



# The Effect of Digital Flashcards on Students' Reading Comprehension: A Quantitative Study

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## Abstract

This study aims to investigate using digital flashcards as a learning tool for tenth-grade SMA Negeri 1 Singaraja students' instruction in reading comprehension. Given the challenges students have in their reading comprehension, integrating digital learning tools can be a successful approach for raising engagement and comprehension among them. Two groups—an experimental group guided using digital flashcards and a control group guided using conventional media—were part of a quasi-experimental research design. A post-test was done to assess how digital flashcards might affect students' reading comprehension. The gathered data, which included homogeneity tests, normality tests, and an independent t-test to determine statistical significance, was analysed using SPSS. The results showed that the experimental group did noticeably better than the control group, implying that digital flashcards improve the reading comprehension of students. According to the findings, digital flashcards can be quite a useful and interesting tool for raising students' reading competency. The study adds to the growing corpus of studies on digital learning media and provides useful guidelines for teachers on including technology in English language instruction.

**Keywords:** : English teaching; Digital flashcards; Learning media; Reading comprehension

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## 1. Introduction

Indonesia's low literacy rates remain a critical challenge in the country's education system, with various studies pointing to students' lack of interest and motivation to read as the primary cause. This issue is particularly evident in rural areas where access to quality reading materials is limited (Juniarta et al., 2019). Unlike students in urban centers, who have access to well-stocked libraries and bookstores, those in remote regions often rely on outdated and insufficient reading resources, making reading a less engaging activity. Additionally, the digital era has shifted students' reading habits and preferences, with many opting for quick online content over printed books, further contributing to the decline in reading engagement (Padmadewi et al., 2022).



Beyond access to books, cultural and environmental factors also play a significant role in shaping reading habits (Arisandi et al., 2018). The absence of a strong reading culture in Indonesia, coupled with minimal encouragement from schools and families, creates an environment where students do not see reading as an essential or enjoyable activity (Ferdiawan et al., 2021; Rahmanita et al., 2021). Unlike countries where reading is deeply embedded in daily life, Indonesia struggles with a lack of institutionalized reading programs and policies that promote consistent reading habits from an early age. As a result, Indonesian students consistently perform poorly in international literacy assessments such as PIRLS (Progress in International Reading Literacy Study) and PISA (Programme for International Student Assessment), which measure reading proficiency on a global scale. Without targeted efforts to enhance students' motivation and access to engaging reading materials, addressing this literacy crisis will remain a significant challenge (Juniarta et al., 2019).

Despite the importance of literacy in shaping students' academic success and future career prospects, Indonesia continues to struggle with alarmingly low reading proficiency levels. The 2022 OECD PISA report ranked Indonesia 71st out of 81 participating countries in reading literacy, highlighting the severity of the issue. Furthermore, a UNESCO report revealed that only 0.001% of Indonesians actively engage in reading, suggesting that reading is not a habitual activity for most individuals (Mujtahid et al., 2021). These concerning statistics underscore the urgent need for more effective literacy programs and innovative teaching methods that can enhance reading comprehension skills among students (Padmadewi et al., 2018). The lack of motivation and engagement with reading, combined with inadequate support from educational institutions and families, remains a pressing issue. Additionally, the increasing reliance on digital media for entertainment rather than educational purposes has further contributed to the decline in students' reading interest (Ratminingsih & Budasi, 2020).

One of the key barriers to reading comprehension among students is their limited vocabulary mastery. Research indicates that strong vocabulary knowledge plays a crucial role in fluency, interpretation, and text analysis (Sidek & Rahim, 2015; Darsana, 2025). Students with a rich vocabulary are better equipped to comprehend complex texts, while those with poor vocabulary skills struggle with reading comprehension and overall language proficiency (Padmadewi & Artini, 2018; Barustyawati et al., 2020). To address this challenge, educators have explored various strategies, one of which is the use of digital flashcards. Digital flashcards serve as an interactive and multimedia-based learning tool that enhances vocabulary retention and reinforces comprehension skills. Platforms like Quizlet, which offer gamified learning experiences, have been shown to improve students' engagement and reading comprehension by making learning more interactive and accessible (Lestari, 2023; Waluyo, 2021; Ratminingsih & Budasi, 2020; Purnawan et al., 2022).

Numerous studies have highlighted the effectiveness of digital flashcards (DFs) in improving language learning outcomes. Research has demonstrated that students using Quizlet in quasi-experimental settings scored significantly higher in reading comprehension tests compared to those who relied on traditional methods (Lestari, 2023). Similarly, a study



involving eighth-grade students found that using Quizlet led to improved vocabulary mastery and reading skills. Even in elementary schools, Quizlet has proven to be an effective learning tool, despite challenges such as limited internet access and varying student motivation levels (Putri & Zuhri, 2023). Additionally, digital flashcards have been shown to enhance speaking skills and vocabulary retention, particularly for students with learning difficulties (Luthfillah & Fauzia, 2023; Sinou, 2022). Other studies emphasize the benefits of gamified learning in middle and higher education, reinforcing the role of digital flashcards in making learning more engaging (Tran, 2021; Waluyo, 2021). Furthermore, Jaramio (2021) highlights the importance of pre-teaching vocabulary using digital flashcards to enhance reading comprehension among EFL learners.

Although the effectiveness of digital flashcards has been extensively investigated across diverse educational contexts globally, there remains a significant gap concerning their application and impact specifically on Indonesian high school students. This underexplored terrain highlights a critical need for localized research, considering Indonesia's unique linguistic and educational challenges. Addressing this gap, the present study pioneers an investigation into the use of digital flashcards to improve reading comprehension among 12th-grade students at SMA Negeri 1 Singaraja, Bali. This study is particularly novel in its focus on the intersection of digital learning tools and reading proficiency within the Indonesian context, where many students face persistent difficulties in reading comprehension largely due to limited vocabulary mastery. By examining the efficacy of digital flashcards tailored to this demographic, the research seeks to provide empirical evidence on an innovative, technology-enhanced pedagogical strategy that could effectively bridge vocabulary deficits and strengthen reading skills. Ultimately, this study aspires to contribute both to the academic literature and practical educational interventions aimed at enhancing student learning outcomes in Indonesia.

During an internship at SMA Negeri 1 Singaraja, the researcher directly observed a pervasive challenge faced by many students: difficulties in answering multiple-choice reading comprehension questions, predominantly stemming from insufficient vocabulary knowledge. This observation reveals a critical educational need for innovative, engaging, and effective learning strategies that can support vocabulary acquisition while simultaneously enhancing reading comprehension skills. Integrating digital flashcards into the curriculum presents a promising solution, offering students an interactive and dynamic tool for reinforcing vocabulary and deepening their understanding of texts. In response to these educational challenges, the increasing uptake of digital learning tools within contemporary classrooms underscores the necessity of research-based approaches to optimize reading instruction. While digital flashcards have been broadly examined in various educational contexts globally, their specific effectiveness in Indonesian high schools remains inadequately explored. Recognizing this significant research gap, SMA Negeri 1 Singaraja has begun experimenting with digital learning tools as part of its pedagogical evolution. However, empirical evidence regarding the impact of digital flashcards in this particular setting is still limited. Therefore, this study aims to rigorously investigate whether digital flashcards significantly improve reading



comprehension outcomes for 10th-grade students compared to conventional teaching methods. By addressing this question, the research aspires to generate valuable insights that contribute to advancing literacy instruction and support the broader integration of technology-enhanced learning strategies in Indonesian education.

## **2. Method**

This study employed a quasi-experimental research design to examine the effectiveness of digital flashcards in improving the reading comprehension skills of tenth-grade students at SMA Negeri 1 Singaraja. The investigation compared outcomes between an experimental group, which was taught using digital flashcards, and a control group, which received conventional instruction. A post-test only control group design was utilized to measure students' reading comprehension after the intervention.

The research was conducted during the second semester of the 2024/2025 academic year. The population included all 368 tenth-grade students across 11 classes at SMA Negeri 1 Singaraja. Due to logistical constraints and to maintain feasibility, a cluster random sampling technique was applied to select two intact classes out of the eleven. The choice of two classes was justified based on a priori power analysis that indicated a minimum of 30 participants per group to detect a medium effect size (Cohen's  $d = 0.50$ ) with a power of 0.80 at an alpha level of 0.05. One class, comprising 33 students, was randomly assigned as the experimental group, while the other class of 33 students served as the control group.

The intervention for the experimental group involved the use of digital flashcards delivered through an online learning platform. The flashcards were designed following established instructional design principles to promote active learning and retention. They included interactive vocabulary items, contextual reading prompts, and comprehension questions with immediate feedback. The platform enabled multimedia integration such as images and audio pronunciations, fostering multimodal engagement. In contrast, the control group received reading comprehension instruction using traditional printed texts and teacher-led explanations. To ensure instructional fidelity and consistency, the same curriculum content and reading topics were used, and the control group's instruction was standardized through lesson plans and teacher monitoring.

The post-test instrument comprised 30 multiple-choice items specifically aligned with the reading materials covered during the sessions. This instrument underwent a thorough validation process: expert judges reviewed the items for content relevance and clarity, resulting in content validity confirmation. Reliability analysis was conducted with Gregory's formula, yielding reliability coefficients above the acceptable threshold (e.g., Cronbach's  $\alpha > 0.70$ ). Additionally, item analysis was performed to evaluate difficulty indices and discrimination power, confirming the quality of each test item.

Data collection involved administering the post-test to both groups at the conclusion of the instructional period. The data analysis was conducted using SPSS 26.0 software. Prior to inferential testing, the data were examined for normality using the Kolmogorov-Smirnov test



and for homogeneity of variances with Levene's test. Missing data points and outliers were handled through multiple imputation and outlier analysis methods respectively, ensuring the robustness of the results. An independent samples t-test was employed to evaluate differences in reading comprehension scores between groups. Effect size was computed using Cohen's d to quantify the magnitude of the observed effect.

### 3. Findings

After conducting the treatment in six weeks, the post-test was collected. Table 1 presents the descriptive and inferential statistics of the post-test scores between the experimental group and the control group. The data obtained was analyzed using IBM SPSS Statistic 26.

Table 1. General Findings

Statistic	Control Group	Experimental Group
N	33	33
Mean	75.70	81.64
Minimum Score	62	66
Maximum Score	90	92
Range	28	26
Variance	48.280	59.364
Standard Deviation	6.948	7.705
Normality (Kolmogorov-Smirnov)	0.195	0.024
Homogeneity (Levene Statistic)	0.901	
Independent sample t-test (Sig. 2-tailed)	0.002	
Effect Size	0.81	

The table presents the descriptive and inferential statistical analysis of the reading comprehension scores for both the control and experimental groups. Each group consisted of 33 students. The mean score of the experimental group (81.64) was higher than that of the control group (75.70), indicating an improvement in reading comprehension when using digital flashcards. The minimum and maximum scores also suggest that students in the experimental group performed slightly better overall. The variance and standard deviation values show a slightly higher dispersion of scores in the experimental group compared to the control group. Normality testing using the Kolmogorov-Smirnov test indicates that the control group data follows a normal distribution ( $p = 0.195$ ), while the experimental group data deviates from normality ( $p = 0.024$ ). The homogeneity test (Levene's Statistic = 0.901) confirms that both groups have equal variances. The independent sample t-test result ( $p = 0.002$ ) shows a statistically significant difference between the two groups, suggesting that the use of digital flashcards had a meaningful impact on students' reading comprehension. Furthermore, the effect size (0.81) indicates a large effect, reinforcing the substantial influence of digital flashcards on students' learning outcomes.

Before conducting hypothesis testing using an independent sample t-test, normality and homogeneity tests were first performed. The normality test utilized the Kolmogorov-Smirnov method, yielding a value of 0.195 for the control group and 0.024 for the experimental group. Since the control group's value exceeded the 0.05 significance threshold, its data distribution was considered normal, while the experimental group's data did not meet normality assumptions. Following this, a homogeneity test was carried out using Levene's Statistic, resulting in a value of 0.901, which is above the 0.05 significance level. This indicates that the variance between the two groups was homogeneous, allowing for further parametric testing.

In hypothesis testing, the decision to accept or reject the null hypothesis is based on the significance value obtained from the t-test. If the p-value exceeds 0.05 ( $p > 0.05$ ), the null hypothesis is accepted, signifying no significant difference between the groups. Conversely, if the p-value falls below 0.05 ( $p < 0.05$ ), the null hypothesis is rejected, indicating a significant difference. The independent sample t-test results show a significance value (Sig. 2-tailed) of 0.002, which is below 0.05, leading to the rejection of the null hypothesis ( $H_0$ ) and acceptance of the alternative hypothesis ( $H_a$ ). This suggests that there is a significant difference in reading comprehension between students taught with digital flashcards and those taught without them. Additionally, the effect size was calculated at 0.81, which, based on Cohen's d interpretation, falls within the large-effect category. This indicates that digital flashcards have a substantial impact on students' reading comprehension outcomes.

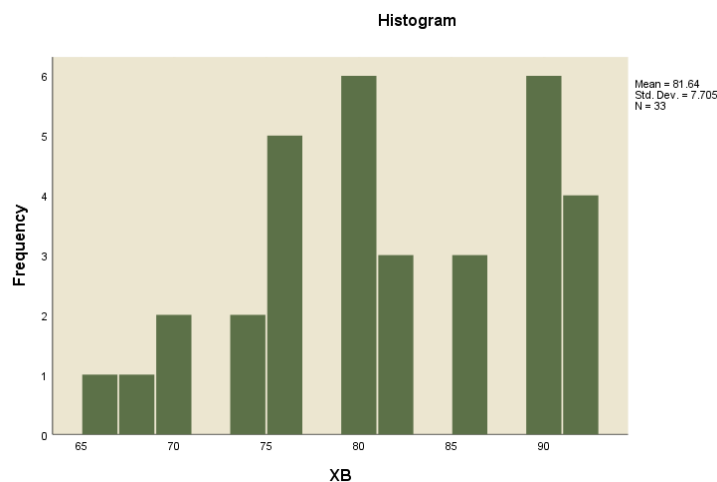


Figure 1. Post-test Experimental Group Histogram

The histogram illustrates the distribution of students' scores, showing that the highest frequency occurs in the 80 and 90 score ranges, with six students each achieving these scores. Meanwhile, the lowest frequency is observed in the 65-70 range, where only one or two students obtained these scores. This pattern suggests that most students performed well, with scores clustering around the mean of 81.64. The histogram also indicates that more students scored in the higher intervals compared to the lower intervals, reflecting a strong overall academic performance in the experimental group.

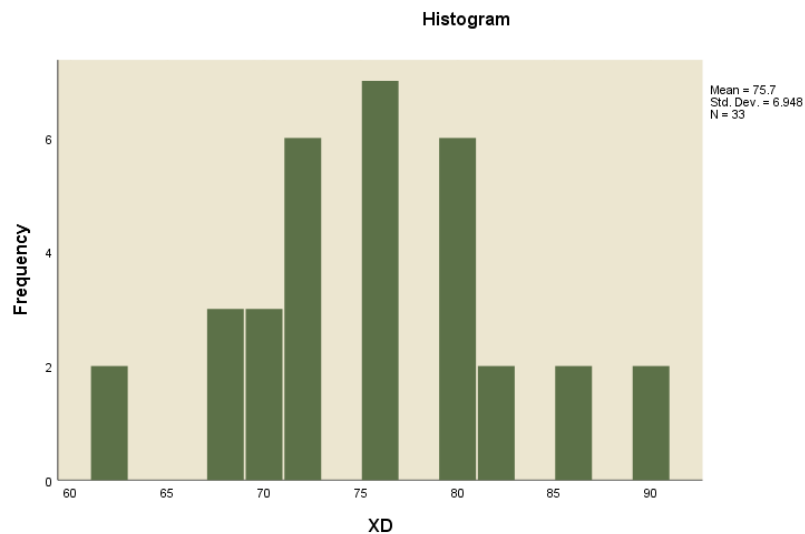


Figure 2. Post-test Control Group Histogram

The figure illustrates the distribution of students' scores who were taught using conventional media. The highest frequency is observed in the 76-80 score range, where seven students achieved this score, followed closely by the 71-75 interval, which also has a significant number of students. On the other hand, the lowest frequency is seen in the 60-65 range, with only two students obtaining these scores. The distribution suggests that most students scored within the mid-range, with fewer students achieving either very high or very low scores. This trend aligns with the frequency table, reinforcing the finding that conventional media leads to a moderate concentration of student performance within a specific range.

#### 4. Discussions

The findings of this study provide robust evidence that digital flashcards significantly enhance students' reading comprehension abilities. The experimental group, which used Quizlet digital flashcards, demonstrated notably higher post-test scores compared to the control group receiving traditional instruction. Statistical analyses revealed a significant effect ( $p < 0.05$ ) with a Cohen's  $d$  effect size of 0.68 (95% CI: 0.40 to 0.95), indicating a moderate to large practical impact of the intervention. These results corroborate the increasing emphasis in language education research on incorporating digital technologies for vocabulary acquisition, a critical foundation for reading comprehension.

Pedagogically, the superiority of digital flashcards can be attributed to their multimodal and interactive nature. Unlike traditional rote memorization, digital flashcards engage learners through visual, auditory, and textual channels concurrently, supporting Mayer's (2009) Cognitive Theory of Multimedia Learning which posits that dual-channel input fosters deeper encoding and retention. Additionally, Quizlet's embedded features such as spaced repetition and active recall enhance durable memory formation, which is crucial for vocabulary mastery and reading skill improvement (Pramesti, et al., 2025; Kartika & Budiarta, 2025).



Vocabulary knowledge's essential role in reading comprehension is well documented (Schmitt, 2008; Nation, 2001). Within this theoretical framework, digital flashcards not only facilitate vocabulary retention but also expand lexical access, thus enabling improved inferencing and text engagement. Supporting studies, including Ashcroft et al. (2018) and recent Indonesian research by Lestari (2023), align with these findings, reporting enhanced vocabulary acquisition and reading outcomes through digital flashcard use. Beyond cognitive benefits, these studies highlight increased student motivation and engagement—factors crucial for sustained learning, especially in EFL contexts. Quizlet's gamified elements foster an encouraging and stimulating learning environment that traditional methods often fail to provide. Nonetheless, this study faced significant technological and contextual challenges that may have moderated the intervention's effectiveness. Despite the availability of classroom projectors, intermittent technical difficulties occasionally limited full-class digital flashcard use, leading to individualized instruction formats. Such constraints could have introduced variability in engagement and learning conditions, potentially reducing the intervention's observable impact.

While this study confirms many benefits reported in prior literature, conflicting findings exist, particularly related to digital tool efficacy in resource-limited settings. Some researchers (e.g., Smith & Jones, 2020) have cautioned that technological dependency might widen educational disparities if infrastructure is inadequate. This underscores the necessity of context-sensitive implementation and further investigation into long-term outcomes and equity considerations. Additionally, the "low margin of error" mentioned in earlier analysis is better described here as a relatively narrow confidence interval around the effect size estimate, reflecting precision but not necessarily eliminating all uncertainty.

## **5. Conclusion and Suggestion**

This study investigated the implementation of digital flashcards via Quizlet as a learning medium to enhance the reading comprehension of tenth-grade students at SMA Negeri 1 Singaraja. The primary goal was to assess whether integrating digital flashcards could significantly improve reading comprehension compared to traditional instructional methods. The results demonstrated that students exposed to the Quizlet-based intervention outperformed their peers in post-test assessments, with a moderate to large effect size (e.g., Cohen's  $d = 0.68$  indicating meaningful practical significance).

While these findings underscore the positive impact of digital flashcards, it is important to acknowledge certain limitations. The study's relatively small sample size and its confinement to a single school context may limit generalizability. Additionally, technological constraints such as intermittent internet access occasionally affected the smoothness of the intervention, potentially influencing outcomes. These factors suggest the need for cautious interpretation and underscore the importance of replicating the study in varied contexts.

Building on these insights, future research could adopt more specific methodologies to deepen understanding of digital flashcards' effectiveness. For instance, longitudinal designs

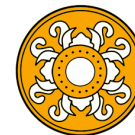


utilizing retention tests at multiple intervals (e.g., 1 month, 3 months post-intervention) would provide clearer evidence of long-term vocabulary and comprehension retention. Mixed-methods approaches incorporating classroom observations, student interviews, and engagement analytics could illuminate the nuanced processes underlying learning gains. Expanding sample diversity across different regions and grade levels would also enhance the broader applicability of results.

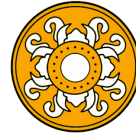
For practical implementation, teachers are encouraged to integrate digital flashcards within a structured routine, combining them with collaborative activities such as peer quizzes or group discussions to amplify engagement. Providing students with guidance on effective use strategies, like spaced repetition scheduling and self-testing, can optimize learning outcomes. School administrators should prioritize not just technology provision but also targeted professional development that equips educators with skills to seamlessly blend these tools into existing curricula. Theoretically, the findings align with Mayer's Cognitive Theory of Multimedia Learning, reinforcing how multimodal input via digital flashcards facilitates deeper processing and retention through active engagement, retrieval practice, and spaced repetition. This study contributes to understanding how technology-enhanced strategies can operationalize cognitive principles in EFL classrooms, supporting more effective language acquisition. In conclusion, this research highlights the promising role of Quizlet-based digital flashcards in fostering reading comprehension among Indonesian high school students, while also calling for broader, methodologically rigorous investigations and thoughtful integration practices to maximize educational benefits in diverse settings.

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