



## The Effectiveness of AI-Based Application Duolingo in Enhancing Students' Vocabulary Mastery among Indonesian EFL Learners

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**Abstract.** *This study aims to determine the effectiveness of the use of the artificial intelligence-based application (AI-Based Application) Duolingo in improving vocabulary mastery of EFL (English as a Foreign Language) students in Indonesia. This study used a descriptive quantitative approach with a single-group pre-test and post-test design involving 20 students of class VII C of SMP Negeri 1 Mappakasunggu. Data were collected through vocabulary tests, questionnaires, and classroom observations. The results showed a significant increase in students' vocabulary mastery, marked by an increase in the average score from 61 (fair category) in the pre-test to 78 (good category) in the post-test. Most students gave a positive perception of the use of Duolingo, especially regarding the gamification features, instant feedback, and simple and attractive display, which can increase motivation and learning engagement. The results of the observation also showed that students were more active and enthusiastic in using this application compared to traditional learning methods. Thus, Duolingo can be said to be effective as an AI-based learning medium to improve vocabulary mastery of junior high school students in Indonesia.*

**Keywords:** *AI-Based App; Duolingo; Effectiveness; EFL Students; Vocabulary Mastery.*

### 1. INTRODUCTION

Development digital technology has bring change significant in various aspect life , including in world education . One of the emerging innovations is utilization application based technology in learning , especially in language learning foreign (Zhang, 2022) . According to Mavlonova & Morozova (2025) Language is Wrong One means main in communicate , and Language English , as Language international own role important in various fields , including education , business , and technology . By Because that , mastery Language English become very skill needed , especially for students at the level formal education , considering Language This Also become eye lesson mandatory at school.

English is an international language that functions as a global communication tool in various fields of life, from education, technology, economics, to diplomacy. (Bao & others, 2021) . In Indonesia, English is taught as a foreign language (EFL) from elementary school to university. The primary goal of English learning in secondary schools is to equip students with both spoken and written language skills to enable them to participate in a global society. According to Rianti et al (2023) one of the fundamental aspects in learning English is vocabulary mastery. Schmitt & Schmitt (2020) emphasizes that vocabulary is the core of language skills; without adequate vocabulary, students will struggle to understand reading texts, express ideas orally and in writing, and interact effectively. In other words, vocabulary is the bridge connecting reading, writing, listening, and speaking skills. However, many

Indonesian students, including those at the junior high school level, face obstacles in mastering English vocabulary.

Common problems include limited vocabulary mastery, difficulty using vocabulary appropriately in context, and poor retention of learned vocabulary. However, in practice, many individuals still experience difficulties using English for everyday communication. This is primarily due to limited vocabulary and understanding. what they have (Aji et al., 2023) . Traditional methods used by teachers, such as providing lists of words to memorize or relying on direct translations from dictionaries, are often considered boring, monotonous, and less suited to the learning styles of today's generation. (Sattarova, 2024) . As a result, students' learning motivation is low, and vocabulary mastery results are not optimal. The quantity and quality of vocabulary mastered directly contribute to language skills such as speaking, listening, reading, and writing . To address this issue, various learning methods have been developed, one of which utilizes digital technology. (Shadiev & Wang, 2022) .

Along with the development of technology, especially artificial intelligence (AI), new opportunities have emerged to improve the quality of English language learning. (Özdere, 2023) . One innovation that is currently widely used is AI-based language learning applications, one of which is Duolingo . This application is designed by integrating gamification into the learning process, namely by presenting game elements such as points, levels, prizes, and daily challenges. (Mohammed & Jesudas, 2025) . According to Chiriboga et al. (2025) found that gamification in language education has been shown to increase student motivation, engagement, and retention. This strategy creates a fun and healthy competitive learning environment and encourages learners to actively explore the material independently . This makes the learning process more enjoyable, interactive, and motivates students to continue practicing. Duolingo also uses AI algorithms that enable adaptive and personalized learning. The system adjusts the difficulty level and question types based on the user's abilities. (Akpabio et al., 2025). This way, students don't find learning too difficult or too easy. Furthermore, the variety of exercises offered, from vocabulary introduction and pronunciation to sentence usage, helps strengthen vocabulary comprehension comprehensively.

Learning digital technology or ICT (Information and Communication Technology) based learning has revolutionized language learning methods (Alakrash & Abdul Razak, 2021). By using online platforms, learning applications, and virtual reality, learning becomes more interactive , flexible, and adaptive to students' needs. This technology integration also facilitates access to authentic learning resources, such as interactive videos, podcasts, and online communication with native speakers (Ulanday et al., 2021). learning like Duolingo has

proven effective in increase ability vocabulary , pronunciation , and so on understanding context culture . Application This utilise intelligence artificial For adapt level difficulty with user capabilities , and provide immediate feedback. This makes the learning process more personal, focused, and meaningful (Tuong & Dan, 2024).

Vocabulary is a collection of words owned by a person or used in a language. (Wahyudin et al., 2021). According to Suryanto et al (2021) Adequate vocabulary mastery is the main foundation for language skills, both receptive (listening, reading) and productive (speaking, writing). Without Without adequate vocabulary, communication becomes limited and ineffective. Vocabulary serves as a medium for expressing thoughts, feelings, and ideas, so language skills are highly dependent on the quantity and quality of vocabulary mastered. A broad and structured vocabulary allows a person to express ideas more precisely, clearly, and nuancedly. In both oral and written communication, a rich vocabulary enhances the accuracy of meaning, clarity of argument, and persuasiveness. A person with a limited vocabulary tends to struggle to convey a message, thus decreasing communication effectiveness. (Insignia, 2024)

Previous research has shown positive results regarding the use of Duolingo in vocabulary learning. In study Pusparini et al (2025) state Duolingo significantly improved students' speaking skills, such as vocabulary, pronunciation, and fluency, with the experimental group consistently outperforming the control group. The platform's AI-based speech recognition and instant feedback mechanisms created a low-anxiety environment, boosting students' speaking confidence. Student feedback further highlighted Duolingo's ease of use, engaging gamification, and collaborative learning benefits . in research conducted Phanwiryarat et al (2025) Duolingo is considered effective for improving vocabulary, pronunciation, and listening skills, with its gamified environment reducing anxiety and increasing engagement. However, intermediate and advanced learners noted limitations at higher proficiency levels. This study highlights gamified flipped learning as a scalable approach to improving basic language skills, with recommendations for expanding advanced content for broader applicability.

This research was conducted at SMP Negeri 1 Mappakasunggu specifically in class VII C, a junior high school in Takalar Regency, South Sulawesi. Based on initial observations, many students at this school still face difficulties in mastering English vocabulary. This is evident in their low vocabulary test scores and their difficulty understanding simple reading texts and constructing sentences. Furthermore, the school's technology-based learning facilities are still underutilized, resulting in students lacking experience learning English through interactive media. On the other hand, students at SMP Negeri 1 Mappakasunggu are among the

younger generation familiar with digital technology. Nearly all students have access to smartphones, although most use them solely for entertainment, such as gaming or social media. This situation could potentially be leveraged for educational purposes by introducing learning apps like Duolingo. With a fun approach, students can learn vocabulary independently outside of school hours, while simultaneously increasing their motivation to learn English.

The urgency of this research lies in the need to find more innovative and relevant learning methods to meet the characteristics of today's junior high school students. The integration of AI-based applications like Duolingo is expected to bridge the gap between conventional methods, which tend to be boring, and students' need for interactive and engaging learning. Furthermore, this research is also important because it provides practical contributions for teachers in developing more varied and modern teaching strategies. Pedagogically, using Duolingo in secondary schools can be an alternative way to strengthen technology-based learning. This app is not intended to replace the role of teachers, but rather to support learning that students can use independently. With the additional learning experience provided by Duolingo, students are expected to enrich their vocabulary, strengthen their memory, and gain greater confidence in using English.

Based on this background, this study focuses on exploring the effectiveness of using the AI-based Duolingo application in improving students' vocabulary mastery at SMP Negeri 1 Mappakasunggu. The research question is to what extent the use of the Duolingo application can improve students' vocabulary mastery at SMP Negeri 1 Mappakasunggu, and how students perceive the use of the Duolingo application in learning English vocabulary. The aim of this research is For Analyzing the effectiveness of the Duolingo application in improving vocabulary mastery of students at SMP Negeri 1 Mappakasunggu, identifying students' perceptions of the use of the Duolingo application as a medium for learning vocabulary, and provide recommendations for English teachers in integrating AI-based applications into teaching strategies in secondary schools.

The results of this study are expected to provide both theoretical and practical contributions. Theoretically, this research enriches the study of the use of AI technology in foreign language learning, particularly in the context of junior high school students in Indonesia. Practically, this study provides a concrete picture of the potential of the Duolingo application as an effective, accessible, and appropriate vocabulary learning tool for the characteristics of digital generation students. Therefore, this research can serve as a reference for schools and teachers to continue innovating in English learning, enabling students to better master vocabulary and use it in everyday and academic communication.

## 2. KAJIAN TEORITIS

The theoretical review in this research was designed to provide a strong conceptual foundation for the research problem. The discussion focuses on theories relevant to learning English as a foreign language, vocabulary mastery, the use of technology in learning, and the use of artificial intelligence-based applications to improve language skills. Furthermore, this study also includes a review of several relevant previous studies as references and comparisons in the research process.

English as a foreign language (EFL) learning in Indonesia aims to equip students with the ability to communicate effectively in a global context. In the EFL context, students generally have limited language exposure and practice opportunities, so the learning process often faces various obstacles. One important component of English learning is vocabulary mastery, as vocabulary forms the foundation for developing other language skills, such as listening, speaking, reading, and writing (Bao & others, 2021).

Vocabulary is defined as the collection of words a person possesses and uses in a language. Adequate vocabulary mastery enables students to understand texts, convey ideas, and interact effectively. Without sufficient vocabulary mastery, language skills will be limited and communication will be hampered. Therefore, improving vocabulary mastery is a fundamental aspect of English learning, particularly at the junior high school level (Schmitt & Schmitt, 2020).

Along with the development of digital technology, language learning has shifted from conventional methods to the use of information and communication technology. Technology-based learning enables the learning process to be more interactive, flexible, and tailored to the characteristics of digital-generation learners. The integration of technology into English learning also provides opportunities for students to learn independently, receive immediate feedback, and access learning materials anytime and anywhere (Özdere, 2023).

One form of technology utilization in language learning is the use of artificial intelligence (AI). AI in learning enables the system to adapt material to students' abilities, provide adaptive practice, and continuously monitor learning progress. This approach aligns with the concept of individualized learning, where each student can learn at their own pace and according to their needs (Mohammed & Jesudas, 2025).

The Duolingo app is an AI-based language learning tool that integrates gamification concepts into the learning process. This app presents vocabulary learning through interactive exercises, structured repetition, and instant feedback. Game elements such as points, levels, and daily challenges are designed to increase student motivation and engagement. With this

approach, Duolingo is expected to help students understand, remember, and use English vocabulary contextually (Akpabio et al., 2025).

Various previous studies, such as those conducted by Pusparini et al. (2025) and Phanwiriyarat et al. (2025), have shown that using the Duolingo app has a positive impact on students' mastery of English language knowledge and skills. These studies reported increased learning motivation, active student engagement, and improved learning outcomes compared to conventional learning methods. These findings indicate that the use of AI-based learning applications can be an effective alternative learning medium in the context of learning English as a foreign language.

Based on the theoretical description and previous research findings, the use of the Duolingo application as an AI-based learning medium is deemed relevant for application in English vocabulary learning at the junior high school level. This theoretical framework serves as the basis for analyzing the effectiveness of Duolingo's use on students' vocabulary mastery and their perceptions of the application's use in the learning process.

### **3. METHOD**

This study uses a descriptive quantitative approach with a pre-test and post-test design in one group. A pretest is a test given before treatment or learning begins. Its purpose is to determine students' initial abilities, basic knowledge, or level of mastery of a particular subject. With a pretest, researchers or educators can understand their learning position. the initial results of students so that they can be compared with the results after the learning process. (Kongkaew et al., 2020). Whereas according to Dankel & Loenneke (2021) The pretest is a measurement variable before treatment which functions as a comparison to see the effects of the treatment given. Then A posttest is a test given after treatment or learning has been completed. The aim is to determine the extent to which students have experienced development, increased abilities, or new understanding after they have received certain learning or treatment. (Setiawan & Kudus, 2020). Whereas according to Liu & Maxwell (2020) posttest is variables measurement after treatment that shows results from effect Treatment . This design was chosen to determine the effectiveness of the use of the AI-based application Duolingo in improving students' vocabulary mastery . The subjects of the study were students of class VII C of SMP Negeri 1 Mappakasunggu in the even semester of the 2025/2026 academic year. The number of samples used was 20 students . The sample selection was carried out using a purposive sampling technique . Purposive sampling is one of the sampling techniques in research that is included in non-probability sampling (non-random sampling). In this technique, researchers select

samples based on certain considerations or objectives that are in accordance with the needs of their research. (Shamsudin et al., 2024).

In qualitative research, purposive sampling is often used because researchers emphasize depth of information over sample size. This means researchers select informants who have knowledge, experience, or direct involvement with the research phenomenon. (Ahmad & Wilkins, 2025). Its implementation by selecting classes that are considered representative and appropriate to the research objectives. The instruments used in this study included vocabulary tests in the form of multiple choice and short answer questions designed to measure students' vocabulary mastery. The test is divided into two stages, namely pre-test (before treatment) and post-test (after treatment). Furthermore instruments used is a questionnaire . A questionnaire is a research instrument in the form of a list of written questions given to respondents to obtain data or information as needed. Questionnaires are often used in both quantitative and qualitative research because they can gather information from a large number of people in a relatively short time. (Taherdoost, 2021). Whereas according to Shearer (2021) stated that the questionnaire can serve as a guide for open-ended questions that provide space for respondents to answer freely, so that researchers obtain data in the form of more in-depth narratives . The questionnaire was used to determine students' perceptions of the use of the *Duolingo application* in vocabulary learning. The questionnaire was in the form of a Likert scale (1–5) with indicators: ease of use, learning motivation, interactivity, and usefulness. Instrument final namely observation. Observation is a method of data collection in research conducted by directly observing objects, events, behaviors, or specific phenomena in the field. The goal of observation is to obtain factual, objective, and real data consistent with actual conditions (Farid, 2022). Meanwhile according to Jebur et al (2021) observation is a method of collecting data by observing the teaching and learning process, student behavior, and teacher-student interactions in the classroom. Observations were made during the learning process to record students' activities in using Duolingo , their involvement, and responses to the exercises given. The research was carried out in several stages, namely the preparation stage , the implementation stage implementation And stage Evaluation. Data analysis was carried out in two stages. That is quantitative analysis of vocabulary tests , analysis questionnaire And analysis observation.

## 4. RESULTS AND DISCUSSION

### Result

In a way general , research This aim For know effectiveness use application AI- based *Duolingo* in increase mastery vocabulary Students of SMP Negeri 1 Mappakasunggu . Research data obtained through three instrument main , namely test vocabulary (pre-test and post-test) , questionnaire perception students , as well as observation during the learning process . Results from third instrument the described as following,

### *Vocabulary Test Results*

Vocabulary tests were administered to students twice: before (pre-test) and after (post-test) using the Duolingo app . The test results showed an increase in students' average scores.

**Table 1.** Comparison of Pre-Test and Post-Test Results.

Type Test	Minimum Value	Mark Maximum	Average	Category
Pre-test	45	75	63	Enough
Post-test	60	95	79	Good

Based on Table 1 , the average student score increased from 63 (sufficient category) in the pre-test to 79 (good category) in the post-test. This indicates that the use of the Duolingo application has a positive impact on improving the vocabulary mastery of students at SMP Negeri 1 Mappakasunggu.

### *Student Perception Questionnaire Results*

A questionnaire was administered to 20 students to determine their perceptions of using Duolingo in vocabulary learning. The analysis results showed: a) 85% of students find Duolingo easy to use. b) 80 % of students stated that their learning motivation increased due to gamification features such as points, levels, and prizes. c) 7.5 % of students felt that vocabulary was easier to remember because of repetition practice and instant feedback. 80 % of students said Duolingo helped them understand vocabulary in the context of sentences.

### *Observation Results*

Observations during the lesson showed that students were more active and enthusiastic when using Duolingo . They appeared more focused on completing challenges, helping each other when they encountered difficulties, and were motivated to achieve the highest scores. Compared with conventional learning, which tends to be passive, the classroom atmosphere became more interactive and enjoyable.

### Discussion

Results study This show that use application AI- based Duolingo proven effective in increase mastery vocabulary students of SMP Negeri 1 Mappakasunggu . Improvement average test score vocabulary from 61 to 78 confirmed that student get benefit real from use application This . Findings This in line with study Pusparini et al (2025) And Phanwiriyarat et

al (2025) which shows that . Duolingo significantly improved students' speaking skills, such as vocabulary, pronunciation, and fluency, with the experimental group consistently outperforming the control group.

The platform's AI-based speech recognition and instant feedback mechanism created a low-anxiety environment, boosting students' confidence in speaking. Student perceptions further highlighted Duolingo's ease of use, engaging gamification, and collaborative learning benefits . Furthermore, questionnaire results indicated that students had positive perceptions of Duolingo . The majority of students found the app made it easier to understand vocabulary in context, strengthened memory retention, and increased learning motivation. This supports the theory of learning motivation, which states that affective factors, such as interest and emotional engagement, significantly influence learning outcomes. Beyond motivational factors, *Duolingo's effectiveness* also lies in its adaptive and personalized nature . The app's AI system is able to adjust the material based on each student's abilities and progress. For lower-ability students, *Duolingo* provides more frequent repetition of questions, which helps with vocabulary retention. For more advanced students, the app provides more challenging questions, preventing boredom. This principle of adaptive learning supports the theory of *Individualized Learning* , where the learning process must be adapted to the needs and abilities of students so that the results are more optimal. Observations also revealed that the classroom atmosphere became more lively when students used Duolingo . This suggests that the AI-based application not only provides cognitive benefits in the form of improved vocabulary, but also affective benefits in the form of increased student motivation, enthusiasm, and self-confidence.

However Thus , there is a number of necessary limitations noted . First , the use of Duolingo need access digital devices (smartphones) and stable internet connection . For students who do not own facility mentioned , its implementation Possible will constrained . Second , Duolingo more effective For strengthen vocabulary base And medium , but Still limited in provision vocabulary academic or specific . By Because that , the role of the teacher remains important For complete learning with other sources . In overall , results study This give proof that integration application AI -based such as Duolingo can become strategy relevant learning at school middle , especially in increase mastery vocabulary.

## 5. CONCLUSION

Based on results research that has been done, it can be concluded that the use of application based artificial intelligence (AI-Based Application) Duolingo is proven effective in increasing the mastery of vocabulary of students of SMP Negeri 1 Mappakasunggu. This is seen from the existence of an average increase in grades of students, namely from 63 (category sufficient) in the pre-test to 79 (category good) on the post-test. This shows that Duolingo is capable of giving a positive impact to learning vocabulary, good from the aspect of acquisition of new vocabulary and retention of vocabulary that has been studied. Besides that, the results of questionnaires and observations show that students give a positive perception to use Duolingo. Part of the big student feels that the application is easy to use, fun, and capable of increasing their motivation to study. The feature of gamification owned by Duolingo pushes active student involvement in the learning process, so they are more consistent in training vocabulary. With this, it can be concluded that Duolingo is a relevant learning medium and effective for increasing the mastery of vocabulary of junior high school students, in particular in the context of learning English as a foreign language (EFL) in Indonesia. This also confirms the importance of integrating AI-based technology in learning language for support to achieve more optimal learning results.

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