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Utilizing Mobile-Assisted Language Learning (Duolingo) to Foster Metacognitive Awareness and Self-Directed Learning in Non-English Major Students

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ABSTRACT

Technology-based language learning, particularly Mobile-Assisted Language Learning (MALL), is increasingly utilized to support autonomous learning. However, limited research has explored how Duolingo contributes to metacognitive awareness and learning autonomy among non-English major students in Indonesia. This study aims to analyse the impact of Duolingo on these two variables and to explore the relationship between them. Using a mixed-methods approach with a quasi-experimental design, 56 non-English major students from Universitas Muhammadiyah Buton participated in the study. Quantitative data were analysed using the Wilcoxon Signed Rank Test and Spearman Rank correlation, while qualitative data were examined through thematic analysis. The Wilcoxon test results indicated a significant increase in metacognitive awareness ($p < 0.001$) and learning autonomy ($p < 0.001$), with a strong positive correlation between them ($r = 0.72$, $p < 0.001$). Interviews revealed that Duolingo's gamification features, such as streaks and leaderboards, helped students become more aware of their learning strategies and more independent in their learning process. This study demonstrates that Duolingo not only facilitates language learning but also enhances students' autonomy and metacognitive awareness.

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Duolingo; learning autonomy; metacognitive awareness; non-English major students; Mobile-Assisted Language Learning (MALL).

1. Introduction

The advancement of technology in the field of education has significantly transformed language learning methods, particularly with the emergence of Mobile-Assisted Language Learning (MALL). MALL is an approach that utilizes mobile devices to support language learning, allowing students to learn more flexibly and independently without relying on traditional classroom settings (Kondo et al., 2012; Hsu & Lin, 2021). Research has shown that this technology can enhance learning motivation, foster positive attitudes toward language learning, and provide easier access to a more diverse range of learning materials (Mulyawan & Resmayani, 2022; Yang, 2013). Moreover, mobile devices such as smartphones enable students to interact more actively with learning materials and develop personalized learning experiences, allowing them to study anytime and anywhere (Duman et al., 2014; Liu, 2020).

One of the most widely used MALL applications today is Duolingo, which adopts a gamification approach to enhance user engagement and motivation (Loewen et al., 2019; Shortt et al., 2021). Gamification in Duolingo creates an engaging learning environment where users receive instant feedback on their answers and earn rewards such as XP, streaks, and levels, encouraging them to continue learning (Pebiana & Febria, 2023; Windya et al., 2023). These elements make the learning process more enjoyable and increase user involvement (Amalia, 2020; Nariyati et al., 2020). Furthermore, the application offers more authentic learning experiences, such as audio-based exercises, AI-powered speaking practices, and interaction with a language-learning community (Cai, 2016).

In the context of English language learning in Indonesia, one of the main challenges faced by non-English major students is the limited time allocated for formal language instruction. Most students receive only 2 credits per semester for English courses, leaving them with limited opportunities to practice communication skills directly (Mulyawan & Resmayani, 2022; Aswad et al., 2019; Yaumi et al., 2023; Sachiya et al., 2025). As a result, many students struggle with speaking and

comprehending English in both academic and professional settings (Franco et al., 2022). Therefore, alternative learning strategies are needed to help students engage in independent learning outside the classroom, one of which is utilizing MALL technologies like Duolingo (Loewen et al., 2019).

Beyond improving learning motivation, research suggests that MALL-based learning also has the potential to enhance students' metacognitive awareness (Veenman et al., 2006; Lai, 2020). Metacognitive awareness refers to an individual's ability to recognize, regulate, and evaluate their learning strategies (Flavell, 1976). Students with higher metacognitive awareness tend to have better control over their learning processes, select more effective strategies, and become more autonomous in improving their English language skills (Schraw & Dennison, 1994; Zimmerman, 2002; Rahman et al., 2019.; Ko et al., 2025). In the context of language learning, students with strong metacognitive awareness can adjust their learning techniques, identify challenges, and choose the most suitable methods to enhance their proficiency (Mulyawan & Resmayani, 2022; Yang, 2013; Amalia et al., 2022).

Additionally, metacognitive awareness plays a crucial role in fostering autonomy and individual responsibility in the learning process (Schunk, 2003; Zimmerman, 2008). Students with well-developed metacognitive awareness can analyse the effectiveness of their learning strategies, reflect on their progress, and adjust their learning approaches as needed (Zohar & David, 2009). Thus, developing metacognitive awareness through MALL applications like Duolingo can help students become more independent learners and improve their English language skills more effectively (Pebiana & Febria, 2023; Windya et al., 2023).

Although various studies have demonstrated that Duolingo can enhance students' learning motivation (Loewen et al., 2019; Shortt et al., 2021), limited research has specifically examined how Duolingo contributes to metacognitive awareness and learning autonomy among non-English major students in Indonesia. Therefore, this study aims to: 1) Analyse how Duolingo usage enhances metacognitive awareness among non-English major students; 2) Evaluate the impact of Duolingo on students' learning autonomy; 3) Explore students' experiences in using Duolingo as a self-directed English learning tool. The findings of this study are expected to provide valuable insights for educators, app developers, and researchers in designing more effective technology-based learning strategies that better align with the needs of non-English major students.

1.1 Mobile-Assisted Language Learning (MALL) in Language Education

Mobile-Assisted Language Learning (MALL) is an innovative approach to language learning that enables students to learn more flexibly and independently through mobile devices. Research has shown that MALL enhances accessibility and allows personalized learning, enabling students to adjust their learning methods according to their individual needs and preferences (Kukulska-Hulme et al., 2017; Loewen et al., 2019). Furthermore, the flexibility of time and place in MALL allows students to learn anytime and anywhere, without being constrained by traditional classroom settings (Kondo et al., 2012; Hsu & Lin, 2021).

The successful implementation of MALL is influenced by various factors, including user-friendly application design and user experience in utilizing mobile technology. A study by Vega et al. (2023) found that students' personalities impact their learning experience with MALL, with independent learners showing a preference for mobile-based learning systems (Mulyawan & Resmayani, 2022). Additionally, students' technological proficiency and prior experience with mobile devices also affect how they utilize MALL for language learning (Yang, 2013).

Previous studies have also shown that MALL contributes to increased motivation and learning autonomy. Pebiana and Febria (2023) reported that MALL usage not only improves language skills but also strengthens speaking motivation, particularly through interactive visual materials (Loewen et al., 2019). Furthermore, instructor support plays a crucial role in enhancing the effectiveness of MALL-based learning by ensuring that technology is integrated with appropriate pedagogical strategies (Hoi & Mu, 2020; Shortt et al., 2021).

Although MALL has proven to be effective in supporting language learning, its implementation still faces challenges, such as the lack of direct interaction in speaking exercises and the need for diverse learning strategies to sustain long-term student motivation (Mortazavi et al., 2021; Pebiana & Febria, 2023). Therefore, the use of MALL in language learning should be combined with other methods to ensure more comprehensive language skill development.

1.2 Duolingo and Gamification in Language Learning

Duolingo is one of the most widely used Mobile-Assisted Language Learning (MALL) applications, incorporating gamification as its primary strategy to enhance user engagement and learning motivation. Features such as experience

points (XP), streaks, and leaderboards have been proven to boost intrinsic motivation by creating a more engaging and competitive learning environment (Zeng & Fisher, 2023; Suherman, et al., 2024). This increased motivation contributes to metacognitive awareness, as users become more conscious of their learning progress and are able to regulate their learning strategies independently (Lai, 2020).

Several studies have shown that Duolingo plays a role in increasing students' learning motivation, both through the sense of achievement provided by gamification features and through interactive learning design. Loewen et al. (2019) found that Duolingo users are more consistent in their learning compared to those using conventional methods. Additionally, Pebiana and Febria (2023) reported that daily challenges and the reward system in Duolingo encourage students to sustain long-term engagement in their learning. Windya et al. (2023) also found that students using Duolingo experienced an increase in both extrinsic and intrinsic motivation, particularly due to the app's flexibility and accessibility.

Most studies on Duolingo focus on its impact on learning motivation or language proficiency, whereas research into how the application contributes to metacognitive awareness and learning autonomy among non-English major students remains limited. This study seeks to bridge that gap by examining Duolingo's role in fostering self-directed learning strategies and enhancing students' self-regulation in English language learning. By integrating both quantitative and qualitative approaches, the study provides a comprehensive analysis of its effectiveness. The findings aim to offer valuable insights for educators, researchers, and app developers in designing more effective language learning strategies.

1.3 Metacognitive Awareness and Learning Autonomy

Metacognitive awareness refers to an individual's ability to understand, regulate, and evaluate their own learning processes. This concept was first introduced by Flavell (1976), who emphasized that reflection and the management of learning strategies are fundamental to achieving optimal academic outcomes. Recent studies indicate that students with high metacognitive awareness tend to be more independent in their learning, capable of adjusting their learning strategies, and more effective in addressing academic challenges (Lai, 2020). Moreover, metacognitive awareness contributes to enhanced self-regulation, which affects students' ability to manage their time and learning resources more efficiently (Kondo et al., 2012).

Several studies have confirmed that strengthening metacognitive awareness has a direct impact on learning quality. Hindun et al. (2020) found that high-achieving students tend to have strong metacognitive awareness components, which correlate positively with their learning effectiveness. Another study by Sulistyawati and Mbato (2022) emphasized that self-efficacy is significantly related to metacognitive strategies, with students who are confident in their abilities more likely to adopt structured and effective learning strategies. Furthermore, Hadwin et al. (2022) revealed that reflective learning practices help students improve their metacognitive awareness, ultimately enhancing their academic resilience in overcoming various challenges (Windya et al., 2023).

In the context of language learning, metacognitive awareness is a crucial aspect as it facilitates students' self-regulation in independent learning. However, while numerous studies have discussed the relationship between metacognitive awareness and learning effectiveness in general, there remains limited research specifically exploring how MALL technologies, such as Duolingo, contribute to the development of metacognitive awareness among non-English major students. Therefore, this study seeks to address this gap by analyzing how Duolingo helps students regulate their learning strategies more effectively and reflect on their learning progress.

2. Methodology

2.1 Research Design

This study employs a mixed-methods approach with a quasi-experimental design, combining both quantitative and qualitative methods. The quantitative approach is used to measure changes in learning motivation, metacognitive awareness, and learning autonomy before and after using Duolingo. Meanwhile, the qualitative approach is utilized to explore students' experiences in using Duolingo as a self-directed English learning tool.

2.2 Participants and Sample

The study involves 56 non-English major students from the Faculty of Economics and Business at Universitas Muhammadiyah Buton. Participants were selected using purposive sampling based on specific criteria to align with the study's objectives. The selected students had no prior experience using Duolingo to ensure that the research findings accurately reflect the impact of the application without previous user bias. Additionally, participants were required to commit to using Duolingo for eight weeks, following a predetermined schedule to ensure consistent engagement in the study.

All participants were students enrolled in a compulsory English course, allowing the integration of Duolingo usage with their formal learning process. This sample selection aims to assess how Duolingo contributes to enhancing metacognitive awareness and learning autonomy among non-English major students, particularly in the context of business and economics students.

2.3 Research Procedure

This study was conducted in four main phases: preparation, intervention, quantitative evaluation, and qualitative evaluation. During the preparation phase, students were provided with a detailed explanation of the study's objectives and procedures. Before the intervention began, they completed a pre-test to assess their initial levels of learning motivation, metacognitive awareness, and learning autonomy before using Duolingo.

The intervention phase lasted for eight weeks, during which students were required to use Duolingo for at least 30 minutes per day. Throughout this period, they engaged in various learning activities, including reading, listening, writing, and speaking exercises available on the application. To maintain engagement and motivation, they were encouraged to level up, participate in leaderboard competitions, and sustain daily streaks as indicators of their learning commitment.

Following the intervention, the study proceeded to the quantitative evaluation phase, where students took a post-test to measure changes in learning motivation, metacognitive awareness, and learning autonomy. The results from the pre-test and post-test were analysed using the Wilcoxon Signed Rank Test to determine whether there were significant differences after using Duolingo. Additionally, the qualitative evaluation phase involved semi-structured interviews with 20 students to explore their experiences with the application. Their responses were analysed using thematic analysis to identify key patterns, including learning motivation, changes in learning strategies, and challenges encountered during the study.

2.4 Research Instruments

This study employs both quantitative and qualitative instruments to obtain comprehensive data on students' learning motivation, metacognitive awareness, and learning autonomy after using Duolingo as a language learning aid.

a. Quantitative Instrument

The quantitative instrument consists of a Likert-scale questionnaire (1 = strongly disagree, 5 = strongly agree) designed to measure three key variables: learning motivation, metacognitive awareness, and learning autonomy before and after using Duolingo.

The table below outlines the variables, indicators, and the number of items in the questionnaire:

Variable	Indicator	Number of Items
Learning Motivation	Intrinsic and extrinsic motivation	8
Metacognitive Awareness	Awareness of learning strategies and regulation	6
Learning Autonomy	Time management and learning strategy regulation	6

To ensure the reliability of the instrument, **Cronbach's Alpha reliability test** was conducted. A high reliability score indicates that the instrument can consistently measure changes in the studied variables.

b. Qualitative Instrument

The qualitative approach in this study involves semi-structured interviews with 20 students to explore their experiences using Duolingo, particularly in relation to metacognitive awareness and learning autonomy. The following table presents the categories and interview questions used in the qualitative data collection:

Category	Interview Questions
Motivation and Learning Experience	1. What is your main motivation for using Duolingo? 2. How do you feel about learning English after using Duolingo? 3. How was your experience in maintaining learning consistency with Duolingo?

Category	Interview Questions
Metacognitive Awareness	4. How has Duolingo helped you identify the most effective learning strategies? 5. Have you become more aware of when to review materials or adjust your learning methods after using Duolingo?
Learning Autonomy	6. Do you feel more independent in learning English after using Duolingo? 7. How did you manage your study time independently during this research?
Challenges in Using Duolingo	8. What were the biggest challenges you faced while using Duolingo as a learning tool? 9. In your opinion, how could Duolingo be more effective in supporting independent English learning?

This combination of quantitative and qualitative instruments allows for a comprehensive analysis of the impact of Duolingo on students' learning motivation, metacognitive awareness, and learning autonomy.

2.5 Techniques of Data Analysis

The data analysis in this study employed both quantitative and qualitative approaches to gain a comprehensive understanding of the impact of Duolingo on metacognitive awareness and learning autonomy among non-English major students. Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS). Before conducting the main analysis, a normality test was performed using the Kolmogorov-Smirnov and Shapiro-Wilk tests to determine the distribution of the data. Since the data were not normally distributed, differences between the pre-test and post-test were analyzed using the Wilcoxon Signed Rank Test, which aimed to measure significant changes in students' learning motivation, metacognitive awareness, and learning autonomy after using Duolingo. Additionally, to examine the relationship between metacognitive awareness and learning autonomy, a Spearman Rank correlation analysis was conducted to assess the extent to which increased metacognitive awareness influenced students' learning autonomy. Meanwhile, the qualitative analysis was carried out using thematic analysis on data obtained from semi-structured interviews to explore students' experiences with Duolingo. The analysis process began with transcribing the interview data, followed by coding to identify key themes emerging from students' responses.

3. Result and Discussion

3.1 Result

Based on the quantitative data analysis, this study demonstrates that the use of Duolingo has a significant impact on metacognitive awareness and learning autonomy among non-English major students. Additionally, an increase in learning motivation was identified as a supporting factor in developing independent learning habits.

3.1.1 Improvement in Metacognitive Awareness

Metacognitive awareness is a crucial aspect of language learning, reflecting students' ability to identify, regulate, and evaluate their own learning strategies. This study found that the use of Duolingo significantly enhanced students' metacognitive awareness after the eight-week intervention. The Wilcoxon Signed Rank Test results indicated a statistically significant improvement ($p < 0.001$) in students' metacognitive awareness after using Duolingo compared to the pre-intervention phase.

Wilcoxon Test Results for Metacognitive Awareness

Parameter	Pre-test	Post-test	Change
Mean Score	79.43	91.81	+12.38
Standard Deviation	6.606	5.483	-1.123
N-gain Score	-	0.64	64% Increase

The results indicate that students became more aware of effective learning strategies, such as recognizing when to review materials, improving listening skills, and understanding the most suitable learning strategies for their needs. The

decrease in standard deviation suggests that this improvement was relatively evenly distributed among participants, meaning that most students experienced progress in their metacognitive awareness.

Several students reported that before using Duolingo, they struggled to determine effective learning strategies, particularly in identifying their strengths and weaknesses in learning English. After the intervention, they became more aware of how to manage their study time, choose activities that suited their learning styles, and reflect on the effectiveness of their methods. One student stated:

"Previously, I didn't know which learning strategy worked best for me. After using Duolingo, I realized that repetitive practice helped me learn more effectively."

These findings suggest that Duolingo not only serves as a language learning tool but also encourages students to take an active role in managing and evaluating their learning processes, which is a key indicator of improved metacognitive awareness.

3.1.2 Improvement in Learning Autonomy

Learning autonomy refers to students' ability to regulate, control, and evaluate their learning process independently, without heavy reliance on instructions from lecturers or instructors. The findings indicate that the use of Duolingo significantly enhanced students' learning autonomy, particularly in terms of learning motivation, control over the learning process, and self-regulation. The Wilcoxon Signed Rank Test results revealed a statistically significant improvement ($p < 0.001$) after eight weeks of using Duolingo.

Wilcoxon Test Results for Learning Autonomy

Learning Autonomy Aspect	Pre-test (Mean)	Post-test (Mean)	p-value
Learning Motivation	3.45	4.30	$p < 0.001$
Control Over Learning	3.50	4.28	$p < 0.001$
Self-Regulation	3.42	4.15	$p < 0.001$
Total Learning Autonomy	**10.37**	**12.73**	**$p < 0.001$**

These results suggest that students became more accustomed to independent learning without relying on lecturers' instructions and gained greater control over their study schedules and strategies. The significant increase in self-regulation indicates that students became more disciplined in managing their study time, setting learning goals, and utilizing learning resources effectively.

Additionally, interviews with students revealed that Duolingo helped them develop consistent independent learning habits. Many students previously struggled to maintain an English learning routine outside the classroom. However, after using Duolingo, they adopted more flexible and personalized learning strategies. One student stated:

"I feel more independent because I can study on my own without waiting for instructions from my lecturer."

These findings indicate that Duolingo not only serves as a language learning tool but also plays a role in fostering independent learning habits, which is a key indicator of learning autonomy development among non-English major students.

3.1.3 Relationship Between Metacognitive Awareness and Learning Autonomy

To examine the relationship between metacognitive awareness and learning autonomy, a Spearman Rank correlation analysis was conducted.

Spearman Rank Correlation Results

Variables	r (Correlation Coefficient)	p-value	Interpretation
Metacognitive Awareness vs. Learning Autonomy	0.72	$p < 0.001$	Strong positive correlation

The Spearman Rank correlation results indicate a strong positive relationship ($r = 0.72$, $p < 0.001$) between metacognitive awareness and learning autonomy. This suggests that the higher the metacognitive awareness, the greater the level of learning autonomy exhibited by students.

The high statistical significance ($p < 0.001$) further highlights the crucial role of metacognitive awareness in shaping students' learning habits, particularly in independent language learning supported by technology such as Duolingo. These findings reinforce previous research, indicating that MALL-based learning applications not only enhance content comprehension but also help students organize, evaluate, and improve their independent learning strategies.

3.2 Discussion

The findings of this study indicate that Duolingo has a significant positive impact on metacognitive awareness and learning autonomy among non-English major students. Additionally, the analysis revealed a strong positive correlation between metacognitive awareness and learning autonomy, showing that students who are more aware of their learning strategies tend to exhibit higher levels of independent learning. These findings align with previous research on technology-assisted learning, particularly within the context of Mobile-Assisted Language Learning (MALL), which has been shown to support the development of self-directed learning strategies (Hsu & Lin, 2021; Windya et al., 2023). As technology continues to play a vital role in education, this study adds empirical evidence that MALL not only enhances language comprehension but also fosters more structured and independent learning habits.

The results indicate a significant improvement in students' metacognitive awareness after eight weeks of using Duolingo. Students who previously struggled to organize their learning strategies became more capable of identifying effective learning methods, such as determining when to review materials and how to optimize their listening and reading skills. These findings are consistent with Lai (2020), who demonstrated that technology-based learning applications help learners become more reflective about their learning process, thereby increasing metacognitive awareness. This improvement is further supported by Duolingo's interactive features, such as instant feedback and repetitive exercises, which allow students to assess their progress in real-time and adjust their learning strategies accordingly. The decrease in standard deviation in the statistical results suggests that this improvement was observed consistently among all participants, indicating that the effects of Duolingo were not limited to only certain students but were widespread across the sample.

In addition to enhancing metacognitive awareness, this study found that Duolingo significantly improved students' learning autonomy. The Wilcoxon Signed Rank Test results revealed that students became more accustomed to studying independently, without relying on instructors, while also developing better time management and self-regulation skills. This improvement is in line with previous research suggesting that technology-based learning enhances students' motivation and autonomy (Nariyati et al., 2020; Liu, 2020). Duolingo provides students with flexibility in learning anytime and anywhere, which is particularly beneficial for students with limited study time due to academic or work commitments. This was further supported by the interview findings, where students reported that they found it easier to maintain learning habits due to the flexibility offered by the application. Additionally, gamification features, such as streaks and leaderboards, contributed to sustaining students' motivation, ultimately strengthening their independent learning routines.

Furthermore, this study identified a strong positive correlation between metacognitive awareness and learning autonomy ($r = 0.72$, $p < 0.001$). This finding suggests that students who are more aware of their learning strategies are also more likely to study independently and take greater control over their learning process. This result is consistent with Zimmerman's (2002) theory of self-regulated learning, which states that metacognitive awareness enables learners to effectively manage their learning strategies, ultimately leading to greater autonomy. Within the context of Duolingo, students who better understood their learning strategies utilized the application more effectively, such as repeating specific exercises, selecting appropriate difficulty levels, and setting personalized learning goals. This highlights how technology-assisted learning not only enhances language comprehension but also promotes a more independent and strategic approach to learning.

Despite the positive findings, this study also identified several challenges and limitations that should be considered. Some students reported that Duolingo's speaking exercises were limited, requiring them to seek additional methods to improve their speaking skills. Additionally, unstable internet access was a challenge for some students, particularly those living in areas with limited connectivity. Another limitation of this study was the relatively short intervention period of eight weeks, which may not have been sufficient to measure the long-term impact of Duolingo on students' learning habits. Future research is recommended to explore the effects of using Duolingo over a longer period and to examine how combining the application with other learning methods can overcome its limitations.

Overall, this study provides new insights into how MALL-based learning technology can enhance metacognitive awareness and learning autonomy among students. From a practical perspective, the findings suggest that educators can integrate applications like Duolingo into English language curricula to promote more independent learning habits. Additionally, language learning app developers may consider adding more features that support reflective learning and direct interaction to further enhance learning effectiveness. These findings reaffirm that the use of technology in language learning not only improves linguistic skills but also cultivates more independent and strategic learning habits.

4. Conclusion

This study reveals that the use of Duolingo significantly enhances metacognitive awareness and learning autonomy among non-English major students. Students who previously struggled with organizing their learning strategies became more capable of identifying effective learning methods, such as determining the right time to review materials and optimizing their listening and reading skills. Additionally, the findings indicate a strong positive relationship between metacognitive awareness and learning autonomy. Students with higher awareness of their learning strategies tend to be more independent in managing their time, controlling their learning process, and applying methods that suit their needs.

These findings contribute to the literature on Mobile-Assisted Language Learning (MALL) by providing empirical evidence that technology-based learning applications can support students in developing more independent and reflective learning strategies. The results also reinforce self-regulated learning theory, which states that metacognitive awareness is a key factor in fostering learning autonomy (Zimmerman, 2002). Furthermore, this study highlights the role of Duolingo's gamification features, such as streaks, leaderboards, and repetitive exercises, in maintaining student engagement and motivation for independent learning.

Despite its positive findings, this study has several limitations that should be considered. The limited intervention duration (8 weeks) may not be sufficient to observe the long-term impact of using Duolingo on students' English language learning. Additionally, Duolingo's limited speaking features present a challenge in developing students' oral communication skills, which may require supplementary methods to support speaking proficiency. The use of questionnaire-based quantitative data and qualitative data from interviews also introduces subjectivity limitations. Future research could employ more diverse approaches, such as observations or longitudinal studies, to obtain a more comprehensive understanding.

As a recommendation, future research should explore the long-term effects of Duolingo through a longitudinal approach and combine the use of this application with other learning methods that focus more on direct interaction and speaking skill development. Additionally, further exploration of the impact of gamification features on long-term learning motivation could provide additional insights into the design of MALL-based learning technologies.

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