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The Effectiveness of Game-Based Learning Using the Duolingo Application in Enhancing Students' Mastery of Passive Vocabulary

Siti Indrawati[1], Santi Farmasari[2], Ahmad Junaidi[3], Muhammad Amin[4]
[1 2 3 4] English Education Department, Faculty of Teacher Training and Education, University of Mataram, Indonesia

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Corresponding Author
Author Name: Siti Indrawati
Email: sitiindrawatiiin06@gmail.com

DOI:

Phone: +6287860958345

Abstract: Vocabulary is a crucial aspect in all English language teaching. The greater the vocabulary mastery a person has, the better their language skills and communication abilities. Various strategies, methods, and techniques have been employed by educators to teach vocabulary to students. The use of game-based learning through the Duolingo application offers an alternative for teachers to develop students' vocabulary, particularly in mastering new words, spelling, pronunciation, and correction. This game is suitable for teachers to incorporate vocabulary teaching into the learning process. This research was conducted to enhance students' mastery of passive vocabulary by implementing game-based learning through the Duolingo application. The study used a quantitative method with a pre-experimental approach, specifically employing a one-group pre-test and post-test design. The population consisted of all tenth-grade students, totaling 287 learners across eight classes. The sample was chosen through a cluster random sampling technique, resulting in 36 students from class E 2. Students completed an initial pre-test, participated in the treatment sessions, and then took a post-test. The results show a significant increase in learners' passive vocabulary following the use of Duolingo as a game-based learning tool. This improvement is reflected in the rise of the mean score from 39.30 on the pre-test to 80 on the post-test. Additionally, at the 5% significance level, the obtained t-value of 4.43 is higher than the t-table value of 2.030 ($4.43 \geq 2.030$) with 35 degrees of freedom.

Keywords: Game-Based Learning (GBL), Duolingo Application, Passive Vocabulary.

INTRODUCTION

A strong vocabulary foundation plays a significant role in enhancing students' language skills, not only in English but also in other languages. As stated by Desi (2020), vocabulary serves as a key component that learners must acquire in order to master a second language. The greater the number of words an individual understands, the more proficient they become in the four language skills: listening, speaking, reading, and writing. Mastery of vocabulary is therefore essential, as it supports comprehension of sentence patterns and contributes significantly to overall language competence.

Vocabulary is a core component of language learning, enabling individuals to comprehend texts and express ideas effectively (Nation, 2021). Without sufficient vocabulary mastery, students may lose confidence, experience decreased motivation, and struggle to express their ideas in English. Therefore, an effective and enjoyable learning method is needed to help students improve their vocabulary acquisition.

In Indonesia, English is considered a compulsory subject or an essential courseR, especially at the secondary school level. However, in reality, many students struggle with English learning and face various challenges, such as low motivation, lack of interest in learning, limited engagement in the learning process, and difficulty in retaining language skills. According to Anwar (2020), traditional teaching methods, which often rely on lectures and memorization, may not effectively address these issues, leading to decreased student interest and participation in English language learning.

In today's technological era, educational systems around the world have increasingly integrated technology as an accessible means for delivering learning materials. Technology is also frequently used to enhance the teaching and learning process. With the emergence of digital learning platforms, educators can explore various ways to incorporate digitalization to support students' learning strategies and promote effective learning. Among these strategies, Game-Based Learning (GBL) has emerged as a popular approach that combines educational content with interactive features and gamification elements, creating a stimulating learning environment for students.a

In this study, the researcher identified one prominent application that supports an engaging and accurate learning system that is Duolingo. This application is a widely recognized platform specifically designed for language learning, particularly for English. Pauzan (2024) highlights that Krashen's Input Hypothesis remains a foundational theory in language learning, emphasizing the importance of meaningful and comprehensible input within a supportive social context. This theory revisits and reinforces Krashen's earlier ideas, highlighting that second language acquisition remains highly relevant in modern educational contexts. Although times have changed and technology continues to advance, the core principles of this theory still serve as a foundation for designing second language curricula and instructional strategies.

Duolingo offers fun and user-friendly learning features that are suitable for students and university learners alike. These features include quizzes, challenges, score,

commitment, and rewards. Additionally, the application incorporates gamification elements such as point systems, level progression, and achievements for each level completed. Indirectly, these features serve as a form of motivation, encouraging students to persist in completing each level. Duolingo can also be used for independent learning outside of the classroom. Moreover, the platform combines visual and auditory cues, making it suitable for a wide range of learners (Loewen et al., 2019).

Recognizing these problems, the integration of game-based learning (GBL) through the Duolingo application presents a promising solution. Integrating game mechanics into English instruction allows teachers to create a more enjoyable classroom atmosphere, which can substantially increase students' motivation, interest, and overall participation in learning activities. Previous research indicates that learners who engage with gamified instructional environments tend to show greater involvement and achieve better academic outcomes than those who receive traditional instruction (Hamari et al., 2016).

Based on the researcher's initial observations at SMAN 1 Lenek, it was found that many tenth-grade students showed low motivation in learning English and experienced difficulties in developing their vocabulary mastery, particularly in understanding vocabulary encountered in reading and learning materials. These difficulties indicate limitations in students' passive vocabulary, which affects their ability to comprehend texts effectively.

Although some students also encountered challenges in using vocabulary for speaking activities, the primary problem observed was related to vocabulary recognition and comprehension. Therefore, the use of the Duolingo application as a game-based learning medium is intended to address students' low motivation and limited passive vocabulary through repeated exposure, recognition, and contextual practice. Accordingly, this study aims to experimentally examine the effectiveness of Duolingo in improving students' passive vocabulary by utilizing technology that is familiar, accessible, and engaging for learners.

RESEARCH METHOD

This study employed a quantitative approach using a pre-experimental research design, specifically a one-group pre-test and post-test model. This design was selected to examine the effectiveness of Game-Based Learning through the Duolingo application in improving students' passive vocabulary by comparing their performance before and after the treatment within the same group (Sugiyono, 2015).

The research was conducted at SMAN 1 Lenek, East Lombok Regency, West Nusa Tenggara, from 29 July to 16 August 2025. The school was selected due to its implementation of the Merdeka Curriculum, which emphasizes vocabulary learning as a fundamental component of English instruction and supports the integration of technology in the learning process.

The population of this study consisted of all tenth-grade students at SMAN 1 Lenek in the 2024/2025 academic year, totaling 287 students distributed across eight classes. A cluster random sampling technique was applied to select the research sample, as the population was naturally grouped into classes. Following this procedure, one class consisting of 36 students was selected as the sample of the study (Creswell, 2018).

The research instrument used in this study was a vocabulary test comprising 20 multiple-choice items designed primarily to measure students' passive vocabulary mastery. The test focused on students' ability to recognize and understand vocabulary encountered in reading and learning contexts. The instrument was administered twice: as a pre-test to measure students' initial passive vocabulary knowledge prior to the treatment, and as a post-test to assess vocabulary improvement after the implementation of Game-Based Learning using the Duolingo application.

To ensure the quality of the instrument, content validity was applied. The test items were developed based on the Merdeka Curriculum for tenth-grade English and adapted from relevant textbook materials, particularly descriptive texts related to great athletes and healthy food. The instrument was reviewed and revised based on feedback from the research advisor to ensure clarity, relevance, and alignment with the indicators of passive vocabulary mastery (Arikunto, 2013). Instrument reliability was examined using Cronbach's Alpha coefficient through SPSS analysis. The results indicated that the reliability coefficient exceeded the acceptable threshold ($\alpha \geq 0.60$), confirming that the instrument was reliable for measuring students' passive vocabulary mastery (Ghozali, 2018).

The data collection procedure consisted of three main stages. First, a pre-test was administered to assess students' initial passive vocabulary comprehension. Second, the treatment was implemented through four instructional sessions using the Duolingo application as a game-based learning tool. During the treatment sessions, students engaged in vocabulary recognition activities, contextual reading tasks, and interactive exercises provided by the application, both in classroom activities and independent practice. These activities were designed to promote repeated exposure and recognition of vocabulary in meaningful contexts. Third, a post-test was administered to measure students' improvement in passive vocabulary after the completion of the treatment.

The data obtained from the pre-test and post-test were analyzed using descriptive and inferential statistics. Descriptive statistics were used to calculate mean scores and standard deviations to describe students' passive vocabulary performance before and after the treatment. To determine whether there was a statistically significant difference between the pre-test and post-test scores, a paired-sample t-test was conducted. The results of the statistical analysis were used to evaluate the effectiveness of Game-Based Learning using the Duolingo application in enhancing students' passive vocabulary.

FINDINGS AND DISCUSSION

Findings

This section presents the findings of the study obtained from the pre-test and post-test results. The data describe students' passive vocabulary mastery before and after the implementation of Game-Based Learning using the Duolingo application.

Students' Passive Vocabulary Achievement in the Pre-Test

The pre-test was administered to measure students' initial level of passive vocabulary mastery prior to the treatment. The results revealed that students generally demonstrated low vocabulary recognition and comprehension skills before participating in the game-based learning activities. Table 1 presents a summary of the descriptive statistics for the pre-test scores below.

Table 1 Descriptive Statistics of Pre-Test Score

Number of Students	Mean Score	Standard Derivation	Lowest Score	Highest Score
36	39.30	16.50	10	75

The mean score of the pre-test was 39.30, indicating that students' passive vocabulary mastery was generally low. The relatively high standard deviation (16.50) suggests considerable variation among students' initial vocabulary knowledge.

To further describe students' performance, the pre-test scores were classified into five achievement levels. The distribution of students' scores is presented in Table 2 below.

Table 2 Classification of Pre-Test Score

Classification	Score Range	Frequency	Percentage (%)
Very Good	81-100	0	0%
Good	66-80	2	5.56%
Fair	56-65	3	8.33%
Poor	41-55	6	16.67%
Very Poor	<40	25	69.44%
Total		**36**	**100%**

As shown in Table 2, the majority of students (69.44%) were categorized as having very poor passive vocabulary mastery, while only a small proportion achieved fair or good levels. These findings indicate that students experienced substantial difficulties in recognizing and understanding English vocabulary before the implementation of the Duolingo-based learning activities.

Students' Passive Vocabulary Achievement in the Post-Test

After the treatment, a post-test was administered to measure students' passive vocabulary mastery following their participation in Game-Based Learning using the Duolingo application. The post-test results showed a noticeable improvement in students' vocabulary recognition and comprehension. Table 3 presents the descriptive statistics of the post-test scores below.

Table 3. Descriptive Statistics of Post-Test Score

Number of Students	Mean Score	Standard Derivation	Lowest Score	Highest Score
36	80	24.30	40	95

The mean post-test score increased substantially to 80.00, indicating that students' passive vocabulary mastery improved after the treatment. Although the standard deviation (24.30) increased, the overall performance shifted toward higher achievement levels. The classification of students' post-test scores is presented in Table 4 below.

Table 4. Classification of Post-Test Score

Classification	Score Range	Frequency	Percentage (%)
Very Good	81-100	17	47.22%
Good	66-80	11	30.56%
Fair	56-65	4	11.11%
Poor	41-55	3	8.33%
Very Poor	<40	1	2.78%
Total		**36**	**100%**

The results indicate that most students achieved good to very good levels of passive vocabulary mastery after the treatment. Only one student remained in the very poor category, demonstrating a significant shift from lower to higher performance levels.

Comparison of Pre-Test and Post-Test Results

To illustrate the improvement more clearly, Table 5 compares the percentage distribution of students' scores in the pre-test and post-test below.

Table 5. Comparison of Pre-Test and Post-Test Score Distribution

Classification	Pre-Test (%)	Post-Test (%)
Very Good	0%	47.22%
Good	5.56%	30.56%
Fair	8.33%	11.11%
Poor	16.67%	8.33%
Very Poor	69.44%	2.78%

The comparison shows a substantial shift in students' performance from lower to higher classification levels after the implementation of the Duolingo application, indicating improved passive vocabulary mastery.

Statistically Significant of Vocabulary Improvement

To determine whether the improvement in students' passive vocabulary mastery was statistically significant, a paired-sample t-test was conducted. The results of the analysis show that the obtained t-test value was 4.43, while the critical value of the t-table at the 0.05 significance level, the critical t-table value was 2.030. Table 6 show the t-test of significance below.

Table 6. T-test of Significance

Variable	t-test	t-table
Pre-test and Post-test	4.43	2.030

Since the calculated t-value exceed the t-table value (4.43 > 2.030), the difference between the pre-test and post-test scores was statistically significant. Therefore, the alternative hypothesis (H_1) was accepted, indicating that the use of the Duolingo application had a significant effect on improving students' passive vocabulary, while the null hypothesis (H_0) was rejected.

Discussion

The enhancement of students' passive vocabulary using the Duolingo application.

Vocabulary, as explained by Harmer (1991), is divided into two types, namely active vocabulary and passive vocabulary. Active vocabulary refers to words that students are able to use actively, while passive vocabulary consists of words that students can recognize and understand when they encounter them in particular contexts. Although this theory distinguishes between active and passive vocabulary, the present study places greater emphasis on passive vocabulary, particularly students' ability to recognize and comprehend vocabulary through receptive learning activities facilitated by game-based learning.

Theoretically, active and passive vocabulary develop through different processes. According to Gairns and Redman (1986), passive vocabulary develops primarily through receptive activities such as listening and reading, while active vocabulary is associated with productive activities such as speaking and writing. In the context of this study, receptive activities play a more dominant role, as the research instruments and learning tasks mainly focus on students' ability to understand and recognize vocabulary items rather than produce them independently.

In relation to this focus, the Duolingo application provides various learning activities that strongly support the development of passive vocabulary, such as reading, listening, translation, and multiple-choice exercises. These activities expose students to vocabulary repeatedly and contextually, enabling them to recognize word meanings and usage patterns. Although some activities may also encourage basic language production, the primary contribution of Duolingo in this study lies in enhancing students' receptive vocabulary knowledge.

Moreover, in addition to the exposure provided through receptive activities, the effectiveness of Duolingo is further supported by the use of immediate feedback. Chen et al. (2022) emphasized that game-based learning accompanied by instant feedback can enhance students' learning effectiveness. In the Duolingo application, automatic corrections and examples of correct word usage help students quickly identify and understand their mistakes. This immediate feedback strengthens students' understanding of word meanings and reinforces their passive vocabulary retention.

The findings of this study indicate that before the treatment (pre-test), students' passive vocabulary mastery was still relatively low. Based on Tables 1 and 2, when converted into percentages, two students (5.56%) achieved a good category, three students (8.33%) achieved a fair category, six students (16.67%) achieved a poor category, and twenty-five students (69.44%) were in the very poor category, while none of the students reached the very good category. The mean score of the pre-test was 39.30 with a standard deviation of 16.5, indicating that most students had limited ability to recognize and understand vocabulary prior to the treatment.

After the implementation of the treatment through game-based learning using the Duolingo application, the post-test results showed a substantial improvement in students' passive vocabulary mastery. Based on Tables 3 and 4, seventeen students (47.22%) achieved a very good category, eleven students (30.56%) achieved a good category, four students (11.11%) achieved a fair category, three students (8.33%) achieved a poor category, and one student (2.78%) remained in the very poor category. The mean score of the post-test increased to 80 with a standard deviation of 24.3, indicating an improvement of 40.7 points compared to the pre-test results. This improvement reflects a significant enhancement in students' ability to recognize and comprehend vocabulary.

The significant increase in scores from a mean of 39.30 to 80 was influenced not only by classroom instruction but also by students' involvement in independent learning outside the classroom. In this study, students were encouraged to continue using the Duolingo application independently at home to reinforce vocabulary exposure and comprehension. Although no official usage logs were collected, students were consistently motivated to complete learning units until they experienced improvements in their vocabulary understanding. The flexible and repetitive nature of Duolingo supported the internalization of vocabulary, particularly at the passive level.

In addition to independent learning, the improvement in students' passive vocabulary was also supported by guided discussions between the researcher and the students related to the descriptive texts used in the tests. During these discussions, students analyzed text content, interpreted vocabulary meanings, and examined contextual usage. This process helped students deepen their understanding of vocabulary and strengthened their ability to recognize word meanings within meaningful contexts.

Comparison with Previous Studies

The findings of this study are consistent with previous research on the effectiveness of Game-Based Learning and the Duolingo application in vocabulary development. Studies by Andini and Salmiah (2024) and Tohdin et al. (2024) reported significant improvements in students' vocabulary achievement after the implementation of Duolingo, as reflected in higher post-test scores compared to pre-test scores. These studies highlight Duolingo's effectiveness in facilitating vocabulary recognition and comprehension.

Similarly, Andriani (2020) found that Duolingo positively influenced vocabulary learning by creating an enjoyable and motivating learning environment, which encourages students to engage more actively with vocabulary input. Sari and Purnama (2021) also confirmed that Game-Based Learning significantly enhances students' vocabulary mastery, particularly in terms of receptive understanding.

Compared to previous studies, the present research contributes a more specific focus by emphasizing passive vocabulary as the primary outcome of measurement and analysis. While most prior studies examined vocabulary

mastery as a general construct, this study highlights receptive vocabulary as a distinct and measurable component. In addition, the use of a one-group pre-test and post-test design provides methodological insight into examining vocabulary improvement within a single learning context. This focus strengthens the evidence that Duolingo-based game learning is particularly effective in enhancing students' passive vocabulary mastery.

CONCLUSION

The findings revealed a significant improvement in students' passive vocabulary mastery following the treatment. Statistical analysis showed a substantial increase in the mean score from the pre-test to the post-test, indicating that students' ability to recognize and comprehend English vocabulary improved considerably after participating in game-based learning activities. Furthermore, the t-test results confirmed that the obtained t-value exceeded the critical value at the 0.05 significance level. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted, signifying that the use of the Duolingo application had a statistically significant effect on improving students' passive vocabulary mastery. This improvement can be attributed to several factors. First, Duolingo provides repeated and contextualized exposure to vocabulary through receptive learning activities such as reading, listening, translation, and multiple-choice tasks, which support passive vocabulary development by enabling students to recognize word meanings and usage in meaningful contexts. Second, its game-based features, including immediate feedback and level-based progression, enhanced students' engagement and motivation, contributing to more effective vocabulary learning. In addition, students' independent practice outside the classroom reinforced vocabulary exposure and supported the internalization of vocabulary knowledge. Based on these findings, this study concludes that game-based learning using Duolingo is an effective instructional strategy for enhancing students' passive vocabulary mastery, particularly in EFL classroom contexts, as it creates a more engaging learning environment and improves students' receptive vocabulary skills.

Despite its positive findings, this study has several limitations. The duration of the treatment was relatively short, which limited the observation of students' long-term vocabulary development. In addition, the sample size involved only one class, which restricts the generalizability of the findings. Moreover, the study focused primarily on passive vocabulary and did not examine other aspects of language proficiency such as pronunciation, grammar, or productive language skills.

Therefore, future research is recommended to extend the duration of the intervention, involve larger and more diverse samples, and explore the integration of game-based learning with other language skills. Further studies may also employ more rigorous experimental designs to provide deeper insights into the long-term effectiveness of digital game-based applications in English language learning. Overall, this study contributes empirical evidence supporting the use of Duolingo as an effective game-based learning tool for improving students' passive vocabulary mastery.

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