Voices of English Language Education Society
| Volume 10, Number 1| | April 2026 | | E-ISSN 2579-7484 |
DOI: https://doi.org/10.29408/veles.v10i1.33909

When Digital Vocabulary Learning Meets Student Engagement: Comparing HyperCard and Hypertext Models in EFL Classrooms

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Abstract: Vocabulary mastery is essential for English as a Foreign Language (EFL) learners because it supports reading comprehension, listening accuracy, writing fluency, and oral communication. However, vocabulary instruction is still frequently dominated by memorization and decontextualized exercises, which may limit students' lexical development and engagement. This study examined the effects of HyperCard and hypertext learning models on students' vocabulary mastery by considering different levels of student engagement. A quantitative experimental design with a 2×3 factorial arrangement was employed. The participants were 100 eleventh-grade students from a senior high school in Pandeglang, Indonesia, selected from a population of 245 students. Data were collected through vocabulary pre-tests and post-tests and a student engagement questionnaire. The data were analyzed using descriptive statistics, two-way ANOVA, and Tukey's post-hoc test. The findings showed that the learning model had a significant effect on students' vocabulary mastery, with the HyperCard model producing higher post-test scores than the hypertext model. Student engagement also significantly affected vocabulary mastery, as highly engaged students achieved better vocabulary outcomes than students with medium and low engagement. In addition, a significant interaction was found between learning models and engagement levels, indicating that the effectiveness of digital vocabulary instruction varied according to students' engagement. These findings suggest that structured, card-based, and multimodal vocabulary learning can enhance students' lexical development, particularly when supported by active learner engagement. The study implies that EFL teachers should integrate digital vocabulary models with instructional strategies that promote students' attention, participation, persistence, and meaningful use of new words.

Keywords: digital vocabulary instruction, EFL vocabulary learning, HyperCard, hypertext, student engagement, vocabulary mastery.

1. Introduction

Vocabulary mastery is a central component of English as a Foreign Language (EFL) learning because it supports learners' ability to understand, process, and produce language across different communicative skills. Learners need sufficient vocabulary knowledge to comprehend written texts, recognize spoken input, express ideas in writing, and communicate orally. Schmitt (2019) emphasizes that vocabulary acquisition is multidimensional, involving knowledge of word form, meaning, use, collocation, and productive control. Similarly, Nation (2022) argues that vocabulary knowledge develops through repeated exposure, deliberate learning, meaningful use, and opportunities for retrieval. Without adequate vocabulary mastery, learners

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Submitted: January 14, 2026 Revised: March 19, 2026 Accepted, April 16, 2026

may struggle to understand texts, follow spoken communication, and express ideas accurately. Previous studies have also shown that vocabulary knowledge is strongly related to reading comprehension, listening ability, speaking performance, and writing quality (Matthews & Cheng, 2015; McLean et al., 2015; Laufer & Aviad-Levitzky, 2017; Uchihara & Clenton, 2020; Webb, 2020). This indicates that vocabulary is not an isolated language component, but a foundational resource that influences broader language proficiency.

Despite its importance, vocabulary learning remains a persistent challenge in many EFL contexts. Students often have limited exposure to English outside the classroom, making school-based instruction a major source of vocabulary input. Muñoz and Cadierno (2021) show that differences in language exposure can influence English learning outcomes, while studies on incidental vocabulary learning suggest that repeated encounters with words through reading, audiovisual input, and meaningful language contact contribute to vocabulary development (Webb & Chang, 2015; De Wilde & Eyckmans, 2017; Peters & Webb, 2018). In contexts where such exposure is limited, vocabulary instruction needs to provide learners with rich, repeated, and contextualized encounters with words. However, classroom vocabulary instruction is still often dominated by traditional practices, such as memorizing word lists, translating isolated words, copying definitions, and completing textbook-based exercises. Although these practices may support short-term recognition, they are often insufficient for developing deeper lexical knowledge and flexible word use.

Vocabulary learning requires more than knowing dictionary meanings. Learners need to encounter words in different contexts, notice form–meaning relationships, understand collocations, retrieve words repeatedly, and apply them meaningfully in communication. Pellicer-Sánchez (2016) highlights the importance of attention and repeated exposure in incidental vocabulary acquisition, while Teng (2018) and Vu and Peters (2022) show that reading, listening, and textual enhancement can support vocabulary learning when learners engage with input meaningfully. Yanagisawa et al. (2020) also demonstrate that glossing can contribute to vocabulary learning from reading, particularly when learners receive support that helps them connect word meanings with context. These findings suggest that vocabulary instruction should move beyond passive memorization toward learning environments that promote repeated exposure, meaningful processing, contextual use, and active learner involvement.

Digital learning models offer promising opportunities to address these limitations. Technology-supported language learning can expand learners' access to vocabulary input, provide multimodal representations of meaning, support repeated practice, and allow students to learn at their own pace. Chun et al. (2016) argue that technology has become increasingly important in language use, teaching, and learning because it provides new ways for learners to interact with language. Meta-analytic evidence also suggests that mobile and digital learning can support language learning outcomes when used appropriately (Burston, 2015; Sung et al., 2015; Mahdi, 2018; Lin & Lin, 2019). More recent work by Zhang and Zou (2022) further shows that various technologies can support second- and foreign-language learning by providing flexible access, interaction, and individualized learning opportunities. In vocabulary instruction, digital tools can help students encounter words through text, images, audio, examples, links, and contextualized tasks, thereby supporting both recognition and deeper lexical processing.

HyperCard and hypertext learning models are relevant in this digital learning landscape because both offer interactive ways to organize and present vocabulary. HyperCard presents vocabulary content through structured card-like units that may include word meanings, examples, images, pronunciation support, synonyms, antonyms, and contextual sentences. This format can help learners process vocabulary in smaller, focused, and multimodal units. Hypertext, on the other hand, allows learners to navigate linked words, explanations, examples, and related concepts in a non-linear way. Such navigation gives students opportunities to explore vocabulary materials that align with their learning needs and interests. Studies on hypermedia and multimedia learning suggest that linked, annotated, and multimodal materials can support vocabulary acquisition, reading comprehension, motivation, and learner autonomy (Khezrlou et al., 2017; Kessler, 2018; Ramezanali et al., 2021; Wang & Lee, 2021). These features are pedagogically important

because vocabulary knowledge develops through connections among form, meaning, use, and context rather than through isolated memorization.

Previous research has provided evidence for the value of hypermedia-based learning in EFL contexts. Karimi (2013) found that learners' beliefs about online knowledge were related to grammar achievement in a hypermedia environment, suggesting that students' interaction with digital materials can influence learning outcomes. Abdolmanafi-Rokni and Hamidi (2014) reported that hypermedia-supported instruction improved EFL learners' oral performance and motivation. Shang (2016) showed that metacognitive strategies and hypermedia annotations affected foreign language reading, indicating that learners' strategy use matters in digital learning environments. More recently, Rahman et al. (2022) developed a hypermedia-based English learning model for tourism and found it to be suitable and motivating for learners, while Erni et al. (2023) examined Indonesian EFL learners' reading styles in hypermedia materials. These studies indicate that hypermedia can support different aspects of EFL learning, but they also suggest that the effectiveness of digital learning depends on how students interact with the materials.

This point is particularly relevant because digital learning models do not automatically produce better learning outcomes. Learners must be actively engaged in exploring materials, processing information, completing tasks, and applying what they learn. Student engagement is, therefore, an important factor in digital vocabulary learning. Engagement involves learners' behavioral participation, cognitive effort, emotional involvement, attention, persistence, and willingness to invest in learning activities. Mercer and Dörnyei (2020) argue that engaged language learners are more likely to participate actively, sustain effort, and take responsibility for their learning. Hiver et al. (2021) similarly emphasize that engagement in the language classroom is multidimensional, involving behavioral, cognitive, emotional, and social aspects. From the perspective of self-determination theory, learners' motivation and engagement are also shaped by their need for autonomy, competence, and relatedness (Ryan & Deci, 2017). These perspectives suggest that even well-designed digital vocabulary models may yield different outcomes depending on students' levels of engagement. Although previous studies have examined digital, hypermedia, and technology-assisted language learning, there remains a need to compare specific digital vocabulary learning models while considering student engagement as an important learner-related factor. Much of the existing research has discussed the benefits of hypermedia and multimedia learning in general. Still, fewer studies have examined how HyperCard and hypertext models differ in supporting vocabulary mastery among students with high, medium, and low engagement. This gap is important because students do not interact with digital materials in the same way. Highly engaged students may explore learning materials more actively, review vocabulary more frequently, and process examples more deeply, while less engaged students may use the same digital model more passively. Therefore, examining the interaction between learning models and student engagement can provide a more nuanced understanding of when and for whom digital vocabulary instruction is most effective.

Based on this background, this study examines the effects of HyperCard and hypertext learning models on students' vocabulary mastery by considering different levels of student engagement. Specifically, this study addresses the following research question: Is there a significant difference in vocabulary mastery between students taught using the HyperCard learning model and those taught using the hypertext learning model? Second, is there a significant difference in vocabulary mastery among students with high, medium, and low levels of engagement? Third, is there a significant interaction between learning models and student engagement levels in affecting students' vocabulary mastery? By addressing these questions, this study contributes to EFL vocabulary instruction by clarifying how digital learning models and learner engagement jointly influence vocabulary mastery. It also provides pedagogical insight for teachers in selecting digital vocabulary models and designing learning activities that promote active engagement, repeated practice, and meaningful lexical development.

2. Method

2.1 Research Design

This study employed a quantitative experimental design with a 2 × 3 factorial arrangement to examine the effects of digital learning models and student engagement levels on students' English vocabulary mastery. The first independent variable was the learning model, consisting of two instructional treatments: the HyperCard learning model and the hypertext learning model. The second independent variable was student engagement, categorized into three levels: high, medium, and low. The dependent variable was students' vocabulary mastery, measured through vocabulary post-test scores after the instructional treatment. A factorial design was used because the study aimed to examine not only the main effects of learning models and student engagement, but also the interaction effect between the two variables in influencing vocabulary mastery. Such a design is appropriate when researchers seek to determine whether the effect of an instructional treatment varies across different learner characteristics (Kirk, 2013; Montgomery, 2020). In this study, the factorial structure enabled the researcher to compare students' vocabulary outcomes across six conditions: HyperCard with high, medium, and low engagement, and hypertext with high, medium, and low engagement.

2.2 Participants and Group Assignment

The study population comprised 245 eleventh-grade students at a senior high school in Pandeglang, Indonesia. From this population, 100 students were randomly selected and assigned to two instructional groups, with 50 students in each. One group was taught using the HyperCard learning model, while the other group was taught using the hypertext learning model. Random sampling was used to reduce selection bias and to provide students in the population with an equal opportunity to be selected (Cohen et al., 2018; Mills & Gay, 2019). Before the instructional treatment, all participants completed a vocabulary pre-test to identify their initial vocabulary mastery. The pre-test scores were used to assess the groups' initial condition before treatment. Students also completed a student engagement questionnaire, which was used to classify them as high-, medium-, or low-engagement. The classification was conducted using the tertile method: students in the upper third of the engagement score distribution were categorized as having high engagement, those in the middle third as having medium engagement, and those in the lower third as having low engagement. This classification allowed the researcher to examine whether students with different levels of engagement benefited differently from the two digital vocabulary learning models.

2.3 Instructional Treatments

The instructional treatment was conducted over six meetings, with each meeting lasting approximately 90 minutes. Both groups learned the same target vocabulary, followed the same learning objectives, and received the same amount of instructional time. The target vocabulary consisted of 40 English vocabulary items selected from eleventh-grade English learning materials and reading texts relevant to the school curriculum. The vocabulary items included nouns, verbs, adjectives, and expressions that students were expected to understand and use in contextual language activities. The same teacher facilitated both groups to minimize teacher-related variation. The main difference between the two groups was the format through which vocabulary materials were presented, accessed, and practiced.

In the HyperCard group, vocabulary instruction was delivered through structured digital cards. Each card presented one target vocabulary item and included its meaning, a pronunciation guide, part of speech, an example sentence, a synonym or antonym, contextual use, and a visual cue where appropriate. Students moved from one card to another, reviewed the vocabulary information, answered short practice questions, and constructed simple sentences using the target words. The card-based format was designed to provide focused, organized, and multimodal vocabulary exposure. This model helped students concentrate on individual vocabulary items while connecting word form, meaning, and use. The teacher guided students in reviewing the cards, checking their understanding, and discussing examples of word use in context.

In the hypertext group, vocabulary instruction was delivered through linked text-based materials. Students accessed vocabulary items through hyperlinks embedded in short reading passages and explanatory texts. When students clicked on a target word, they were directed to definitions, examples, related words, and contextual explanations. Unlike the HyperCard model, which presented vocabulary in structured card units, the hypertext model allowed students to navigate vocabulary information in a more non-linear way. Students could move between linked words, revisit explanations, and explore related vocabulary items as needed. The teacher provided initial guidance on using the hypertext materials and monitored students' progress during the activities. Both treatments included vocabulary exploration, guided practice, sentence construction, review, and feedback.

2.4 Vocabulary Mastery Test

The vocabulary mastery test was administered as both a pre-test and a post-test. The pre-test was administered before the treatment to measure students' initial vocabulary mastery. In contrast, the post-test was administered after the treatment to measure their vocabulary mastery following instruction using HyperCard or hypertext. The test was developed based on the 40 target vocabulary items taught during the intervention. It assessed students' knowledge of word meaning, form recognition, synonym and antonym recognition, contextual use, and sentence completion. The test consisted of 40 items, including multiple-choice, matching, and sentence-completion items. Each correct answer was scored one point, while an incorrect answer was scored zero, producing a maximum possible score of 100 after conversion.

To ensure content validity, the vocabulary test was reviewed by two English language teaching experts and one senior English teacher. The reviewers examined the alignment between the test items, target vocabulary, learning objectives, and students' proficiency level. Revisions were made to unclear instructions, ambiguous options, and items that did not adequately represent the vocabulary content. The test was then administered to 30 eleventh-grade students outside the research sample to examine item quality and reliability. Item analysis was conducted to check item difficulty and discrimination. Items with very low discrimination or unclear wording were revised before the test was used in the main study. The reliability of the vocabulary test was assessed using KR-20, as the items were scored dichotomously. The reliability coefficient was .84, indicating that the test had good internal consistency for measuring students' vocabulary mastery.

2.5 Student Engagement Questionnaire

The student engagement questionnaire was used to measure students' engagement in vocabulary learning and to classify them into high-, medium-, and low-engagement groups. The questionnaire was developed based on the multidimensional view of student engagement, which includes behavioral, cognitive, and emotional engagement (Mercer & Dörnyei, 2020). Behavioral engagement was defined as students' attention, participation, task completion, and involvement in vocabulary learning activities. Cognitive engagement referred to students' effort, use of strategies, concentration, and willingness to understand and remember vocabulary items. Emotional engagement was defined as students' interest, enjoyment, and positive feelings toward vocabulary learning and digital learning activities.

The questionnaire consisted of 24 items, each rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The indicators included students' attention to vocabulary materials, participation in learning activities, effort to review new words, persistence when encountering difficult vocabulary, interest in digital vocabulary learning, and willingness to use vocabulary in practice. The total score ranged from 24 to 120. Students' engagement levels were categorized into tertiles based on the distribution of total questionnaire scores. Students with scores in the upper tertile were categorized as highly engaged, those in the middle tertile as moderately engaged, and those in the lower tertile as lowly engaged. Two English education experts reviewed the questionnaire to ensure content relevance, item clarity, and appropriateness for senior high school students. A pilot test was conducted with 30 students outside the research sample, and the internal consistency was examined using Cronbach's alpha. The questionnaire obtained a reliability coefficient of .88, indicating good internal consistency.

2.6 Data Collection Procedure

Data collection was conducted in four stages. First, the vocabulary pre-test was administered to both groups under the same testing conditions. The same instructions, time allocation, and scoring procedures were used to ensure consistency. Second, the student engagement questionnaire was distributed to all participants to assess their engagement levels before the main analysis. The questionnaire results were used to classify students into high, medium, and low engagement categories. Third, the instructional treatments were implemented over six meetings. The HyperCard group learned vocabulary through structured card-based digital materials, while the hypertext group learned the same vocabulary through linked text-based materials. Both groups received the same target vocabulary, learning objectives, instructional duration, and teacher guidance. After the treatment period, the vocabulary post-test was administered to both groups. The post-test used the same content coverage and item structure as the pre-test, but with items reordered to reduce recall effects. Students' responses from the pre-test, post-test, and engagement questionnaire were coded and entered into SPSS for statistical analysis. The post-test scores served as the main outcome data for examining the effects of learning models, engagement levels, and their interaction on vocabulary mastery.

2.7 Data Analysis

The data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to present the mean scores, standard deviations, and score distributions of students' vocabulary mastery across learning models and engagement levels. These descriptive results provided an initial overview of students' vocabulary performance before and after the instructional treatment. Before conducting inferential analysis, the data were tested for normality and homogeneity of variance. The Shapiro–Wilk test was used to examine normality, while Levene's test was used to examine the homogeneity of variance. These assumption tests were conducted because ANOVA requires normally distributed data and relatively equal variances across groups (Gravetter & Wallnau, 2017; Tabachnick & Fidell, 2019).

After the assumptions were met, a two-way ANOVA was conducted to examine the main effects of learning models and student engagement levels, as well as their interaction, on students' vocabulary mastery. The significance level was set at .05. When the ANOVA indicated a significant effect of student engagement, Tukey's HSD post-hoc test was conducted to identify specific differences among high, medium, and low engagement groups. The results were interpreted based on F values, significance values, mean differences, and interaction patterns. This analysis was appropriate because the study involved two independent variables and one dependent variable and sought to determine whether the instructional model, engagement level, and their interaction significantly influenced students' vocabulary mastery.

3. Findings

3.1 Descriptive Results of Students' Vocabulary Mastery

The descriptive statistics show that students in both learning model groups improved from pre-test to post-test. However, the improvement was more substantial in the HyperCard group than in the hypertext group. Table 1 presents students' vocabulary mastery scores across engagement levels in the HyperCard group.

Table 1. Descriptive statistics of vocabulary mastery in the HyperCard group

Engagement level	Pre-test mean	Post-test mean	Post-test N	Post-test SD
High	57.76	83.18	25	4.511
Medium	54.00	74.76	15	1.091
Low	55.00	64.00	10	4.304

As shown in Table 1, students in the HyperCard group demonstrated clear improvement after the treatment. Students with high engagement obtained the highest post-test mean score, increasing from 57.76 to 83.18. Students with medium engagement also improved from 54.00 to 74.76, while students with low engagement increased from 55.00 to 64.00. The pattern indicates that vocabulary mastery increased across all engagement levels, but students with higher engagement achieved stronger outcomes. The high-engagement group showed the strongest post-test performance, followed by the medium- and low-engagement groups. This suggests that the structured, card-based vocabulary learning model was particularly effective when students were actively engaged in the learning process.

Table 2. Descriptive statistics of vocabulary mastery in the hypertext group

Engagement level	Pre-test mean	Post-test mean	Post-test N	Post-test SD
High	58.00	65.32	19	4.075
Medium	50.30	58.17	11	7.389
Low	40.50	50.00	20	6.975

Table 2 shows that students in the hypertext group also improved from pre-test to post-test, but the gains were more moderate than those in the HyperCard group. Students with high engagement increased from 58.00 to 65.32, students with medium engagement improved from 50.30 to 58.17, and students with low engagement increased from 40.50 to 50.00. The pattern again shows that higher engagement was associated with better vocabulary mastery. However, compared with the HyperCard group, the hypertext group's post-test means were consistently lower across all engagement levels. This descriptive pattern suggests that HyperCard provided stronger support for vocabulary mastery than hypertext. To provide a clearer comparison between learning models, Table 3 summarizes the post-test mean scores across the two instructional groups.

Table 3. Summary of post-test vocabulary mastery by learning model and engagement level

Engagement level	HyperCard mean	Hypertext mean	Mean difference
High	83.18	65.32	17.86
Medium	74.76	58.17	16.59
Low	64.00	50.00	14.00

Table 3 shows that the HyperCard group outperformed the hypertext group at all engagement levels. The largest difference appeared among students with high engagement, where the HyperCard group scored 17.86 points higher than the hypertext group. The medium-engagement group showed a difference of 16.59 points, while the low-engagement group showed a difference of 14.00 points. These descriptive results indicate that HyperCard was more effective than hypertext in supporting students' vocabulary mastery, regardless of engagement level. Nevertheless, the magnitude of the difference varied across engagement groups, suggesting a possible interaction between the learning model and student engagement.

3.2 Effects of Learning Models and Student Engagement on Vocabulary Mastery

A two-way ANOVA was conducted to examine the main effects of learning models and student engagement, as well as their interaction, on students' vocabulary mastery. The results are presented in Table 4.

Table 4. Two-way ANOVA results for vocabulary mastery

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Corrected model	18143.299	5	3628.660	165.363	< .001	—
Learning models	428.889	1	428.889	19.545	< .001	.172
Student engagement	3929.898	2	1964.949	89.545	< .001	.656

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial eta squared
Learning models × student engagement	136.552	2	68.276	3.111	.049	.062
Error	2062.701	94	21.944	—	—	—
Corrected total	20206.000	99	—	—	—	—

The corrected model was statistically significant, $F(5, 94) = 165.363$, $p < .001$, indicating that the model explained a significant proportion of variance in students' vocabulary mastery. The model also showed strong explanatory power, with $R^2 = .898$ and adjusted $R^2 = .892$. This means that learning models, student engagement, and their interaction collectively explained approximately 89.8% of the variance in students' vocabulary mastery.

The main effect of learning models was statistically significant, $F(1, 94) = 19.545$, $p < .001$, partial $\eta^2 = .172$. This result indicates that students' vocabulary mastery differed significantly between the HyperCard and hypertext groups. Based on the descriptive results, students taught through the HyperCard learning model achieved higher vocabulary mastery than those taught through the hypertext learning model. Therefore, the first research question is answered affirmatively: there was a significant difference in vocabulary mastery between students taught using HyperCard and those taught using hypertext. In addition, the main effect of student engagement was also statistically significant, $F(2, 94) = 89.545$, $p < .001$, partial $\eta^2 = .656$. This shows that students with high, medium, and low engagement levels differed significantly in vocabulary mastery. The large effect size indicates that student engagement was a strong predictor of students' vocabulary outcomes. Therefore, the second research question is also answered affirmatively: there was a significant difference in vocabulary mastery among students with varying levels of engagement.

The interaction between learning models and student engagement was statistically significant, $F(2, 94) = 3.111$, $p = .049$, partial $\eta^2 = .062$. This indicates that the learning model's effect on vocabulary mastery varied across engagement levels. In other words, the difference between HyperCard and hypertext varied across students with high, medium, and low engagement. Therefore, the third research question is also answered affirmatively: there was a significant interaction between learning models and student engagement in affecting students' vocabulary mastery.

3.3 Post-Hoc Comparisons among Student Engagement Levels

Since the main effect of student engagement was significant, Tukey's HSD post-hoc test was conducted to identify which engagement groups differed significantly from one another. The results are presented in Table 5.

Table 5. Tukey HSD post-hoc test for student engagement levels

Engagement comparison	Mean difference	Std. error	Sig.	95% CI lower	95% CI upper
High – Medium	13.71	1.173	< .001	10.92	16.50
High – Low	34.09	1.259	< .001	31.09	37.09
Medium – Low	20.38	1.098	< .001	17.77	23.00

The Tukey HSD results show that all pairwise comparisons among engagement levels were statistically significant. Students with high engagement achieved significantly higher vocabulary mastery than those with medium engagement, with a mean difference of 13.71 points $p < .001$). Students with high engagement also significantly outperformed those with low engagement, with a larger mean difference of 34.09 points $p < .001$). In addition, students with medium engagement achieved significantly higher vocabulary mastery than those with low engagement, with a mean difference of 20.38 points $p < .001$). These results confirm a consistent pattern: vocabulary mastery increased with student engagement. Highly engaged students

achieved the strongest vocabulary outcomes, followed by students with medium engagement, while students with low engagement obtained the lowest vocabulary mastery scores. This finding indicates that student engagement was not only statistically significant but also practically important in supporting vocabulary learning.

3.4 Interaction Pattern between Learning Models and Student Engagement

The significant interaction effect indicates that the effectiveness of the learning model depended partly on students' engagement levels. The descriptive pattern shows that HyperCard produced higher post-test vocabulary scores than hypertext did across high-, medium-, and low-engagement groups. However, the difference between the two learning models was not consistent across the three engagement levels. The gap between HyperCard and hypertext was largest among highly engaged students, followed by medium-engagement students and low-engagement students. This interaction pattern suggests that HyperCard was more beneficial when students were more engaged in the learning process. Highly engaged students appeared to gain the greatest advantage from the structured, card-based, and multimodal format of HyperCard learning. They may have been better able to actively use the available vocabulary information, examples, and practice activities. Students with lower engagement also benefited from HyperCard, but the difference was smaller. Thus, the findings suggest that digital vocabulary learning is most effective when instructional design is supported by active student engagement.

Based on the descriptive and inferential results, three main findings can be concluded. First, the HyperCard learning model produced significantly better vocabulary mastery than the hypertext learning model. Second, student engagement significantly influenced vocabulary mastery, with high-engagement students outperforming medium- and low-engagement students. Third, the significant interaction between learning models and student engagement indicates that the effectiveness of digital vocabulary instruction varied with students' engagement levels. These results provide empirical support for the importance of combining structured digital vocabulary materials with strategies that promote students' active participation, attention, effort, and persistence in learning.

4. Discussion

The results demonstrate that students' vocabulary mastery was significantly influenced by the digital learning model used in instruction. Students taught through the HyperCard learning model achieved higher post-test vocabulary scores than those taught through the hypertext learning model across high, medium, and low engagement levels. This finding suggests that the structure of digital vocabulary materials matters in supporting lexical development. HyperCard offered vocabulary input in focused, card-based units that combined word meaning, example sentences, contextual use, synonyms or antonyms, and visual cues. Such an organization may have helped students process vocabulary more systematically than the more open, non-linear navigation provided by hypertext. Vocabulary learning requires repeated exposure, attention to form–meaning connections, contextualized examples, and opportunities for retrieval and use (Schmitt, 2019; Webb, 2020; Nation, 2022). From this perspective, HyperCard may have supported vocabulary mastery by making lexical information more visible, organized, and easier to revisit during learning.

The superiority of HyperCard over hypertext can also be interpreted in terms of the role of multimodal, structured input in vocabulary learning. Research on multimedia glosses and technology-supported vocabulary learning has shown that learners benefit when verbal information is accompanied by visual, contextual, and explanatory support (Khezrlou et al., 2017; Ramezanali et al., 2021; Wang & Lee, 2021; Yanagisawa et al., 2020). The HyperCard model provided this type of support by presenting vocabulary items in compact but enriched units. By contrast, hypertext allowed students to move through linked information more freely, but this flexibility may have required greater self-regulation and navigation skills. For some learners, especially those who are less strategic or less engaged, non-linear hypertext navigation can become cognitively demanding because students must decide which links to follow, how much information to process, and how to connect related vocabulary items. Shang (2016) similarly emphasizes that successful

learning in hypermedia environments depends on learners' use of strategies and metacognitive control. Therefore, the stronger performance of the HyperCard group indicates that structured digital design may be more effective for vocabulary instruction when learners need clearer guidance in processing lexical information.

This finding does not mean that hypertext is pedagogically ineffective. Students in the hypertext group also improved from pre-test to post-test, indicating that linked text-based vocabulary learning can support lexical development. Hypertext provides opportunities for learner-controlled exploration, flexible access to information, and non-linear learning pathways. These features are consistent with the potential of digital environments to promote autonomy and self-directed learning (Godwin-Jones, 2019; Lai, 2018; Reinders & Benson, 2017). However, the present findings suggest that autonomy in digital vocabulary learning needs to be balanced with sufficient structure. When students are given too much navigational freedom without strong scaffolding, the learning process may become less focused. HyperCard appears to offer a more guided form of digital autonomy: students can interact with digital materials, but the information is organized into manageable units that reduce unnecessary searching and keep attention focused on vocabulary learning.

Student engagement also emerged as a strong factor in vocabulary mastery. The ANOVA results showed significant differences among high-, medium-, and low-engagement students, and the Tukey test confirmed that all engagement groups differed significantly from one another. Students with high engagement achieved the highest vocabulary mastery, followed by students with medium engagement, while students with low engagement obtained the lowest scores. This pattern is consistent with the view that vocabulary learning is not a passive process. Learners need to pay attention, participate in tasks, review difficult words, persist when encountering unfamiliar vocabulary, and use new words in meaningful contexts. Engagement in language learning involves behavioral participation, emotional involvement, cognitive investment, and social interaction (Mercer & Dörnyei, 2020). These dimensions are particularly important in vocabulary learning because students develop lexical knowledge through active processing, repeated retrieval, and sustained involvement with language input. The strong effect of student engagement also supports motivational perspectives in language learning. Ryan and Deci (2017) argue that learners are more likely to invest effort when learning environments support autonomy, competence, and relatedness, whereas Dörnyei and Ryan (2015) emphasize the role of motivation and learner psychology in shaping language-learning success. In this study, students with higher engagement likely benefited more because they were more attentive to vocabulary materials, more willing to complete tasks, and more persistent in reviewing and applying new words. Their stronger outcomes suggest that digital vocabulary models cannot be separated from the quality of students' involvement. Even well-designed digital materials may produce limited effects if students interact with them superficially. Conversely, when students are actively engaged, digital tools can become more powerful because learners use the available features more purposefully.

The significant interaction between learning models and student engagement provides a more nuanced understanding of digital vocabulary instruction. The effect of the learning model was not uniform across engagement levels. HyperCard produced higher vocabulary scores than hypertext across all engagement groups, but the advantage was strongest among highly engaged students. This suggests that the benefits of structured and multimodal digital materials are amplified when students actively invest attention, effort, and persistence in the learning process. HyperCard may have provided structured vocabulary input, but students needed engagement to use it effectively. Highly engaged learners were likely more willing to review cards, examine examples, connect meanings with contexts, and practice target words repeatedly. This interaction supports the argument that technology-enhanced language learning is most effective when instructional design and learner engagement work together (Chun et al., 2016; Kessler, 2018; Zhang & Zou, 2022).

The interaction effect is pedagogically important because it challenges the assumption that digital learning models automatically improve vocabulary mastery. The findings indicate that the effectiveness of digital vocabulary instruction depends on both the design of the learning model and the learner's engagement with the materials. This aligns with research showing that technology-supported language learning is shaped by

learner autonomy, motivation, strategy use, and the quality of interaction with digital resources (Godwin-Jones, 2019; Lai, 2018; Shadiev et al., 2017; Kukulska-Hulme & Viberg, 2018). For teachers, this means that adopting digital vocabulary tools is not enough. Teachers also need to design tasks that require students to actively interact with vocabulary materials, retrieve target words, use them in sentences, compare their meanings, and revisit difficult items over time. The findings also contribute to vocabulary pedagogy by showing that structured digital learning may be particularly useful in EFL contexts where learners have limited exposure to English outside the classroom. In such contexts, classroom instruction needs to provide rich and repeated vocabulary input. HyperCard can help address this need by organizing vocabulary items into accessible units that combine form, meaning, and use. This supports Nation's (2022) view that vocabulary learning requires deliberate attention, repeated encounters, and opportunities for use. It also resonates with studies showing that vocabulary development is strengthened through multimodal input, glossing, reading support, and contextualized exposure (Pellicer-Sánchez, 2016; Teng, 2018; Vu & Peters, 2022; Yu, 2022). Therefore, HyperCard-based instruction can be seen as a practical way to integrate deliberate vocabulary learning with digital support.

At the same time, the study highlights the need to support students with lower engagement. Although low-engagement students benefited from HyperCard more than from hypertext, their scores remained lower than those of medium- and high-engagement students. This suggests that structured digital materials alone may not fully compensate for weak learner engagement. Teachers need to provide additional scaffolding for less-engaged students, such as guided practice, progress monitoring, peer collaboration, brief vocabulary challenges, retrieval activities, and feedback. Mercer and Dörnyei (2020) argue that engagement can be shaped by classroom conditions, task design, teacher support, and learners' sense of competence. Thus, low engagement should not be treated simply as a fixed learner trait. It can be addressed through instructional design that makes vocabulary learning more interactive, achievable, and meaningful.

This study offers several implications for EFL vocabulary instruction. First, teachers should consider using structured digital vocabulary models, such as HyperCard, when introducing new vocabulary items. Card-based digital materials can help students focus on individual words while connecting them to meaning, examples, pronunciation, and contextual use. Second, teachers should not rely only on digital presentations. Vocabulary learning activities should require students to retrieve words, use them in meaningful sentences, compare related words, and revisit them across sessions. Third, engagement should be deliberately built into digital vocabulary instruction. Teachers can increase engagement by setting clear learning goals, providing immediate feedback, using pair or group tasks, encouraging self-monitoring, and designing vocabulary activities that connect with students' interests and communicative needs. Fourth, hypertext-based learning may be more effective when students receive explicit guidance on how to navigate links, select relevant information, and avoid superficial browsing. Furthermore, the study also contributes to research on digital vocabulary learning by comparing two specific models rather than discussing technology-assisted learning in general. Previous studies have shown that digital, mobile, multimedia, and hypermedia learning can support vocabulary development and broader language learning outcomes (Burston, 2015; Sung et al., 2015; Mahdi, 2018; Lin & Lin, 2019; Rahman et al., 2022). The present study adds that different digital models may not produce the same effects. HyperCard and hypertext both provide technology-supported vocabulary learning, but their instructional structures differ. HyperCard provides more focused, organized input, while hypertext provides more open, flexible navigation. The better performance of the HyperCard group suggests that, for vocabulary mastery, structure and multimodal support may be more beneficial than open navigation, especially when the goal is to help students acquire and retain target words.

Several limitations should be acknowledged to guide future research. The study involved eleventh-grade students from one senior high school in Pandeglang, so the findings should be interpreted within this context. Future studies could involve students from different school levels, regions, and proficiency backgrounds to examine whether similar patterns occur in broader EFL settings. The treatment was also conducted within a limited instructional period. Longer interventions may provide clearer evidence about vocabulary retention

and long-term lexical development. In addition, this study focused on vocabulary mastery as measured through test performance. Future research could examine how HyperCard and hypertext learning influence productive vocabulary use in speaking and writing, as well as students' learning strategies, motivation, and perceptions of digital vocabulary instruction. The findings point to a central argument: effective digital vocabulary learning depends on the alignment between instructional design and learner engagement. HyperCard supported vocabulary mastery by providing structured, multimodal, and focused vocabulary input, but its strongest effects were evident when students were highly engaged. Hypertext also supported improvement, but its open navigation may require stronger learner control and teacher guidance. For EFL teachers, the implication is clear: digital vocabulary models should be selected not only for their technological features, but also for how well they support attention, repeated exposure, meaningful processing, and active engagement.

5. Conclusion

This study examined the effects of HyperCard and hypertext learning models on students' vocabulary mastery by considering different levels of student engagement. The findings show that the HyperCard learning model produced significantly better vocabulary outcomes than the hypertext learning model across high, medium, and low engagement levels. This suggests that structured, card-based, and multimodal vocabulary materials can provide clearer support for students in learning word meanings, recognizing contextual use, and retaining new vocabulary. The study also found that student engagement significantly influenced vocabulary mastery. Students with high engagement achieved the strongest vocabulary outcomes, followed by those with medium engagement, while students with low engagement obtained the lowest scores. These results indicate that vocabulary learning is shaped not only by the instructional model but also by students' attention, effort, participation, interest, and persistence during learning activities. The significant interaction between learning models and student engagement further shows that digital vocabulary instruction is most effective when structured learning materials are combined with active learner involvement. Pedagogically, EFL teachers should not only select appropriate digital learning models such as HyperCard, but also design tasks that encourage students to review vocabulary, use new words meaningfully, interact with learning materials, and remain engaged throughout the learning process. For students with lower engagement, additional scaffolding, guidance, feedback, and collaborative activities may be needed to help them benefit more fully from digital vocabulary instruction. Future research may examine the effects of HyperCard and hypertext models on long-term vocabulary retention, productive vocabulary use in speaking and writing, and learners' motivation or strategies across different EFL contexts and educational levels.

6. Acknowledgement

The authors would like to express their sincere gratitude to the school principal, English teacher, and eleventh-grade students who participated in this study. Their cooperation and involvement during the implementation of the HyperCard and hypertext learning activities made this research possible. The authors also appreciate the support of the senior high school in Pandeglang, Indonesia, for granting permission and facilitating data collection.

7. Declaration of AI-Assisted Tools

The authors acknowledge that ChatGPT, Grammarly, and QuillBot were used to support language refinement, grammar checking, paraphrasing assistance, and manuscript editing during the preparation of this article. These tools were not used to generate research data, conduct statistical analyses, interpret findings, or alter the study's original results. All AI-assisted suggestions were carefully reviewed, verified, and approved by the authors, who take full responsibility for the accuracy, originality, and integrity of the final manuscript.

8. References

Abdolmanafi-Rokni, S. J., & Hamidi, H. (2014). Hypermedia in an EFL context: The impact on speaking and motivation. *Journal of Universal Language*, *4*(28), 13–24.

Burston, J. (2015). Twenty years of MALL project implementation: A meta-analysis of learning outcomes. *ReCALL, 27*(1), 4–20. https://doi.org/10.1017/S0958344014000159

Chen, J. C., & Kent, S. (2020). Task engagement, learner motivation, and avatar identities of struggling English language learners in the 3D virtual world. *System, 88*, Article 102168. https://doi.org/10.1016/j.system.2019.102168

Chen, Y. (2021). Comparing incidental vocabulary learning from reading-only and reading-while-listening. *System, 97*, Article 102442. https://doi.org/10.1016/j.system.2020.102442

Chun, D., Kern, R., & Smith, B. (2016). Technology in language use, language teaching, and language learning. *The Modern Language Journal, 100*(S1), 64–80. https://doi.org/10.1111/modl.12302

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge.

De Wilde, V., & Eyckmans, J. (2017). Game on! Young learners' incidental language learning of English before instruction. *Studies in Second Language Learning and Teaching, 7*(4), 673–694. https://doi.org/10.14746/ssllt.2017.7.4.6

Dörnyei, Z., & Ryan, S. (2015). *The psychology of the language learner revisited*. Routledge.

Erni, E., Mohamad, M., Azhar, F., & Syahfutra, W. (2023). Tertiary Indonesian EFL learners' learning style in reading hypermedia material. *Arab World English Journal*, *14*(2), 344–359. https://doi.org/10.24093/awej/vol14no2.24

Godwin-Jones, R. (2019). Riding the digital wilds: Learner autonomy and informal language learning. *Language Learning & Technology, 23*(1), 8–25. https://doi.org/10125/44667

Gravetter, F. J., & Wallnau, L. B. (2017). *Statistics for the behavioral sciences* (10th ed.). Cengage Learning.

Hashimoto, B. J., & Egbert, J. (2019). More than frequency? Exploring predictors of word difficulty for second language learners. *Language Learning, 69*(4), 839–872. https://doi.org/10.1111/lang.12353

Hiver, P., Al-Hoorie, A. H., & Mercer, S. (Eds.). (2021). *Student engagement in the language classroom*. Multilingual Matters.

Karimi, M. N. (2013). EFL students' grammar achievement in a hypermedia context: Exploring the role of Internet-specific personal epistemology. *System*, *42*, 1–11. https://doi.org/10.1016/j.system.2013.10.017

Kessler, G. (2018). Technology and the future of language teaching. *Foreign Language Annals, 51*(1), 205–218. https://doi.org/10.1111/flan.12318

Khezrlou, S., Ellis, R., & Sadeghi, K. (2017). Effects of computer-assisted glosses on EFL learners' vocabulary acquisition and reading comprehension in three learning conditions. *System, 65*, 104–116. https://doi.org/10.1016/j.system.2017.01.009

Kim, M., Crossley, S. A., & Kyle, K. (2018). Lexical sophistication as a multidimensional phenomenon: Relations to second language lexical proficiency, development, and writing quality. *The Modern Language Journal, 102*(1), 120–141. https://doi.org/10.1111/modl.12447

Kirk, R. E. (2013). *Experimental design: Procedures for the behavioral sciences* (4th ed.). SAGE Publications.

Kremmel, B., & Schmitt, N. (2016). Interpreting vocabulary test scores: What do various item formats tell us about learners' ability to employ words? *Language Assessment Quarterly, 13*(4), 377–392. https://doi.org/10.1080/15434303.2016.1237516

Kukulska-Hulme, A., & Viberg, O. (2018). Mobile collaborative language learning: State of the art. *British Journal of Educational Technology, 49*(2), 207–218. https://doi.org/10.1111/bjet.12580

Lai, C. (2018). Self-directed use of mobile devices for language learning beyond the classroom. *ReCALL, 30*(3), 299–318. https://doi.org/10.1017/S0958344017000258

Laufer, B., & Aviad-Levitzky, T. (2017). What type of vocabulary knowledge predicts reading comprehension: Word meaning recall or word meaning recognition? *The Modern Language Journal, 101*(4), 729–741. https://doi.org/10.1111/modl.12431

Lin, J. J., & Lin, H. (2019). Mobile-assisted ESL/EFL vocabulary learning: A systematic review and meta-analysis. *Computer Assisted Language Learning, 32*(8), 878–919. https://doi.org/10.1080/09588221.2018.1541359

Mahdi, H. S. (2018). Effectiveness of mobile devices on vocabulary learning: A meta-analysis. *Journal of Educational Computing Research, 56*(1), 134–154. https://doi.org/10.1177/0735633117698826

Matthews, J., & Cheng, J. (2015). Recognition of high-frequency words from speech as a predictor of L2 listening comprehension. *System*, *52*, 1–13. https://doi.org/10.1016/j.system.2015.04.015

McLean, S., Kramer, B., & Beglar, D. (2015). The creation and validation of a listening vocabulary levels test. *Language Teaching Research, 19*(6), 741–760. https://doi.org/10.1177/1362168814567889

McLean, S., Stewart, J., & Batty, A. O. (2020). Predicting L2 reading proficiency with modalities of vocabulary knowledge: A bootstrapping approach. *Language Testing, 37*(3), 389–411. https://doi.org/10.1177/0265532219898380

Mercer, S., & Dörnyei, Z. (2020). *Engaging language learners in contemporary classrooms*. Cambridge University Press.

Mills, G. E., & Gay, L. R. (2019). *Educational research: Competencies for analysis and applications* (12th ed.). Pearson.

Montgomery, D. C. (2020). *Design and analysis of experiments* (10th ed.). John Wiley & Sons.

Muñoz, C., & Cadierno, T. (2021). How do differences in exposure affect English language learning? A comparison of teenagers in two learning environments. *Studies in Second Language Learning and Teaching, 11*(2), 185–212. https://doi.org/10.14746/ssllt.2021.11.2.2

Nation, I. S. P. (2022). *Learning vocabulary in another language* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781009093873

Pellicer-Sánchez, A. (2016). Incidental L2 vocabulary acquisition from and while reading: An eye-tracking study. *Studies in Second Language Acquisition, 38*(1), 97–130. https://doi.org/10.1017/S0272263115000224

Peters, E., & Webb, S. (2018). Incidental vocabulary acquisition through viewing L2 television and factors that affect learning. *Studies in Second Language Acquisition, 40*(3), 551–577. https://doi.org/10.1017/S0272263117000407

Rahman, A., Wibawa, B., & Sumantri, S. (2022). Developing an English for Tourism learning model based on Hypermedia. *Education Quarterly Reviews*, *5*(4). https://doi.org/10.31014/aior.1993.05.04.670

Ramezanali, N., Uchihara, T., & Faez, F. (2021). Efficacy of multimodal glossing on second language vocabulary learning: A meta-analysis. *TESOL Quarterly, 55*(1), 105–133. https://doi.org/10.1002/tesq.579

Reinders, H., & Benson, P. (2017). Research agenda: Language learning beyond the classroom. *Language Teaching, 50*(4), 561–578. https://doi.org/10.1017/S0261444817000192

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.

Schmitt, N. (2019). Understanding vocabulary acquisition, instruction, and assessment: A research agenda. *Language Teaching, 52*(2), 261–274. https://doi.org/10.1017/S0261444819000053

Seibert Hanson, A. E., & Brown, C. M. (2020). Enhancing L2 learning through a mobile-assisted spaced-repetition tool: An effective but bitter pill? *Computer Assisted Language Learning, 33*(1–2), 133–155. https://doi.org/10.1080/09588221.2018.1552975

Shadiev, R., Hwang, W.-Y., & Huang, Y.-M. (2017). Review of research on mobile language learning in authentic environments. *Computer Assisted Language Learning, 30*(3–4), 284–303. https://doi.org/10.1080/09588221.2017.1308383

Shang, H. (2016). Exploring metacognitive strategies and hypermedia annotations on foreign language reading. *Interactive Learning Environments*, *25*(5), 610–623. https://doi.org/10.1080/10494820.2016.1171787

Sung, Y.-T., Chang, K.-E., & Yang, J.-M. (2015). How effective are mobile devices for language learning? A meta-analysis. *Educational Research Review, 16*, 68–84. https://doi.org/10.1016/j.edurev.2015.09.001

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Pearson.

Teng, F. (2018). Incidental vocabulary acquisition from reading-only and reading-while-listening: A multi-dimensional approach. *Innovation in Language Learning and Teaching, 12*(3), 274–288. https://doi.org/10.1080/17501229.2016.1203328

Teng, M. F. (2022). The effectiveness of multimedia input on vocabulary learning and retention. *Innovation in Language Learning and Teaching*. Advance online publication. https://doi.org/10.1080/17501229.2022.2131791

Uchihara, T., & Clenton, J. (2020). Investigating the role of vocabulary size in second language speaking ability. *Language Teaching Research, 24*(4), 540–556. https://doi.org/10.1177/1362168818799371

Vu, D. V., & Peters, E. (2022). Learning vocabulary from reading-only, reading-while-listening, and reading with textual input enhancement: Insights from Vietnamese EFL learners. *RELC Journal, 53*(1), 85–100. https://doi.org/10.1177/0033688220911485

Wang, S., & Lee, C.-I. (2021). Multimedia gloss presentation: Learners' preferences and the effects on EFL vocabulary learning and reading comprehension. *Frontiers in Psychology, 11*, Article 602520. https://doi.org/10.3389/fpsyg.2020.602520

Webb, S. (Ed.). (2020). *The Routledge handbook of vocabulary studies*. Routledge.

Webb, S., & Chang, A. C.-S. (2015). Second language vocabulary learning through extensive reading with audio support: How do frequency and distribution of occurrence affect learning? *Language Teaching Research, 19*(6), 667–686. https://doi.org/10.1177/1362168814559800

Yanagisawa, A., Webb, S., & Uchihara, T. (2020). How do different forms of glossing contribute to L2 vocabulary learning from reading? A meta-regression analysis. *Studies in Second Language Acquisition, 42*(2), 411–438. https://doi.org/10.1017/S0272263119000688

Yu, J. (2022). Text first or picture first? Evaluating two modes of multimodal input on EFL learners' word meaning learning and retention. *SAGE Open, 12*(3), 1–13. https://doi.org/10.1177/21582440221119469

Zhang, R., & Zou, D. (2022). Types, purposes, and effectiveness of state-of-the-art technologies for second and foreign language learning. *Computer Assisted Language Learning, 35*(4), 696–742. https://doi.org/10.1080/09588221.2020.1744666