for practice outside the classroom. Through mobile applications, learners can engage in repeated practice, receive immediate feedback, and participate in interactive communication over an extended period of time. This extended exposure is important because language learning is a gradual process that requires consistent practice. This design allowed for the comparison of learning outcomes between an experimental group receiving MALL-based instruction and a control group receiving conventional instruction, while also capturing learners' perceptions and experiences (Metruk, 2024; Hwang, Rahimi, & Fathi, 2024; Nguyen Huu, 2025).

Another advantage of using mobile technology in language learning is its impact on learners' motivation and engagement. Mobile applications are often designed to be interactive and user-friendly, which makes learning more enjoyable and less stressful. For example, gamification features in Duolingo can motivate learners to continue practicing, while social interaction in WhatsApp can create a supportive learning environment. These factors are important because motivation plays a key role in language learning success. When learners are motivated, they are more likely to participate actively and persist in their learning efforts (Dimas & Daulay, 2025). In addition, the informal nature of mobile communication can reduce anxiety, especially for learners who are hesitant to speak in traditional classroom settings.

Although recent studies have confirmed the effectiveness of MALL, most of them focus on short-term interventions and single-platform use, leaving limited understanding of extended and integrated applications across different learner groups. First, many studies focus on the use of a single application without examining how different platforms can be integrated to support multiple aspects of language learning (G.-J. Hwang et al., 2024). Second, most studies are conducted over a short period of time, which may not adequately capture the long-term or extended impact of MALL on language development, particularly in speaking. Since language acquisition requires continuous exposure and sustained practice, short-term interventions may not fully reflect learners' actual progress. Therefore, investigating extended MALL instruction becomes important in order to better understand its effectiveness in developing both accuracy and fluency over time. In addition, learner differences, such as age, are often overlooked, even though they may influence learning outcomes and technology use.

Based on these considerations, this study aims to investigate the impact of extended MALL instruction using Duolingo and WhatsApp on learners' speaking accuracy and fluency across different age groups. By combining structured learning and communicative practice over an extended period, this study seeks to provide a deeper understanding of how mobile technology can support speaking development. In addition, this study also explores learners' perceptions of using these applications, which can provide valuable insights into their effectiveness and practicality in real learning contexts. The findings of this study are expected to contribute to both theoretical and practical aspects of language learning, particularly in the integration of mobile technology in EFL contexts.

Based on these gaps, this study aims to

investigate the impact of extended MALL instruction using Duolingo and WhatsApp on EFL learners' speaking accuracy and fluency across different age groups. Specifically, this study addresses the following research questions: (1) to what extent does extended MALL instruction using Duolingo and WhatsApp improve EFL learners' speaking accuracy and fluency compared to conventional instruction, and (2) how do learners from different age groups perceive and experience the use of these platforms in supporting their speaking development? The novelty of this study lies in the integration of structured and communicative mobile tools within an extended instructional framework, the inclusion of both accuracy and fluency as key speaking indicators, and the examination of learner diversity through a quasi-experimental design involving different age groups. This study is expected to contribute to a more comprehensive understanding of how MALL can be effectively implemented to support speaking development in EFL learning environments.

METHOD

This study employed a quasi-experimental mixed-methods design to investigate the impact of extended Mobile-Assisted Language Learning (MALL) instruction using Duolingo and WhatsApp on EFL learners' speaking accuracy and fluency across different age groups. This design allowed for the comparison of learning outcomes between an experimental group receiving MALL-based instruction and a control group receiving conventional instruction, while also capturing learners' perceptions and experiences (Creswell, 2021). Quantitative and qualitative data were collected concurrently and integrated during the interpretation stage to provide a comprehensive understanding of both learning outcomes and contextual factors influencing the effectiveness of the intervention.

"The participants of this study consisted of 40 EFL learners, divided equally into two groups: an experimental group (n = 20) and a control group (n = 20). The participants were drawn from SMA Semen Gresik (ages 16–18) In the experimental group, there were 10 adolescent learners (16–18 years old) and 10 adult learners (18–22 years old). Similarly, the control group consisted of 10 adolescents and 10 adults and Politeknik Semen Indonesia (ages 18–22) and were selected using purposive sampling based on specific criteria, including access to mobile devices, prior familiarity with mobile learning applications, and willingness to participate in extended learning activities. Purposive sampling was applied to deliberately select participants who met these key characteristics relevant to the research objectives, as commonly recommended in recent methodological literature. This sampling approach ensured that all participants possessed sufficient technological readiness to engage with the MALL intervention (Assapari & Hidayati, 2023; Irzawati & Unamo, 2023; Nguyen Huu, 2025).

Data were collected using speaking tests, questionnaires, and semi-structured interviews. The speaking test was administered as both a pre-test and post-test to measure changes in learners' speaking performance. It assessed two key dimensions:

Accuracy: grammar, vocabulary, pronunciation
Fluency: speech rate, coherence, and smoothness

A standardized scoring rubric was used to ensure consistency, and two independent raters evaluated the performances. Inter-rater reliability was calculated using the Intraclass Correlation Coefficient (ICC = 0.87), indicating high agreement between raters.

The questionnaire consisted of 20 items measured on a five-point Likert scale, covering perceived usefulness, ease of use, engagement, and learning challenges. The instrument was validated through expert judgment and pilot testing, while its reliability was assessed using Cronbach's Alpha ($\alpha = 0.82$), indicating good internal consistency and exceeding the acceptable threshold of 0.70 (Cronbach, 1951; Jia, 2025).

In addition, semi-structured interviews were conducted with selected participants to explore their experiences and perceptions in greater depth. All interviews were audio-recorded and transcribed for analysis. Eight participants from the experimental group, consisting of four adolescents and four adults, were purposively selected for semi-structured interviews based on their level of engagement and willingness to share their learning experiences.

The data collection procedure was conducted in several stages. First, participants completed a pre-test to establish baseline speaking performance.

This was followed by a six-week treatment phase, during which:

The experimental group engaged in structured learning using Duolingo and communicative activities via WhatsApp, participants in the experimental group used Duolingo for approximately 30 minutes per day, five days per week, and participated in WhatsApp-based communicative activities for 30 minutes three

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times per week. During the six-week intervention, participants completed approximately 30 Duolingo lessons and 18 WhatsApp discussion sessions.

The control group received conventional classroom instruction consisting of teacher-led grammar explanation, reading comprehension exercises, and controlled speaking practice for 90 minutes per week without mobile-assisted integration.

After the intervention, A post-test was administered to measure improvement. Subsequently, participants completed the questionnaire, and selected individuals participated in interviews to provide qualitative insights (Olimat, 2024).

Quantitative data were analyzed using SPSS (Statistical Package for the Social Sciences). Descriptive statistics, including mean and standard deviation, were used to summarize learners' performance. Inferential statistics were conducted as follows: (1) Paired Sample t-test to examine within-group improvement (pre-test vs post-test) (2) Independent Sample t-test to compare differences between the experimental and control groups (3) Gain score analysis to examine differences across age groups

All statistical tests were conducted at a significance level of 0.05 ($p < 0.05$).

Qualitative data from interviews were analyzed using thematic analysis, involving coding, categorization, and theme development (Braun & Clarke, 2021). Two researchers independently coded 20% of the interview transcripts. The inter-coder agreement reached 89%, and themes were finalized through iterative discussion until consensus was achieved. The integration of quantitative and qualitative findings enabled data triangulation, enhancing the validity and depth of the study. Ethical approval for this study was obtained from the Research Ethics Committee of Universitas Muhammadiyah Gresik. All participants provided informed consent prior to participation, and parental consent was obtained for adolescent participants under 18 years old.

RESULTS AND DISCUSSION

Descriptive statistics

A closer inspection of the pre-test scores confirms this assumption. The mean differences between the experimental and control groups in both accuracy and fluency were minimal, with discrepancies of less than one point. Such small variations fall well within the expected range of natural variability and indicate that the two groups were statistically equivalent at baseline. This equivalence provides a solid foundation for meaningful comparison in the post-test phase.

The results showed that both the experimental and control groups had relatively comparable baseline scores prior to the intervention, indicating that the initial speaking proficiency of participants was relatively homogeneous. This baseline equivalence is essential in quasi-experimental research, as it minimizes selection bias and strengthens internal validity, allowing subsequent differences to be more confidently attributed to the intervention.

This finding is consistent with previous research emphasizing the importance of baseline comparability in experimental and quasi-experimental studies to ensure the validity of treatment effects (Creswell & Creswell, 2021). Studies in language learning contexts have similarly highlighted that equivalent starting points are crucial for accurately measuring instructional impact.

However, this study extends these findings by demonstrating that even when groups begin with comparable proficiency levels, the integration of extended and technology-enhanced instruction can lead to significantly different learning trajectories over time.

The results further showed that, following the six-week treatment period, a clear divergence emerged between the two groups. The experimental group demonstrated substantial improvement in both speaking accuracy and fluency, whereas the control group showed only marginal gains.

This finding is consistent with prior studies reporting that mobile-assisted language learning significantly enhances speaking performance and learner interaction compared to conventional instruction (G. J. Hwang & Xie, 2023). These studies highlight the role of mobile technologies in providing increased exposure and interactive learning opportunities that support language development.

However, this study extends previous findings by demonstrating that not only the use of MALL, but also its extended and integrated implementation through multiple platforms, plays a crucial role in producing more substantial improvements in speaking performance. While earlier research often focused on short-term interventions or single applications, the present study provides evidence that sustained and combined use of platforms such as Duolingo and WhatsApp can lead to more pronounced and meaningful gains in both accuracy and fluency.

Table 1. *Mean and standard deviation of speaking scores (N = 40)*

Group	Accuracy Pre (M±SD)	Accuracy Post (M±SD)	Fluency Pre (M±SD)	Fluency Post (M±SD)
Experimental (n=20)	62.45 ± 6.12	78.30 ± 5.87	60.25 ± 5.98	75.10 ± 6.20
Control (n=20)	61.80 ± 6.45	65.20 ± 6.10	59.90 ± 6.00	63.15 ± 5.95

The magnitude of improvement in the experimental group is particularly noteworthy. The mean gain of approximately +15.85 points in accuracy and +14.85 points in fluency reflects a substantial enhancement in speaking performance. Such gains indicate not only statistical change but also meaningful pedagogical progress, suggesting that learners were able to internalize and apply linguistic knowledge more effectively.

These findings are consistent with previous studies demonstrating the effectiveness of Mobile-Assisted Language Learning (MALL) in improving speaking performance. For instance, Hwang & Xie (2023) reported significant improvements in learners' speaking skills through mobile-based interventions, particularly in terms of increased engagement and interaction. Similarly, Recent studies have shown that app-based language learning can enhance learners' linguistic knowledge and oral ability through repeated practice and immediate feedback (Shadiev et al., 2024).

However, unlike many previous studies that focused on short-term interventions or single applications, the present study provides evidence of the effectiveness of extended and integrated MALL use. The combination of Duolingo and WhatsApp appears to support both form-focused learning and communicative practice, thereby facilitating balanced development in accuracy and fluency. This finding extends prior research by demonstrating that sustained exposure and platform integration can produce more substantial and meaningful gains in speaking performance.

Furthermore, while earlier studies often emphasized either accuracy or fluency, the current findings highlight the importance of addressing both dimensions simultaneously. This suggests that integrated MALL environments may offer a more holistic approach to speaking development. Therefore, the contribution of this study lies in demonstrating that extended, dual-platform MALL instruction not only enhances speaking performance but also promotes balanced language development across multiple dimensions.

In contrast, the control group exhibited only modest gains (+3.40 in accuracy and +3.25 in fluency). These limited improvements are likely attributable to normal learning progression rather than the impact of a structured instructional approach. Similar patterns have been reported in previous studies, where learners receiving conventional instruction showed minimal improvement in speaking performance due to limited opportunities for extended practice and authentic interaction (Hwang & Xie, 2023).

Traditional classroom settings often emphasize controlled and form-focused activities, which may support limited gains in accuracy but provide insufficient opportunities for spontaneous communication and fluency development (Tavakoli & Skehan, 2020). As a result, improvements in such contexts tend to be incremental rather than substantial.

The relatively small gains observed in the control group in this study are therefore consistent with earlier findings and highlight the limitations of conventional instruction when not supplemented with interactive and technology-enhanced learning environments. This discrepancy further underscores the effectiveness of the MALL intervention, which provides extended exposure, immediate feedback, and meaningful interaction opportunities that are often absent in traditional approaches.

From a pedagogical perspective, these descriptive findings suggest that extended exposure to mobile-assisted learning environments can significantly accelerate language development by providing continuous practice opportunities beyond the classroom. Practically, EFL teachers are encouraged to integrate both structured applications such as Duolingo and communicative platforms such as WhatsApp to support balanced development of speaking accuracy and fluency. Curriculum designers are also encouraged to develop extended MALL programs lasting at least six weeks to maximize language learning outcomes. This finding is consistent with previous studies highlighting the role of sustained practice and increased language exposure in improving learners' proficiency (Kukulska-Hulme, 2020). In particular, mobile-assisted environments enable learners to engage in repeated practice, receive immediate feedback, and access learning materials anytime and anywhere, all of which contribute to more effective language acquisition.

Moreover, prior research has emphasized that extended engagement with mobile learning tools leads to higher levels of learner autonomy and engagement, which are critical factors in language development (Lai & Zheng, 2023). Unlike traditional classroom instruction, which is often

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limited in time and interaction, MALL environments provide continuous and flexible learning opportunities that support both cognitive and communicative aspects of language learning.

Therefore, the findings of this study extend previous research by demonstrating that not only the use of mobile technology, but also the duration and continuity of its use, play a crucial role in accelerating language development. This highlights the importance of designing pedagogical interventions that incorporate sustained and integrated use of mobile learning platforms to maximize learning outcomes.

Normality test

Before conducting inferential statistical analysis, it is essential to verify whether the data meet the assumptions required for parametric testing. One of the key assumptions is that the data are normally distributed. Therefore, The Shapiro-Wilk test results indicated that all variables were normally distributed, including accuracy pre-test ($p = 0.132$), accuracy post-test ($p = 0.118$), fluency pre-test ($p = 0.145$), and fluency post-test ($p = 0.127$).

The results indicated that all variables both pre-test and post-test scores for accuracy and fluency produced significance values greater than 0.05 ($p > 0.05$). This indicates that the data did not significantly deviate from a normal distribution.

The confirmation of normality is critical for two reasons. First, it validates the use of parametric statistical tests such as paired sample t-tests and independent sample t-tests, which assume normally distributed data. Second, parametric tests are generally more powerful than non-parametric alternatives, meaning they are more sensitive in detecting true differences when they exist.

By meeting the assumption of normality, the study ensures that the subsequent statistical analyses are both appropriate and reliable.

Paired sample t-test (within-group analysis)

To determine whether the observed improvements within each group were statistically significant, paired sample t-tests were conducted comparing pre-test and post-test scores.

Experimental group

Accuracy: $t(19) = 11.02$, $p < 0.001$
Fluency: $t(19) = 10.21$, $p < 0.001$

These results indicate a highly statistically significant improvement in both dimensions of speaking performance. The extremely low p-values ($p < 0.001$) suggest that the probability of these improvements occurring by chance is exceedingly small. Moreover, the large t-values indicate a substantial difference between pre-test and post-test scores, reflecting the strong impact of the intervention.

This finding is consistent with previous studies that have demonstrated the effectiveness of Mobile-Assisted Language Learning (MALL) in enhancing learners' speaking performance. For example, Hwang and Xie (2023) and Rahimi & Fathi (2023) reported significant improvements in learners' speaking abilities when mobile technologies were integrated into language learning environments. Similarly, (Loewen et al., 2020) found that app-based language learning contributes to both linguistic accuracy and oral proficiency through repeated exposure and immediate feedback.

The substantial improvement observed in this study can be attributed to the complementary roles of the platforms used. Duolingo supports structured and form-focused learning through repetition and feedback, while WhatsApp facilitates meaningful interaction and real-time communication. This combination aligns with previous findings that emphasize the importance of integrating form-focused instruction with communicative practice to achieve balanced language development (Tavakoli & Skehan, 2020).

Furthermore, unlike many prior studies that examined single applications or short-term interventions, the present study demonstrates that extended and integrated use of multiple platforms can lead to stronger and more sustained improvements in speaking performance. This highlights the contribution of the study in showing that the effectiveness of MALL is not only determined by the type of technology used, but also by how it is combined and sustained over time.

From a theoretical perspective, these findings align with established principles of second language acquisition that emphasize the importance of input, interaction, and feedback. Specifically, Krashen's (1985) Input Hypothesis highlights the role of comprehensible input in language development, while Long's (1996) Interaction Hypothesis underscores the importance of interaction in facilitating language acquisition. In addition, Swain's (1985) Output Hypothesis emphasizes the role of language production and feedback in developing linguistic competence. The MALL environment in this study appears to have facilitated all three elements, thereby enhancing learning outcomes.

Control group

Accuracy: $t(19) = 1.85$, $p = 0.079$

Fluency: $t(19) = 1.72$, $p = 0.101$

In contrast, the control group did not show statistically significant improvement. Although slight increases in mean scores were observed, the p-values exceeded the conventional significance threshold ($p > 0.05$), indicating that these changes were not statistically meaningful.

This finding suggests that traditional instruction, in the absence of extended practice and interactive opportunities, may not be sufficient to produce significant improvements in speaking performance within a limited timeframe. This result is consistent with previous studies indicating that conventional classroom instruction often leads to limited progress in speaking skills due to restricted exposure and lack of authentic communication opportunities (Hwang & Xie, 2023).

In many traditional learning contexts, instructional practices tend to emphasize controlled exercises and form-focused activities, which may support incremental gains in accuracy but do not sufficiently promote fluency development or spontaneous language use (Tavakoli & Skehan, 2020). As a result, learners may acquire knowledge of linguistic forms without being able to apply them effectively in real-time communication.

Therefore, the limited improvement observed in this study reinforces earlier findings and highlights the need for more interactive and sustained learning environments. In contrast, technology-enhanced approaches such as MALL provide opportunities for continuous practice and meaningful interaction, which are essential for achieving more substantial improvements in speaking performance.

Additionally, the relatively low t-values in the control group indicate that the difference between pre-test and post-test scores was minimal, further reinforcing the limited effectiveness of conventional instruction in this context.

Effect size (Cohen's d)

While statistical significance provides evidence that an effect exists, it does not indicate the magnitude of that effect. Therefore, effect size was calculated using Cohen's d to evaluate the practical significance of the findings.

Accuracy (Experimental): $d = 1.85$

Fluency (Experimental): $d = 1.72$

These values represent very large effect sizes, significantly exceeding the conventional threshold of 0.80 for a large effect. Effect sizes of this magnitude indicate that the intervention had a powerful and meaningful impact on learners' speaking performance.

In practical terms, this suggests that the improvement observed in the experimental group is not only statistically detectable but also educationally significant. Learners did not merely improve slightly; rather, they experienced substantial gains in their ability to use language accurately and fluently.

This finding is consistent with previous studies that have highlighted the pedagogical effectiveness of mobile-assisted language learning in enhancing both linguistic accuracy and communicative fluency (Loewen et al., 2020). These studies emphasize that continuous exposure, immediate feedback, and interactive learning environments contribute significantly to meaningful language development.

Moreover, the substantial gains observed in this study support the argument that technology-enhanced learning environments can facilitate deeper language acquisition rather than surface-level improvement. This aligns with prior research suggesting that sustained engagement with mobile learning tools enables learners to internalize linguistic structures and develop greater automaticity in language use (Stockwell & Hubbard, 2021).

Therefore, the contribution of this study lies in demonstrating that extended and integrated MALL instruction not only produces statistically significant outcomes but also leads to practically meaningful improvements in learners' speaking performance, particularly in achieving balanced development of accuracy and fluency.

From an instructional perspective, such large effect sizes provide strong justification for the integration of MALL tools into language teaching practices. They suggest that the use of mobile-assisted learning is not simply an innovative approach, but a highly effective one.

Furthermore, the large effect sizes reinforce the argument that extended exposure to MALL environments can lead to accelerated language acquisition by providing learners with continuous opportunities for practice, feedback, and interaction. This finding is in line with previous studies that emphasize the effectiveness of mobile-assisted language learning in promoting sustained engagement and improving language proficiency (Hwang & Xie, 2023).

In particular, Loewen et al. (2020) highlighted that repeated practice and immediate feedback in

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app-based learning significantly contribute to the development of linguistic knowledge and oral skills. Similarly, Stockwell and Hubbard (2021) argued that extended exposure to mobile learning environments enhances language acquisition by increasing learners' access to input and opportunities for interaction beyond the classroom.

The large effect sizes observed in this study therefore not only confirm the statistical strength of the intervention but also support the pedagogical value of sustained and integrated MALL use. Unlike previous studies that examined single platforms or short-term interventions, this study integrates two complementary mobile platforms over six weeks and compares learning outcomes across adolescent and adult learners Theoretically, this study contributes to the development of MALL theory by demonstrating the effectiveness of integrating structured and communicative mobile platforms. Practically, the findings provide guidance for teachers and curriculum designers regarding effective implementation of MALL in EFL speaking instruction.

This highlights the contribution of the study in showing that the effectiveness of MALL is closely linked not only to the use of technology itself but also to the duration and integration of its implementation in language learning contexts.

Comparison between experimental and control groups

To further examine the effectiveness of the intervention, independent sample t-tests were conducted to compare post-test scores between the experimental and control groups. This analysis aimed to determine whether the differences observed between the two groups after the treatment were statistically significant and not merely due to chance.

The results of the independent sample t-test revealed the following:

Accuracy: $t(38) = 7.45$, $p < 0.001$

Fluency: $t(38) = 6.98$, $p < 0.001$

These results indicate that there is a highly statistically significant difference between the experimental and control groups in both speaking accuracy and fluency. In addition to within-group effect sizes, the between-group effect size analysis also revealed large differences between the experimental and control groups in the post-test scores (accuracy $d = 1.62$; fluency $d = 1.55$). The p-values, which are well below the conventional threshold of 0.05, suggest that the probability of these differences occurring by chance is extremely low.

Furthermore, the magnitude of the t-values indicates a strong separation between the two groups, suggesting that the effect of the intervention is not only statistically significant but also substantial in practical terms. In other words, the experimental group did not merely perform slightly better they demonstrated a markedly higher level of speaking proficiency compared to the control group.

From a comparative perspective, the experimental group outperformed the control group by a considerable margin in both dimensions of speaking performance. This confirms that the extended MALL instruction was significantly more effective than conventional learning methods in improving learners' speaking skills.

This finding is consistent with previous studies that have demonstrated the superiority of mobile-assisted language learning over traditional instruction. For example, Rahimi & Fathi (2023) reported that learners who engaged in mobile-supported learning environments achieved significantly higher gains in speaking performance compared to those receiving conventional classroom instruction. Similarly, Loewen et al. (2020) found that app-based language learning can lead to greater improvements in both linguistic accuracy and oral proficiency due to increased opportunities for practice and feedback.

In contrast, traditional instructional approaches are often constrained by limited classroom time and reduced opportunities for authentic communication, which may hinder substantial development in speaking skills (Tavakoli & Skehan, 2020). As a result, learners in conventional settings tend to show slower and less pronounced improvement.

The present study extends these findings by demonstrating that not only the use of MALL, but also its extended and integrated implementation through multiple platforms, can lead to more substantial improvements in speaking performance. This highlights the contribution of the study in providing empirical evidence that sustained and combined use of mobile learning tools is more effective than isolated or short-term interventions in enhancing learners' speaking abilities.

To ensure the robustness of the analysis, the assumption of homogeneity of variance was also considered. The results of Levene's Test indicated that the variances between groups were equal ($p > 0.05$), thereby satisfying the assumption required for the independent sample t-test. This further

strengthens the validity of the findings.

The superiority of the experimental group can be attributed to the complementary nature of the learning tools used in the intervention. Duolingo supports form-focused learning by providing structured exercises, repetition, and immediate corrective feedback, which are essential for developing grammatical accuracy. On the other hand, WhatsApp facilitates communicative interaction by enabling learners to engage in real-time conversations, thereby enhancing fluency and communicative competence.

This finding is consistent with previous research highlighting the effectiveness of combining structured language applications and communicative platforms in MALL environments. For instance, Loewen et al. (2020) emphasized that app-based learning tools contribute to the development of linguistic accuracy through repeated practice and feedback. Similarly, Andújar (2020) found that mobile messaging applications such as WhatsApp promote meaningful interaction and improve learners' oral fluency and confidence.

Furthermore, the integration of form-focused instruction and communicative practice aligns with established principles in second language acquisition, which suggest that balanced exposure to both language forms and meaningful use is essential for effective language development (Tavakoli & Skehan, 2020).

The present study extends these findings by demonstrating that the combined and sustained use of these platforms can produce more substantial improvements in both accuracy and fluency than the use of a single tool. This highlights the contribution of the study in showing that integrating complementary mobile learning tools within an extended instructional framework can create a more holistic and effective learning environment for speaking development.

This dual approach reflects the integration of focus-on-form instruction and communicative language teaching (CLT), both of which are widely recognized in second language acquisition theory as essential components of effective language learning. By combining these two approaches, the MALL intervention creates a more holistic learning environment that supports both accuracy and fluency development.

In addition, the continuous accessibility of mobile platforms allows learners to engage in extended practice beyond classroom hours, increasing exposure to the target language. This increased exposure is a key factor in language acquisition, as it enables learners to internalize linguistic structures and develop automaticity in language use.

Overall, the findings from this analysis provide strong empirical support for the effectiveness of extended MALL instruction and highlight its potential as a powerful pedagogical tool in EFL contexts.

Differences across age groups

To explore the role of learner diversity, particularly age, gain scores were calculated by subtracting pre-test scores from post-test scores for both accuracy and fluency. These gain scores provide a more direct measure of improvement and allow for meaningful comparison across age groups.

Table 2. *Gain scores by age group*

Age Group	Accuracy Gain	Fluency Gain
Adolescents (n=20)	+14.80	+16.90
Adults (n=20)	+16.50	+13.70

The findings indicate that adolescents achieved greater gains in fluency, whereas adult learners demonstrated greater improvement in accuracy. This pattern suggests that age plays a significant role in determining how learners respond to different aspects of the MALL intervention.

From a cognitive and behavioral perspective, younger learners are generally more adaptable to digital environments and are more inclined to engage in interactive and communicative activities. Their familiarity with mobile communication platforms, such as WhatsApp, may have contributed to their higher levels of participation and engagement in speaking activities. As a result, they were able to develop fluency more effectively through frequent and meaningful interaction.

In contrast, adult learners tend to exhibit more structured and goal-oriented learning behaviors. They are often more attentive to grammatical rules and accuracy, which may explain their greater improvement in this area. Adults are also more likely to engage in self-regulated learning, making use of structured tools such as Duolingo to practice and refine their language skills.

These findings are consistent with theories of adult learning, which emphasize the role of cognitive maturity, self-regulation, and metacognitive strategies in learning processes. According to Knowles (1984), adult learners tend to be more self-directed and goal-oriented, which enables them to benefit more from structured input and explicit instruction. In contrast, younger learners are often more responsive to interactive

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and experiential learning environments. This perspective is supported by Ampler (2024), who argues that younger learners, as digital natives, are more accustomed to technology-mediated interaction and are therefore more likely to engage actively in communicative and technology-enhanced learning contexts.

Consequently, adult learners may benefit more from structured learning tools, while younger learners may benefit more from interactive and communicative activities, as reflected in the findings of this study.

The observed differences also highlight the importance of designing MALL interventions that are responsive to learner characteristics. A one-size-fits-all approach may not be effective, as learners with different backgrounds and preferences may respond differently to the same instructional methods.

Therefore, educators should consider incorporating adaptive strategies within MALL environments, such as providing more communicative tasks for younger learners and more structured practice for adult learners. Such differentiation can enhance the effectiveness of the intervention and ensure that all learners benefit optimally.

Learners' perceptions and experiences

The qualitative findings provide valuable insights that complement and reinforce the quantitative results. Overall, participants reported positive experiences with the use of Duolingo and WhatsApp, highlighting several benefits associated with the MALL intervention.

One of the most frequently mentioned benefits was increased motivation. Learners reported that the gamified nature of Duolingo made learning more engaging and enjoyable, while the interactive features of WhatsApp encouraged active participation in communication tasks. This finding is consistent with previous studies highlighting the role of gamification and interactive technologies in enhancing learner motivation and engagement in mobile-assisted language learning (Shortt, Tilak, Kuznetcova, Martens, & Akinkuolie, 2023).

Many participants also emphasized the role of increased confidence in speaking. The opportunity to practice in a less formal and more supportive environment allowed learners to overcome anxiety and develop greater self-confidence in using the target language. This aligns with earlier research indicating that mobile communication platforms can reduce speaking anxiety and promote confidence through low-pressure interaction and peer collaboration (Shadiev et al., 2024; Ma et al., 2025).

> "Using Duolingo helps me improve my grammar because I can practice repeatedly and get feedback immediately." (Participant 2)

> "WhatsApp makes me more confident to speak because I can communicate with my friends more freely." (Participant 6)

These responses suggest that the combination of structured practice and communicative interaction creates a balanced learning experience that supports both cognitive and affective aspects of language learning. This finding is also in line with the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use influence learners' attitudes and engagement with technology (Alnuaim, 2024; Gao, 2024).

Another key benefit reported by participants was the flexibility of mobile learning. Learners appreciated the ability to access learning materials anytime and anywhere, which allowed them to practice more frequently and consistently. This increased exposure is likely to have contributed to the observed improvements in speaking performance, supporting previous findings that emphasize the importance of accessibility and continuous engagement in mobile-assisted learning environments (Chengli, Hashim, & Hussin, 2025; Lin & Lin, 2024).

However, despite these positive experiences, several challenges were also identified. Some participants reported difficulties related to unstable internet connections, which occasionally disrupted their participation in online activities. Others mentioned challenges related to digital literacy, particularly among older learners who were less familiar with mobile applications (Setiawan & Thoyyibah, 2025). These findings are consistent with previous studies highlighting technological and user-related barriers in the implementation of MALL (Gao, 2024).

These challenges highlight the importance of providing adequate technical support and training to ensure the successful implementation of MALL. Without such support, the effectiveness of the intervention may be limited. Additionally, differences in access to technology may create disparities in learning opportunities, suggesting the need for equitable access to digital resources.

Overall, the qualitative findings support the quantitative results by demonstrating that learners not only improved their speaking skills but also

developed positive attitudes toward mobile-assisted learning. These findings extend previous research by showing that the integration of structured and communicative mobile platforms within an extended learning framework can enhance not only cognitive outcomes but also affective factors such as motivation, confidence, and engagement, thereby reinforcing the potential of MALL as an effective and holistic approach to language learning in diverse educational contexts.

CONCLUSION

This study aimed to investigate the impact of extended Mobile-Assisted Language Learning (MALL) instruction using Duolingo and WhatsApp on EFL learners' speaking accuracy and fluency across diverse age groups. The findings clearly demonstrate that learners who participated in the MALL-based intervention showed significant improvement in both speaking accuracy and fluency compared to those who received conventional instruction.

The statistical analysis using SPSS confirmed that the experimental group achieved significantly higher post-test scores, supported by strong t-test results and large effect sizes. These findings indicate that the integration of structured learning tools (Duolingo) and communicative platforms (WhatsApp) creates a balanced learning environment that effectively supports both linguistic accuracy and communicative fluency.

In addition, the study highlights the importance of learner diversity. Age differences influenced learning outcomes, with younger learners benefiting more from interactive communication and adult learners showing stronger gains in structured learning tasks. This suggests that MALL implementation should be adapted to accommodate different learner characteristics and preferences.

From a pedagogical perspective, this study contributes to the field by providing empirical evidence that extended and integrated MALL instruction can significantly enhance speaking performance. It also demonstrates that combining multiple mobile platforms over a sustained period is more effective than relying on a single tool or short-term intervention.

Despite its contributions, this study has several limitations. First, the sample size was relatively small, which may limit generalizability. Second, the six-week intervention may not fully capture long-term retention effects. Third, the study was conducted in a single educational context, limiting broader applicability. Fourth, questionnaire responses relied on self-reported perceptions that may contain social desirability bias. Fifth, the study did not include a delayed post-test to measure long-term retention. Sixth, differences in technological familiarity among participants may have influenced the learning outcomes.

Overall, this study advances current knowledge by confirming that extended MALL instruction is a powerful and effective approach to developing speaking skills in EFL learning environments. Future research is recommended to conduct longitudinal studies over longer periods, compare different MALL platforms such as Duolingo, Babbel, and Memrise, investigate additional speaking sub-skills including pronunciation and interactional competence, examine motivational variables as mediators, conduct cross-cultural comparisons, and include delayed post-tests to evaluate long-term retention.

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