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The Relationship Between Duolingo Usage Intensity as Reinforcement and Vocabulary Mastery and Learning Motivation of Junior High School Students

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Abstract: This study aims to evaluate the effectiveness of Duolingo as a reinforcement activity and analyze the relationship between objective and subjective usage intensity, vocabulary mastery, and learning motivation. Utilizing a quantitative approach with a correlational design, data was collected from 21 Junior High School students selected via purposive sampling. The instruments included digital logs from Duolingo for Schools, pretest-posttest vocabulary assessments, and questionnaires, which were analyzed using the Wilcoxon Signed Rank Test and Spearman Rank Correlation. The results demonstrated a significant increase in vocabulary mastery, achieving a medium N-Gain of 0.29, alongside high, predominantly intrinsic learning motivation with a mean score of 3.48. However, the discussion reveals a distinct "intention-behavior gap," showing a discrepancy between students' perceived subjective intensity and their actual objective usage logs. Furthermore, statistical analysis indicated no significant linear correlation between the duration of use and the improvements in vocabulary or motivation. In conclusion, while Duolingo serves as an effective structured reinforcement tool to enhance engagement and foundational vocabulary, the duration of app usage alone does not determine success, thereby highlighting an "illusion of productivity" within self-directed mobile learning.

Keywords: Gamification; Learning motivation; Mobile-assisted language learning; Vocabulary mastery

Introduction

In the digital era, English proficiency serves as a critical competency for Generation Z to compete globally and access broader educational resources. However, English education in Indonesia often encounters significant hurdles, primarily stemming from passive learning cultures and conventional teaching methods that frequently fail to align with students' evolving digital preferences. While internet penetration among students is remarkably high, reaching 87.02%, mobile devices are predominantly utilized as sources of entertainment and digital distraction rather than as constructive educational tools. This phenomenon presents a persistent dilemma for educators regarding how to effectively transform potential digital distractions into meaningful learning opportunities within the constraints of the national curriculum.

To address this pedagogical challenge, the integration of Mobile-Assisted Language Learning (MALL) has emerged as a highly promising solution. Recent educational research trends indicate a significant shift towards utilizing digital platforms to enhance student engagement inside and outside the classroom. Among various digital strategies, gamification—defined as the application of game-design elements in non-game contexts—has proven theoretically and practically effective in maintaining student interest and driving learning evolution. Applications like Duolingo have gained immense popularity by offering structured,

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gamified micro-learning sessions that strongly appeal to the psychological and behavioral tendencies of the "digital native" demographic.

A specific area requiring urgent reinforcement in language acquisition is vocabulary mastery, which theoretically serves as the essential foundation for developing all other complex language skills, such as reading and speaking. Junior high school students, in particular, often struggle with vocabulary retention due to a lack of consistent exposure and the absence of engaging reinforcement strategies in their daily routines. While recent studies demonstrate that digital tools like Duolingo and TikTok show considerable potential for vocabulary enhancement as supplementary media , the mere adoption of such technology does not automatically guarantee cognitive success without proper pedagogical integration.

This research is theoretically grounded in addressing a critical issue that persists in self-directed mobile learning: the discrepancy between students' perceived effort and their actual engagement. This phenomenon is explained by the "Intention-Behavior Gap", which suggests that while students may have the initial motivation to download and use educational applications, this intention frequently fails to translate into consistent, long-term learning behavior. Consequently, students often succumb to an "illusion of productivity," overestimating their actual learning time when relying on self-reports. This highlights a major methodological flaw in previous MALL research, which has relied heavily on subjective questionnaires to measure usage intensity, methods that are highly prone to bias and inaccuracy. Furthermore, drawing upon Self-Determination Theory (SDT), it is vital to understand how digital tools fulfil students' intrinsic and extrinsic motivational needs for autonomy and competence. While gamification can boost initial engagement, theorists caution that it does not automatically guarantee deep cognitive processing without active teacher monitoring to ensure students focus on linguistic content rather than just "gaming the system" for points.

Therefore, there is a pressing scarcity of research that contrasts subjective student perception with objective data logs to evaluate the true pedagogical effectiveness of gamified apps. The primary rationale for conducting this study is to fill this empirical gap by analyzing the direct relationship between Duolingo usage intensity—validated strictly through objective learning analytics from Duolingo for Schools—and students' vocabulary mastery and learning motivation in a blended learning setting. By actively moving beyond biased self-reports, this research provides a highly accurate, data-driven understanding of how digital reinforcement activities correlate with cognitive and affective outcomes. Ultimately, this study is conducted to equip educators with evidence-based strategies to mitigate the intention-behavior gap, transform digital distractions into structured learning, and validate whether gamified reinforcement can truly foster an active, self-regulated English learning environment for Junior High School students.

Method

Research Design

This study utilized a quantitative approach with a correlational research design to investigate the relationship between gamified usage intensity and learning outcomes. To capture a comprehensive profile of student behavior, the study evaluated usage intensity through two distinct dimensions: subjective intensity (derived from student perception) and objective intensity (derived from digital log data). However, because subjective self-reports are highly prone to bias and frequently reflect an "illusion of productivity" rather than actual engagement, subjective intensity was utilized solely for descriptive comparison to identify the intention-behavior gap. Consequently, the study aimed to measure the correlation strictly between the objective intensity and the two dependent variables: vocabulary mastery and learning motivation.

The research took place over a five-week period using a one-group pretest-posttest design to determine changes in vocabulary proficiency before and after the intervention, which serves as the cognitive variable for vocabulary mastery. Concurrently, to capture the affective impact of the gamified intervention, students' intrinsic and extrinsic drives were assessed to serve as the second dependent variable for learning motivation. The study was implemented at Rumah Belajar GAERA in Padang, West Sumatra, involving a population of Junior High School (SMP) students enrolled in an English enrichment program. Using a purposive sampling technique, 21 students were selected based on specific inclusion criteria: active enrollment in the blended learning program, possession of a compatible smartphone, and a complete digital footprint comprising both mandatory in-class and voluntary out-of-class logs. It is acknowledged that this sample size is below the typical threshold for high-power correlational studies; consequently, this research is positioned as a preliminary study, and non-parametric tests were strictly applied to mitigate Type II error risks.

Instruments

To capture the variables outlined in the research design from this selected sample, the study employed four distinct, expert-validated instruments. First, to measure the primary independent variable for the correlation, objective intensity, learning analytics were

extracted directly from the Duolingo for Schools platform. Specifically, "Time Spent" (cumulative minutes) and "XP Gained" (Experience Points) were utilized as unbiased indicators of actual student engagement. Total time was calculated as the sum of mandatory in-class time and voluntary out-of-class time to capture the true variation in independent usage and self-regulated learning strategies (Anthonysamy et al., 2020). Utilizing objective log data and understanding the role of digital technologies (Haleem et al., 2022) is highly recommended in modern educational research to accurately measure self-regulated learning via multimodal multichannel data (Molenaar et al., 2023), effectively bypassing the inherent biases of self-reporting.

Second, to establish the descriptive baseline needed to identify the intention-behavior gap (Sheeran & Webb, 2016), subjective intensity was measured using a self-assessment Likert-scale questionnaire that gauged students' perceptions of their own usage frequency. Contrasting this subjective metric against objective data logs is a critical methodological step to understand and improve the accuracy of self-reported measures of internet use (Araujo et al., 2017) and to refine the measurement of success based on actual behavior versus mere intention (Henderikx et al., 2017). Third, to evaluate the cognitive dependent variable, vocabulary mastery was assessed using a standardized pre-test and post-test format. This instrument was carefully adapted from the 1,000-word level section of Nation's (2013) Vocabulary Levels Test (VLT), featuring simplified distractors specifically tailored to the proficiency level of Junior High School students.

This aligns with recommended practices for accurately assessing the outcomes of digital game-based vocabulary learning (Zou et al., 2021), evaluating educational mobile games as a tool for increasing vocabulary (Panfilova et al., 2022), accommodating study-test medium congruency effects in digital environments (Halamish & Elias, 2022), and acknowledging EFL students' perceptions of using smartphones for vocabulary (Johari et al., 2024). The overall cognitive effectiveness of the intervention was subsequently calculated utilizing the Normalized Gain (N-Gain) formula. Fourth, to measure the affective dependent variable and evaluate if educational gamification improves students' motivation (Chapman & Rich, 2018), learning motivation was quantified using a comprehensive questionnaire grounded in Self-Determination Theory (SDT) (Ryan & Deci, 2020). This allowed the researchers to rigorously dissect and categorize student motivation into precise domains of intrinsic motivation, extrinsic motivation, and amotivation.

Data Collection Procedure

The intervention phase followed a precise sequence over five weeks, derived from the stages outlined in the research framework (Figure 1). Initially, the Input state of the students, often tired and passive following regular school hours was identified as a critical barrier to engagement. To address this, the Process was implemented using a Rotational Blended Learning model. In this operational scheme, the 90-minute learning sessions were strategically divided between face-to-face instruction and digital reinforcement, an approach specifically chosen to balance the distinct pedagogical requirements and student acceptance levels of mobile gamified language teaching (Baldauf et al., 2017). During these sessions, the first 75 minutes were dedicated to conventional teacher-led instruction focusing on foundational grammar and speaking competencies. Crucially, the final 15 minutes were designated as a gamification-based "Digital Closure" session. During this structured time, students used Duolingo on their personal mobile devices as a reinforcement tool, practicing vocabulary immediately relevant to the day's instructional topic using the app's interactive features. Guided engagement by the teacher during this closure phase ensures that students focus meaningfully on linguistic content rather than merely gaming the application for points (Kessler et al., 2023; Loewen et al., 2019), thereby mitigating potential negative effects from multitasking with mobile phones during learning (Chen & Yan, 2016). Leveraging the app's spaced repetition model during these sessions was vital for vocabulary retention strategy (Settles & Meeder, 2016).

Furthermore, as seen in Figure 1 under Variable X, while the Digital Closure session provided a constant mandatory objective usage baseline, students were also encouraged, but not strictly mandated, to continue using the application outside of formal classes. This specific procedural setup was deliberate to allow the researchers to observe genuine self-regulated learning behaviors, a crucial component for sustainable digital literacy and lifelong learning strategies (Anthonysamy et al., 2020) as the voluntary actions of the students determined the variations in their final Objective Log Data (Variable X1). Ultimately, this data collection sequence ensured that distinct input fatigue was transformed via a structured, gamified process into measurable cognitive (Y1) and affective (Y2) outputs, validated by objective learning analytics rather than solely on student perception (Araujo et al., 2017).

Data Analysis

All collected data were systematically analyzed using statistical software, adhering to a standard significance level of $\alpha = 0.05$. The analytical process

commenced with descriptive statistics to establish a baseline profile of the students' usage intensity and motivation levels, a necessary step for objectively observing the initial evolution of students' learning interests when interacting with digital media (Astuti et al., 2025). Subsequently, a Shapiro-Wilk normality test was administered. Because the purposive sample size was relatively small (N = 21, which is < 30) and the resulting data distribution was determined to be non-normal, non-parametric statistical methods were strictly employed to mitigate the risk of Type II errors. Specifically, the Wilcoxon Signed Rank Test was utilized to determine the statistical significance of the differences between the pre-test and post-test vocabulary scores.

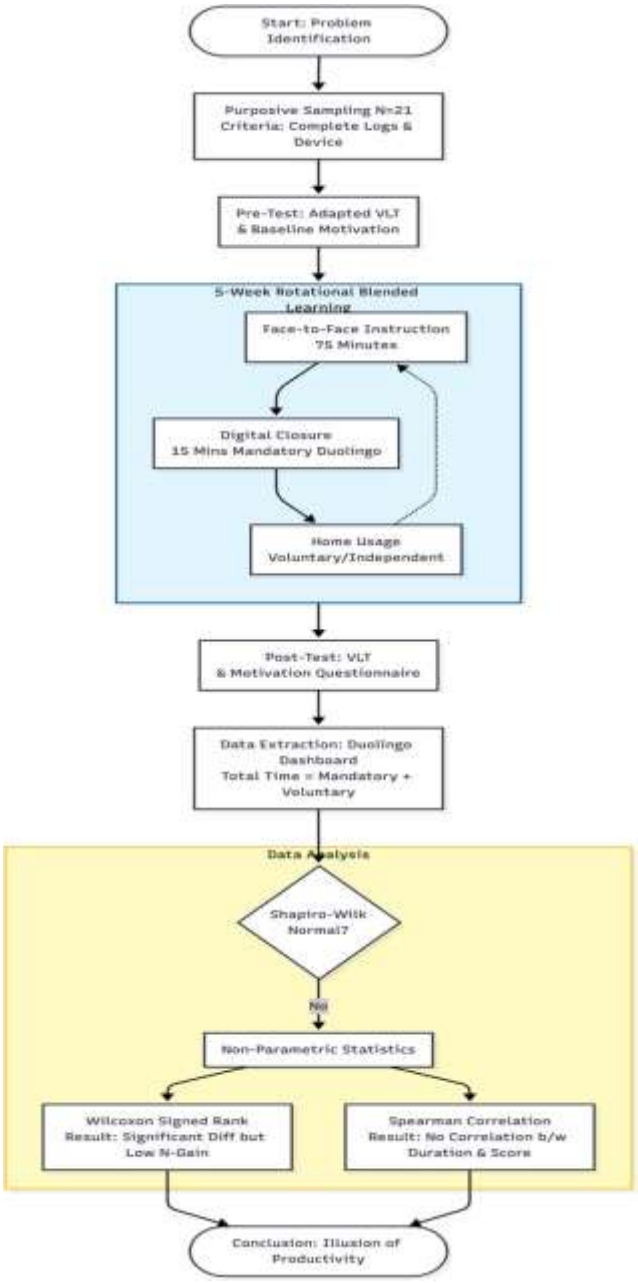

Figure 1. Research flowchart

This robust non-parametric approach is highly suited for measuring comparative L2 learning gains in Mobile-Assisted Language Learning (MALL) interventions (Kessler et al., 2023) and effectively validating the specific pedagogical impact of Duolingo on vocabulary mastery (Achmad et al., 2025; Hutabarat & Situmeang, 2023). Finally, the Spearman Rank Correlation test was applied to analyze both the strength and the direction of the relationships between the objective usage intensity (Variable X1) and the vocabulary N-Gain (Variable Y1), as well as between the objective usage intensity (Variable X1) and the students' learning motivation (Variable Y2). Conducting this correlation strictly with objective log data ensures that the analysis of how digital game-based learning affects academic achievement and self-determined motivation (Yamaoka, 2025; Zou et al., 2021) is grounded in actual behavior, thereby avoiding the analytical pitfalls associated with flawed self-reported perceptions of internet use (Araujo et al., 2017).

Result and Discussion

Result

The research data covers objective intensity (log data), subjective intensity (perception), vocabulary mastery, and learning motivation. The descriptive statistics for objective intensity based on data logs recorded over 5 weeks are presented in Table 1.

Table 1. Descriptive Statistics of Objective Intensity (Data Log)

Indicator	Min.	Max.	Mean	Standard Deviation
Study Time (Minutes)	16.00	237.00	94.71	59.01
Total XP (Experience)	129.00	2940.00	1201.30	676.45

Table 1 reveals a high variation in student usage behavior. While the average learning duration was approximately 1.5 hours cumulatively, there was a sharp disparity between active and passive students. In contrast, the subjective intensity measured via questionnaire showed different results. As shown in Table 2, students generally perceived their intensity as moderate to high.

A critical and unique finding of this study is the discrepancy between students' subjective perceptions of their learning intensity (Table 2) and their actual objective usage (Table 1) logged by the system. This phenomenon can be explained by the "intention-behavior gap," where positive intentions to engage in a task do not consistently translate into actual behavior (Sheeran & Webb, 2016). This phenomenon is clearly illustrated in the Scatter Plot (Figure 3), where the Z-Scores of perception and actual log data are plotted.

Table 2. Descriptive Statistics of Subjective Intensity (Perception)

Variable	N	Min	Max	Mean	SD	Category
Perceived Intensity (X2)	21.00	2.42	4.67	3.44	0.59	Moderate-High

In the context of digital and online learning, Henderikx et al. (2017) noted that learners often overestimate their active participation and struggle to align their high behavioral intentions with actual study time. Furthermore, Araujo et al. (2017) highlight that self-reported measures of digital and internet use are frequently inaccurate due to social desirability bias or memory limitations. Therefore, while students genuinely feel motivated and perceive themselves as highly active (driven by the gamified experience), their actual digital logs reveal a more fragmented engagement, underscoring the necessity of using objective analytics alongside self-reported data in educational technology research.

Figure 2. Scatter plot of Z-score perception vs. Z-score log data (behavioral gap)

Regarding vocabulary mastery, the analysis of test scores demonstrates a clear trajectory of improvement. The baseline data obtained from the pre-test showed that the students' initial vocabulary mastery was at a moderate level with a mean score of 73.33. This indicates that while students were familiar with basic English terms, they lacked depth in specific vocabulary required for higher proficiency.

After implementing the Rotational Blended Learning model where Duolingo served as a closure activity for five weeks, the post-test results revealed a positive shift. The average score escalated to 80.00, showing a raw score improvement of nearly 7 points. Individual comparison of pretest and post-test in vocabulary scores can be seen in Figure 3.

The significant increase in students' vocabulary mastery, as evidenced by the medium N-Gain score (0.29), aligns with the growing body of literature supporting the efficacy of Mobile-Assisted Language Learning (MALL). Several previous studies have consistently demonstrated that the use of the Duolingo application significantly improves English vocabulary mastery among junior and senior high school students (Achmad et al., 2025; Hutabarat & Situmeang, 2023; Lature, 2025). The interactive nature of digital game-based learning provides an engaging environment that facilitates better retention compared to traditional methods (Panfilova et al., 2022; Zou et al., 2021). Furthermore, empirical evidence from Kessler et al. (2023) and Loewen et al. (2019) confirms that continuous engagement with MALL platforms like Duolingo yields measurable second language (L2) learning gains. The spaced repetition model embedded in Duolingo's algorithm also plays a crucial role in preventing cognitive overload, thereby optimizing long-term vocabulary retention (Settles & Meeder, 2016).

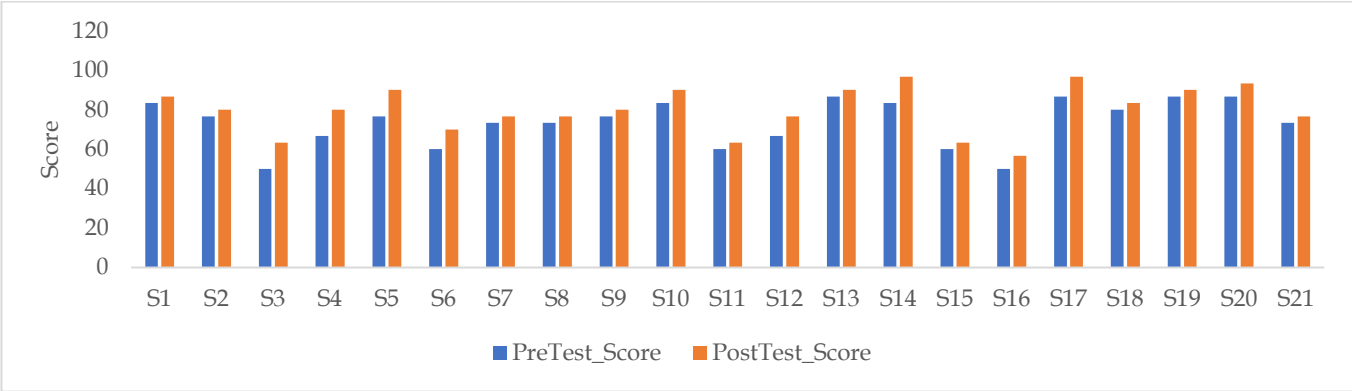

Figure 3. Comparison of pre-test and post-test vocabulary scores

In terms of affect, students demonstrated a high level of learning motivation with a total mean score of 3.48. Breaking down the dimensions based on Self-Determination Theory, Intrinsic Motivation (Interest)

scored the highest with a mean of 4.11, followed by Extrinsic Motivation with a mean of 3.32, while Amotivation was the lowest with a mean of 2.38 as seen in Figure 4.

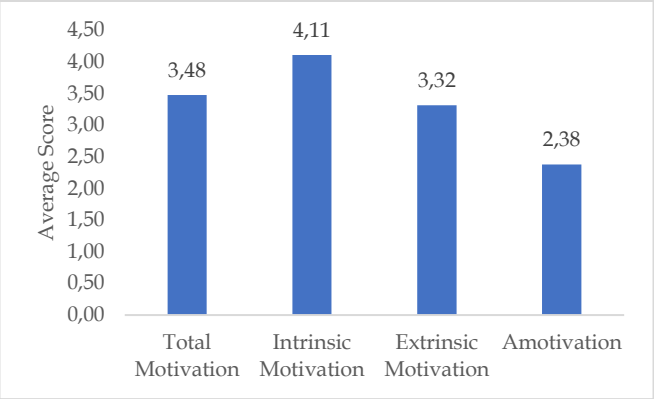

Figure 4. Students profile based on self-determination theory

The high level of intrinsic motivation observed among the students can be attributed to the gamification elements integrated into Duolingo. Viewed through the lens of Self-Determination Theory (SDT), environments that satisfy learners' needs for competence and autonomy naturally foster intrinsic motivation (Ryan & Deci, 2020; Yamaoka, 2025). Gamification in digital learning media has been proven to positively influence the evolution of students' learning interests and academic engagement (Astuti et al., 2025; Chapman & Rich, 2018). Specifically, the application of frameworks like Octalysis within Duolingo, utilizing points, streaks, and leaderboards to creates a compelling learning loop (Rahayu & Putra, 2024; Shortt et al., 2023). This is corroborated by Safitri et al. (2024) and Namaziandost et al. (2025), who found that gamified learning environments significantly elevate students' positive perceptions and intrinsic drive to independently acquire new vocabulary in the digital era.

However, the hypothesis testing using Spearman Rank Correlation showed no significant linear relationship between the variables. The correlation between Objective Intensity (X1) and N-Gain (Y1) was weak and not significant (rs = 0.212, p = 0.357). Similarly, the correlation between Objective Intensity (X1) and Motivation (Y2) was also not significant (rs = 0.238, p = 0.300) as seen in Table 3.

Table 3. Correlation Matrix using Spearman Rank

Variable Pair	Correlation (r_s)	Sig. (2-tailed)	Decision
X1 - Y1 (Log intensity - N-gain)	0.21	0.35	Not significant
X1 - Y2 (Log intensity - Motivation)	0.23	0.30	Not significant
X2 - X1 (Perceived intensity - Log)	0.25	0.27	Not significant

Discussion

The findings confirm the existence of an "Intention-Behavior Gap" or "Illusion of Productivity" among students, as clearly demonstrated in Figure 2. Students felt they were learning intensively (high subjective score) likely due to the gamified nature of Duolingo which provides instant gratification tThe findings confirm the existence of an "Intention-Behavior Gap" among students. Students felt they were learning intensively despite log data showing otherwise. This "Illusion of Productivity" is likely caused by the gamified nature of Duolingo, such as XP, Streaks, and Leaderboards, which provides instant gratification. This aligns with Astuti et al. (2025) and Safitri et al. (2024), who found that gamification significantly influences perceived interest and engagement, often making the process feel more substantial than the actual time spent. Students may confuse the intention of checking the app with the behavior of deep learning.

Despite the lack of a linear correlation between usage duration and score improvement, the significant increase in post-test scores confirms Duolingo's effectiveness as a reinforcement mechanism. The spaced repetition system in the app helps solidify the forgetting curve for vocabulary. The medium N-Gain of 0.29 suggests that even short-term, consistent exposure contributes to vocabulary retention. This supports the findings of Hutasoit et al. (2025) and Achmad et al. (2025), who observed that digital tools like TikTok and Duolingo are effective for vocabulary acquisition when used as supplementary media. This process supports the theory of "Bottom-Up Processing," where mastering high-frequency words strengthens the foundation of General Vocabulary. Even though the N-Gain was in the medium category (0.29), this is a substantial achievement for a short-term intervention (5 weeks), indicating that consistent, albeit brief, exposure to digital learning tools can cumulatively enhance vocabulary retention. Similar to the findings of Rahayu et al. (2024) where mobile learning games improved cognitive outcomes, this study proves that structured app usage facilitates cognitive engagement. The significant increase in students' vocabulary mastery aligns with the growing body of literature supporting the efficacy of Mobile-Assisted Language Learning (MALL). Several previous studies have consistently demonstrated that the use of the Duolingo application significantly improves English vocabulary mastery among junior and senior high school students. The interactive nature of digital game-based learning provides an engaging

environment that facilitates better retention compared to traditional methods. Furthermore, empirical evidence confirms that continuous engagement with MALL platforms like Duolingo yields measurable second language (L2) learning gains. The spaced repetition model embedded in Duolingo's algorithm also plays a crucial role in preventing cognitive overload, thereby optimizing long-term vocabulary retention.

The "Novelty Effect" successfully maintained high intrinsic motivation, satisfying students' psychological needs for competence and autonomy, even amidst post-school cognitive fatigue. The high level of intrinsic motivation indicates that the app successfully satisfied students' psychological needs for competence and autonomy, as posited by Self-Determination Theory. The interactive features prevent cognitive fatigue after school hours. The high level of intrinsic motivation observed among the students can be attributed to the gamification elements integrated into Duolingo. Viewed through the lens of Self-Determination Theory (SDT), environments that satisfy learners' needs for competence and autonomy naturally foster intrinsic motivation. Gamification in digital learning media has been proven to positively influence the evolution of students' learning interests and academic engagement. Specifically, the application of frameworks like Octalysis within Duolingo—utilizing points, streaks, and leaderboards creates a compelling learning loop. This is corroborated by findings that gamified learning environments significantly elevate students' positive perceptions and intrinsic drive to independently acquire new vocabulary in the digital era.

However, educators must be cautious because, as indicated by Namaziandost et al. (2025), while gamification boosts engagement, it does not automatically guarantee deep cognitive processing without proper pedagogical scaffolding. The integration of Duolingo fits the current trend of Mobile-Assisted Language Learning (MALL) in Indonesia. However, as noted by Kessler et al. (2023) and Loewen et al. (2019), using commercial apps requires teacher monitoring to ensure students focus on linguistic content rather than just gaming the system for points.

Conclusion

In conclusion, the integration of Duolingo as a structured reinforcement activity significantly improved students' vocabulary master, achieving a medium N-Gain of 0.29, and maintained high intrinsic learning motivation. However, the study revealed a distinct "intention-behavior gap" and an "illusion of productivity"; students perceived their learning intensity as high due to the app's gamified instant gratification, despite objective digital logs showing highly variable actual usage. Furthermore, statistical analysis indicated no significant linear correlation between the objective duration of app usage and the magnitude of vocabulary or motivation improvements. These findings demonstrate that while short-term, consistent exposure to gamified Mobile-Assisted Language Learning (MALL) effectively facilitates cognitive engagement and satisfies psychological needs for competence and autonomy, the mere duration of usage does not guarantee deep cognitive processing. Therefore, educators must rely on objective learning analytics rather than subjective self-reports, and provide active pedagogical monitoring to ensure students focus on linguistic content rather than simply gaming the system for points.

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Conceptualization, M.F.U.; methodology, M.F.U.; validation, Z; formal analysis, M.F.U.; investigation, M.F.U.; writing—original draft preparation, M.F.U.; writing—review and editing, Z.

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Conflicts of Interest
The authors declare no conflict of interest.

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