

DOI Link: <https://doi.org/10.61586/lke68>
Vol.410, Issue.11, Part.1, Nov 2025, PP. 72-95

Exploring Vocabulary Learning and Self-Regulation through Quizlet: Usage, Gains, and Learner Perceptions among Taiwanese Elementary EFL Learners

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Received Feb 2025 Accepted Oct 2025 Published Nov 2025

Abstract

This study examined how elementary school students learning English as a foreign language (EFL) engaged in intentional vocabulary learning through a digital flashcard environment. Thirteen fourth-grade Taiwanese students (mean age = 10) practiced English vocabulary using Quizlet over four weeks in a self-directed context. A mixed-method design was employed: pre-post vocabulary tests and self-reported usage logs measured vocabulary gains and learning frequency, while questionnaires and interviews captured perceptions and motivational shifts. Quantitative analyses revealed significant improvement in vocabulary knowledge and a strong positive correlation ($r = .915, p < .001$) between the frequency of Quizlet use and vocabulary gains. Qualitative findings further indicated that learners perceived Quizlet as enjoyable, easy to use, and cognitively supportive. Increases in self-efficacy and self-regulation suggested that frequent engagement fostered autonomy and confidence in self-managed study. These results align with Self-Determination Theory and Cognitive Load Theory, indicating that multimodal, feedback-driven digital flashcards enhance intrinsic motivation while reducing cognitive burden. Although the small sample size limits generalizability, the findings provide empirical evidence that structured digital flashcard practice can strengthen both vocabulary acquisition and self-regulated learning among young EFL learners. Integrating such tools into early bilingual curricula may help bridge formal instruction and independent learning within initiatives such as Taiwan's Bilingual Nation 2030.

Keywords: Computer-assisted vocabulary learning; Digital flashcards; Self-regulated learning; Intrinsic motivation; Bilingual education

INTRODUCTION

English occupies a central role in Taiwan's Bilingual Nation 2030 initiative, which aims to enhance English proficiency and cultivate bilingual talent for global competitiveness (National Development Council, 2021). Within this policy, early vocabulary instruction is a priority because lexical knowledge supports reading, communication, and academic success, and early vocabulary growth predicts later literacy achievement (Izmalkova, 2024). Increasing parental demand for early English exposure in primary schools further underscores the need for engaging and age-appropriate instructional approaches.

Vocabulary learning may occur incidentally through exposure or intentionally through focused study (Yanagisawa, 2024). Meta-analytic evidence indicates that intentional learning supported by digital or mobile tools promotes durable retention through retrieval practice, spaced repetition, and multimodal encoding (Belardi et al., 2021; Franzoi et al., 2025; Kranz et al., 2024; Seibert Hanson & Brown, 2020; Yan et al., 2023). Research in mobile-assisted language learning (MALL) likewise reports consistent benefits for L2 proficiency, especially when feedback, gamification, and learner control are integrated (Burston & Giannakou, 2021; Lai et al., 2022a; Mihaylova et al., 2022; Shortt et al., 2021; Teymouri, 2024).

Among intentional learning tools, digital flashcards such as Quizlet and Anki are highly effective intentional learning tools that promote active recall beyond rote memorization. Learners using them outperform those relying on traditional wordlists in both receptive and productive vocabulary knowledge (Ma, 2024; Poláková & Klímová, 2022; Rahmani et al., 2022). Their advantage stems from self-testing and spaced repetition, which strengthen memory consolidation and dual coding (Lei et al., 2022; Zarrati et al., 2024). Meta-analyses report medium-to-large effects of Quizlet on vocabulary gains and motivation (Özdemir & Seçkin, 2024; Burston & Giannakou, 2021; Mihaylova et al., 2022). Sustained use further enhances learners' motivation and self-efficacy, fostering autonomous and confident vocabulary learning (Teng et al., 2024; Belardi et al., 2021).

Despite these advantages, young EFL learners seldom encounter structured and motivating opportunities to develop vocabulary autonomously through digital tools. Most studies focus on adolescents or adults with existing digital and self-regulatory competence, whereas elementary learners still developing autonomy and attention control remain dependent on teacher-led instruction, limiting their independent learning and intrinsic motivation. This gap raises both pedagogical and policy concerns. Taiwan's bilingual education framework emphasizes early self-directed learning (Lin, 2025), yet evidence on how digital flashcards support autonomy and retention in primary contexts remains scarce. Moreover, while Self-Determination Theory (Deci & Ryan, 2009) and Cognitive Load Theory (Sweller, 2020) explain how autonomy, feedback, and multimodal input foster motivation and memory, their combined effects are underexplored among younger learners.

Aligned with Taiwan's bilingual policy and the promotion of learner autonomy from early schooling, this study examines elementary EFL learners' intentional vocabulary learning with Quizlet in a self-directed setting. It addresses two questions:

1. To what extent does the frequency of digital flashcard use predict vocabulary gains among elementary EFL students?
2. What are students' perceptions of learning vocabulary with digital flashcards in a self-directed context?

Method

Participants

This study included 13 Taiwanese EFL learners (eight boys and five girls) with a mean age of 10 years ($SD = 0.55$). All participants were fourth graders from two primary schools in southern Taiwan. In line with the Ministry of Education's bilingual education goals, they were expected to reach at least the Beginner (A1) level of the Common European Framework of Reference for Languages (CEFR). All students had been learning English for at least four years and also attended extracurricular English programs three times per week, each lasting 90 minutes. With an average of four years of computer experience, students possessed sufficient digital literacy to complete computer-assisted vocabulary learning (CAVL) tasks. All had prior experience using printed flashcards in class, while nearly half had already used digital flashcards for vocabulary study. Table 1 provides a summary of the participants' detailed demographic information.

Table 1. Participant demographics

	Subjects (N=13)
Age	
Minimum	9
Mean	10
Maximum	11
Gender	
Male	8
Female	5
Years of English learning	
1 to 2 years	0
3 to 4 years	4
5 years and above	9
Years of using computers	
1 to 2 years	0
3 to 4 years	4
5 years and above	9
Experience of using printed flashcards	
Yes	13
No	0
Experience of using digital flashcards	
Yes	6
No	7

Instructional Design

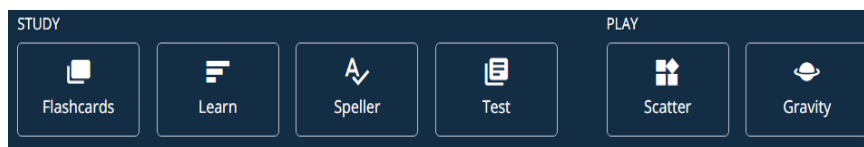
The intervention employed Quizlet as a self-study vocabulary tool. Students were asked to complete 15 minutes of Quizlet-based vocabulary practice twice a week for four consecutive weeks. Activities focused on intentional learning through retrieval and repetition, which previous research identifies as effective for vocabulary acquisition in digital environments.

1. The CAVL Tool: Quizlet

Quizlet is a widely used digital flashcard platform that supports spaced repetition and multimodal learning through text, audio, and imagery (Yüksel & Mercanoğlu, 2022). Unlike traditional flashcards, it integrates pronunciation, image embedding, automated quizzes, and game-based reviews. Empirical evidence shows that Quizlet enhances vocabulary acquisition, retention, and learner motivation across diverse contexts (Boroughani et al., 2023).

In this study, students engaged with four Study Mode formats Flashcards, Learn, Speller, and Test, and two Play Mode games, Scatter and Gravity which collectively develop receptive and productive vocabulary through recognition, recall, and feedback. Such multimodal and gamified tasks have been shown to boost motivation and foster self-regulated learning behaviors (Teymouri, 2024). As illustrated in Figure 1, Quizlet provides six self-assessment formats within two modes (Study and Play), accessible free of charge.

Figure 1. Screenshot of different self-assessment formats available in Quizlet



Quizlet's *Study Mode* includes four self-assessment formats Flashcards, Learn, Speller, and Test that integrate retrieval, feedback, and multimodal support for vocabulary learning.

1. Flashcards: This format simulates traditional cards but with added motion, audio, and display options. Learners can flip or flow through cards, enable pronunciation, adjust playback speed, and choose to view terms, definitions, or images. It supports both receptive and productive vocabulary development.
2. Learn: Learners type vocabulary terms based on images and definitions. Incorrect responses trigger pronunciation, visual display, and repetition, reinforcing recall and spelling accuracy.
3. Speller: Learners listen to words or definitions and type the correct spelling. Adjustable playback speed and instant letter-by-letter feedback enhance listening and spelling precision.

4. Test: Quizlet automatically generates quizzes from a set, including multiple-choice, matching, spelling, and true/false items. Learners receive immediate scores and corrections, mirroring classroom-based vocabulary assessments.

Beyond the *Study Mode*, Quizlet offers two game-based self-assessment formats in *Play Mode* Scatter and Gravity that integrate competition and engagement into vocabulary practice.

1. Scatter: A timed matching game where learners drag and drop terms to their correct definitions. It encourages active recall, attention, and motivation through individual or group competition.
2. Gravity: A typing game in which learners select a difficulty level and type correct terms as definitions descend like asteroids. The game automatically adjusts speed and displays missed items with images and definitions for review. It promotes spelling accuracy and long-term retention through repetition and adaptive challenge.

2. *The Vocabulary Learning Task*

In this study, Quizlet was used as a self-study CAVL tool for the students to complete a vocabulary learning task. More specifically, the students were required to learn ten target words every week, lasting for four weeks. The students first logged in their personal account to Quizlet, and then they started to do drills to learn the weekly sets of ten target words. The students reinforced their memorization of the focal words with the aid of six different self-assessment formats. Finally, the students were required to record how often they used Quizlet each week in the self-reported learning log.

Research Procedures

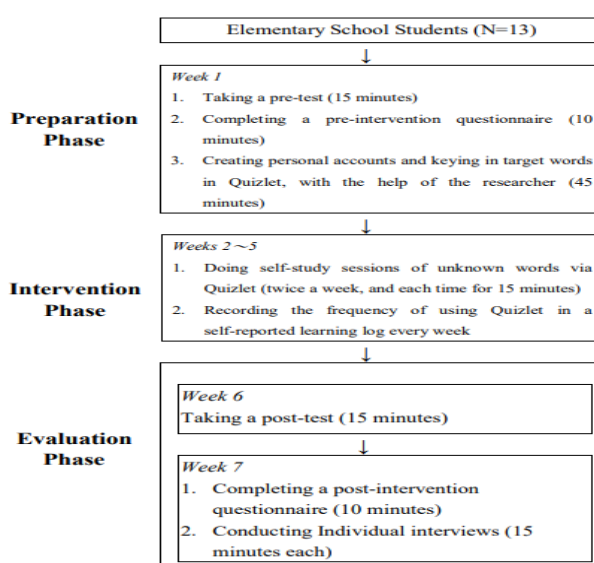
This study adopted a pre- and post-test design to examine elementary EFL students' vocabulary learning with Quizlet as a computer-assisted vocabulary learning (CAVL) tool in a self-study context. Prior to participation, students and their guardians provided written informed consent, with Chinese versions supplied for clarity. The seven-week study comprised three phases: Preparation, Intervention, and Evaluation (see Figure 2).

In the Preparation Phase (Week 1), students completed a 15-minute pre-test containing 100 vocabulary items randomly selected from the *GEPT Vocabulary Basic 1500*, requiring English-to-Chinese translation. Forty words that students answered incorrectly were selected as target items for subsequent learning and post-testing. Students also filled out a brief pre-intervention survey and received instruction on using Quizlet, including creating accounts and uploading target words.

During the Intervention Phase (Weeks 2–5), the researcher uploaded ten new target words to Quizlet each week. Students studied the assigned lists at home twice weekly for about 15 minutes per session using six self-assessment formats within Quizlet. To monitor learning frequency, students kept weekly self-report diaries documenting their usage.

In the Evaluation Phase (Weeks 6–7), students completed a 15-minute post-test translating the 40 target words from Chinese to English. Vocabulary gains were determined by comparing pre- and post-test scores. One week later, students completed a 10-minute post-intervention questionnaire and participated in individual 15-minute interviews to share their perceptions and experiences of digital-flashcard learning.

Figure 2. Research procedures



Data Sources

This study employed multiple data sources vocabulary learning tests, questionnaires, self-reported logs, and interviews to examine students' learning outcomes and perceptions.

1. Vocabulary Learning Tests

Students completed two tests, a pre-test and a post-test. The pre-test contained 100 items randomly selected from the *GEPT Vocabulary Basic 1500* (<https://www.ltc.ntu.edu.tw/wordlist.htm>), a validated benchmark developed by the Language Training and Testing Center to assess English proficiency across five levels (Cheng et al., 2014). Forty incorrect or unanswered items were extracted as target words for the learning intervention using Quizlet. The post-test consisted of the same 40 items, and the number of correct responses was used to calculate vocabulary gains. The difference between pre- and post-test scores

represented improvement in intentional vocabulary learning, consistent with digital flashcard research (Zarrati et al., 2024).

2. Vocabulary Learning Questionnaire

A 20-item Chinese-language questionnaire was administered before and after the intervention to capture students' learning experiences and perceptions of digital flashcards. Items 1–10 collected demographic data, while items 11–19 were adapted from the *Motivated Strategies for Learning Questionnaire* (Pintrich & De Groot, 1990) to measure self-efficacy, intrinsic value, and self-regulation constructs validated in mobile-assisted vocabulary learning studies (Guo et al., 2022). Responses were rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The final open-ended item explored students' approaches to learning new words.

3. Self-reported Vocabulary Learning Logs

From Weeks 2–5, students kept weekly logs adapted from Kim et al. (2013) to record their use of Quizlet's functions and learning frequency. These logs provided quantitative and qualitative evidence of engagement patterns and their relationship to self-study behaviors and vocabulary gains.

4. Individual Interviews

After the post-test, all participants were invited to take part in individual semi-structured interviews adapted from Yamamoto (2014). Each 15-minute session was conducted in Chinese, audio-recorded, transcribed, and translated into English for content analysis. Thirteen interviews were analyzed to gain deeper insights into students' experiences and perceptions of digital flashcard learning.

Findings

The Students' Vocabulary Learning Gains Resulting from their Use of Digital Flashcards

Post-test results and weekly self-reported Quizlet logs were analyzed to examine students' vocabulary learning performance during the four-week intervention. As shown in Table 2, individual vocabulary gains ranged from 10 to 40 items ($M = 24.76$, $SD = 10.63$), while Quizlet use varied between 8 and 50 sessions ($M = 20.92$, $SD = 13.90$). The most frequent user (Student 1) achieved a perfect post-test score of 40, whereas the least frequent user (Student 13) recorded the lowest gain of 10. Overall, students who used Quizlet more frequently attained higher vocabulary gains, indicating that consistent digital practice strengthened retention and recall.

One exception was Student 8, who reported one of the lowest usage frequencies yet achieved an average gain (20). Interview data revealed that this learner spent longer, more concentrated time in each session, suggesting that study quality can partially compensate for lower frequency. This observation underscores the interplay between practice intensity and engagement depth in shaping vocabulary outcomes.

Despite this single deviation, the overall pattern confirmed a strong positive

association between Quizlet use and vocabulary improvement. Frequent engagement fostered repeated retrieval and spaced rehearsal mechanisms that consolidate long-term memory. These results highlight the pedagogical value of digital flashcards for intentional vocabulary learning among young EFL learners. Regular and sustained interaction with Quizlet not only enhanced lexical retention but also promoted self-directed and autonomous learning behaviors in technology-enhanced environments.

Table 2. Descriptive statistics of the students' gains in vocabulary scores and frequency of using Quizlet

Participants	Gains	Frequency
Student 1	40	50
Student 2	40	39
Student 3	38	37
Student 4	32	31
Student 5	30	19
Student 6	28	21
Student 7	22	13
Student 8	20	8
Student 9	19	15
Student 10	17	13
Student 11	15	10
Student 12	11	9
Student 13	10	8
Mean=24.76; SD=10.63		Mean=20.92; SD=13.90

As can be seen in Table 2, which compares the students' vocabulary gain scores from the pre-test to the post-test, all 13 students were divided into two different groups based on the mean score of vocabulary gain. In other words, the students with gain scores higher than the average (Mean=24.76) were classified into the more progress (MP) group, and those with gain scores below this were classified into the less progress (LP) group. Then, as can be seen in Table 3, the six students (S1~S6) in the MP group had a mean score of 34.66, with a standard deviation of 5.31. Among these students, the highest gain score was 40 and the lowest gain score was 28. As for the LP Group, the seven students (S7~S13) in this group had a mean score of 16.28, with a standard deviation of 4.53. Among these students, the highest gain score was 22 and the lowest gain score was 10.

Table 3. The vocabulary gain scores for the more progress and less progress groups in the post-test

<i>More Progress (MP) Group</i>		<i>Less Progress (LP) Group</i>	
<i>Participants</i>	<i>Gains</i>	<i>Participants</i>	<i>Gains</i>
Student 1	40	Student 7	22
Student 2	40	Student 8	20
Student 3	38	Student 9	19
Student 4	32	Student 10	17
Student 5	30	Student 11	15
Student 6	28	Student 12	11
		Student 13	10
Mean=34.66; SD=5.31		Mean=16.28; SD=4.53	

The 13 students were divided into two different groups based on the mean score of frequency of use, as shown in Table 4. As such, those students who reported a frequency of use above the group's average (Mean=20.92) were put into the more frequent (MF) group, and those who reported a frequency lower than this were put into the less frequent (LF) group. The six students (S1~S6) in the MF Group had a mean score of 32.83, with a standard deviation of 11.70. Among these students, the highest frequency was 50 and lowest frequency was 21. As for the LF Group, the seven students (S7~S13) in this group had a mean score of 10.85, with a standard deviation of 2.79. Among these students, the highest frequency was 15 and the lowest frequency was 8.

Table 4. High and low frequency groups of using Quizlet

<i>More Frequent (MF) Group</i>		<i>Less Frequent (LF) Group</i>	
<i>Participants</i>	<i>Frequency</i>	<i>Participants</i>	<i>Frequency</i>
Student 1	50	Student 7	13
Student 2	39	Student 8	8
Student 3	37	Student 9	15
Student 4	31	Student 10	13
Student 5	19	Student 11	10
Student 6	21	Student 12	9
		Student 13	8
Mean=32.83; SD=11.70		Mean=10.85; SD=2.79	

It can be seen in Tables 3 and 4 that the students in the MP Group were the same as those in the MF Group, while those in the LP Group were the same as those in the LF Group. This indicates that the more often the students used Quizlet to learn vocabulary, the higher the gain scores they could get.

Table 5 shows the results of an independent samples *t*-test to examine whether the average gain scores between the MF and LF groups differed significantly. The results indicated that there was a significant difference ($t=6.73$, $p<.001$) between the two groups, revealing that the MF Group ($M=34.66$, $SD=5.31$) performed better in the vocabulary test than the LF Group ($M=16.28$, $SD=4.53$). Overall, the results show that the students could get better scores in the vocabulary test by using Quizlet more frequently, and vice versa.

Table 5. Statistical results of the students' scores in the post-test

	N	Minimum	Maximum	Mean	SD	<i>T</i>	<i>p</i>
MF Group	6	32	40	34.66	5.31	6.73*	.000
LF Group	7	10	22	16.28	4.53		

*Significance $p < .001$

In addition, the relationship between the students' frequency use of digital flashcards, and their vocabulary gain scores was further explored; thus, a Pearson correlation analysis was computed to examine whether there was a statistically significant correlation between the two variables, as shown in Table 6. The results indicated that there was a significant correlation ($r=.915$, $p<.001$) between these two values. That is to say, the results for the MF Group revealed that the more often (Mean=32.83) the students used Quizlet to learn vocabulary, the higher vocabulary gain scores (Mean=34.66) they could get. In contrast, the results for the LF Group showed that the less the students used Quizlet (Mean=10.85), the lower their vocabulary gain scores (Mean=16.28) they could get. Overall, based on the results presented above, the students' vocabulary gains were highly correlated ($r=0.7\sim0.99$) with their frequency of using Quizlet.

Table 6. Correlational analysis of vocabulary gains and frequency of using Quizlet

	Gain		Frequency		<i>r</i>	<i>p</i>
	Mean	SD	Mean	SD		
MF Group	34.66	5.31	32.83	11.7	.915*	.000
LF Group	16.28	4.53	10.85	2.79		

*Significance $p<.001$

The Students' Perceptions of Learning Vocabulary with Digital Flashcards

Questionnaire and interview data were analyzed to explore students' perceptions of vocabulary learning through digital flashcards in a self-study context. Thirteen elementary EFL students completed both pre- and post-intervention questionnaires and participated in follow-up interviews after the four-week activity. The questionnaire examined their attitudes toward Quizlet-based vocabulary learning, while semi-structured interviews provided deeper insights into their experiences.

As shown in Table 7, a paired-sample *t*-test revealed significant improvements in several items: Item 1 ($t = -3.61, p < .05$), Item 2 ($t = -4.07, p < .05$), Item 4 ($t = -2.23, p < .05$), Item 6 ($t = -3.25, p < .05$), and Item 7 ($t = -2.41, p < .05$). Mean scores for all post-intervention items exceeded their pre-intervention counterparts, indicating overall positive shifts in perception. The students increasingly viewed Quizlet as an effective and motivating tool for learning unfamiliar or difficult words. They also reported greater confidence in their vocabulary performance and a stronger belief that goal-setting could help manage what and how they learned. Interview data further supported these findings: students appreciated the app's accessibility, progress tracking, and immediate feedback features, which promoted enjoyment and a sense of control during independent study.

Taken together, the quantitative and qualitative results suggest that Quizlet fostered positive motivational and self-regulatory changes, reinforcing its role as an engaging platform for self-directed vocabulary learning among young EFL learners.

Table 7. The comparison of the pre- and post-intervention questionnaire results regarding the students' perceptions of vocabulary learning

Questionnaire Items	Pre-intervention questionnaire		Post-intervention questionnaire		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
1. I know that I will be able to learn vocabulary well for this class by myself.	3.53	.66	4.53	.51	-3.606*	.004
2. I think that the vocabulary that I am learning in this class is useful for me.	3.61	.86	4.69	.48	-4.070*	.002
3. I ask myself questions to make sure I understand the vocabulary items that I have been studying.	3.23	1.42	4.30	.85	-2.156	.052
4. I'm confident that I can understand the most difficult vocabulary items that I am learning in this class.	2.84	1.28	4.00	1.22	-2.232*	.045
5. I think that the vocabulary that I am learning in this class is interesting.	4.15	.98	4.69	.63	-1.849	.089
6. When studying vocabulary, I will normally set learning goals for myself so that I can decide how and what I want to learn.	3.23	.92	4.38	.86	-3.248*	.007
7. I'm confident that I can do an excellent job in the vocabulary test.	3.07	1.25	3.92	1.18	-2.419*	.032
8. Even when participating in the vocabulary learning sessions does not guarantee that I will get a good grade, I still love to participate in them.	3.53	.87	4.23	1.30	-1.511	.157
9. When studying vocabulary, I will normally try to identify the concept or word usage that I do not understand well.	3.38	.96	3.92	1.18	-1.996	.069

* Significance $p < .05$

Table 8 summarizes students' perceptions of vocabulary learning with Quizlet across three subscales self-efficacy, intrinsic motivation, and self-regulation—measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

For self-efficacy, students expressed strong confidence in their independent vocabulary learning. All participants (100%) agreed or strongly agreed with Item 1,

"I know that I will be able to learn vocabulary well for this class by myself" ($M = 4.53$, $SD = 0.51$). Similarly, 76% endorsed Item 4, *"I'm confident that I can understand the most difficult vocabulary items that I am learning in this class"* ($M = 4.00$, $SD = 1.22$), and 84% agreed with Item 7, *"I'm confident that I can do an excellent job in the vocabulary test"* ($M = 3.92$, $SD = 1.18$).

For intrinsic motivation, students viewed Quizlet learning as both meaningful and enjoyable. All respondents (100%) agreed that *"The vocabulary I am learning is useful for me"* (Item 2; $M = 4.69$, $SD = 0.48$), while 92% found the vocabulary interesting (Item 5; $M = 4.69$, $SD = 0.63$). A further 77% affirmed that they participated out of genuine interest rather than grades (Item 8; $M = 4.23$, $SD = 1.30$).

For self-regulation, learners also demonstrated strong metacognitive awareness and goal setting. Most students (92%) reported monitoring comprehension by asking themselves questions (Item 3; $M = 4.30$, $SD = 0.85$). Likewise, 85% set personal learning goals (Item 6; $M = 4.38$, $SD = 0.86$), and 76% identified vocabulary concepts needing further understanding (Item 9; $M = 3.92$, $SD = 1.18$).

Overall, post-intervention data indicate overwhelmingly positive attitudes toward self-directed vocabulary learning with Quizlet. Students exhibited strong confidence in their learning ability, recognized the usefulness and enjoyment of the process, and displayed enhanced self-regulatory strategies. Collectively, these results suggest that Quizlet not only facilitated vocabulary acquisition but also fostered motivation, goal setting, and self-monitoring in a technology-supported environment.

Table 8. The descriptive results of the post-intervention questionnaire regarding the students' perceptions of vocabulary learning

Item	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)
Self-Efficacy						
1	I know that I will be able to learn vocabulary well for this class by myself.	62	38	0	0	0
4	I'm confident that I can understand the most difficult vocabulary items that I am learning in this class.	46	30	0	24	0
7	I'm confident that I can do an excellent job in the vocabulary test.	38	46	8	8	0
Intrinsic Motivation						
2	I think that the vocabulary that I am learning in this class is useful for me.	70	30	0	0	0
5	I think that the vocabulary that I am learning in this class is interesting.	77	15	8	0	0
8	Even when participating in the vocabulary learning sessions does not guarantee that I will get a good grade, I still love to participate in them.	69	8	0	23	0
Self-Regulation						
3	I ask myself questions to make sure I understand the vocabulary items that I have been studying.	46	46	0	8	0
6	When studying vocabulary, I will normally set learning goals for myself so that I can decide how and what I want to learn.	47	38	0	15	0
9	When studying vocabulary, I will normally try to identify the concept or word usage that I do not understand well.	38	38	16	8	0

Note: SA = strongly agree, A = agree, N = neutral, D = disagree, SD = strongly disagree

Table 9 below shows the results of the paired sample *t*-tests that were carried out to examine whether there were any statistically significant differences in three sub-scales of the pre- and post-intervention questionnaires. The results showed significant improvements in the two sub-scales of self-efficacy ($t=-2.75$, $p=.027$) and self-regulation ($t=-2.46$, $p=.042$). Overall, the results for the three sub-scales in the post-intervention questionnaire ($M=4.29$, $SD=0.91$) showed some improvements compared to those in the pre-intervention questionnaire ($M=3.39$, $SD=1.02$). This indicates that the students believed that Quizlet could not only help them to learn vocabulary well, and thus make them feel more confident about getting good grades in vocabulary tests, but also help them to get better habits with regard to setting learning goals for themselves.

Table 9. Statistical results of the three sub-scales in the pre- and post-intervention questionnaires

Sub-scales	Pre-intervention questionnaire		Post-intervention questionnaire		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
Self-Efficacy	3.14	1.06	4.15	0.97	- 2.752 *	.027
Intrinsic Motivation	3.76	0.90	4.53	0.80	- 2.476	.082
Self-Regulation	3.28	1.10	4.20	0.96	- 2.466 *	.042
Total	3.39	1.02	4.29	0.91	- 2.564	.050

* Significance $p < .05$

In order to obtain students' more detailed perceptions of vocabulary learning using Quizlet, semi-structured interviews were also conducted, with the results summarized in Table 10. Some representative student quotes are also provided to further illustrate the generalized themes based on a content analysis of the interview comments.

Table 10. The students' interview comments on using the digital flashcard tool to learn vocabulary

Themes	Frequency (N)	Percentage (%)
The various functionalities of the tool	12	93%
Ease of use of the tool	10	77%
Language learning potential of the tool	9	69%

□ *Theme 1: The various functionalities of the tool*

The most frequently mentioned reasons why the students expressed positive comments about using Quizlet were the various functionalities of the tool. According to their interview responses, a majority of the students (N=12; 93%) learned the target words using various learning self-assessment formats, and stated that these were both interesting and helpful to facilitate their vocabulary learning. Some related comments from the students are presented below:

'Quizlet gives me many ways to test myself when learning the vocabulary from my teacher. I like the Test mode most because it makes four kinds of questions. It helps me check if I really remember the new words. I also enjoy the Scatter game. It is a

fun matching activity that keeps me focused while learning vocabulary. – [Student 2]

'Quizlet is a very good learning tool for me. It offers many ways to test myself. For example, Flashcards show the word, meaning, and picture together, which helps me remember better. It also gives the word's pronunciation. I like the Gravity game too because it is fun and helps me practice typing and remembering words.' – [Student 5]

□ Theme 2: Ease of use of the tool

Ease of use was the second most frequently mentioned positive factor with regard to using Quizlet. Based on their interview comments, a high percentage of the students (N=10; 77%) stated that Quizlet was easy and convenient to use when they needed to learn the target words. The following comments illustrate this point:

'I think Quizlet is great and easy to use. Even when I miss my English class, I can still learn the new words by myself with Quizlet. It also doesn't take much time to learn how to use it.' – [Student 4]

'Quizlet is very convenient for learning vocabulary. The interface is easy to use, so I can quickly make my own flashcards. When my brother uses the home computer, I can still study with Quizlet on my tablet or smartphone.' – [Student 9]

□ Theme 3: Language learning potential of the tool

The third most frequently mentioned positive factor was the language learning potential of the tool. It was found in the interviews that many of the students (N=9; 69%) believed that Quizlet could improve their vocabulary size and help them to perform better in vocabulary tests, as seen in the following comments:

'Besides the words from my teacher, I sometimes searched for other flashcard sets on Quizlet because I wanted to learn more words than my classmates. I chose the sets that were useful for me to study new vocabulary.' – [Student 1]

'After using Quizlet to learn English words, I felt my learning improved. The digital flashcards were better than paper ones because they had sound, which helped me practice listening and speaking by playing it many times.' – [Student 13]

In short, most of the students held positive attitudes toward the use of Quizlet to support their vocabulary learning, with the most frequently mentioned reasons centering on the various functionalities of the tool, its ease of use, and language learning potential. However, a few students felt uncertain about using Quizlet in a self-study setting, mainly due to the need for more guidance in this context. Some example comments are presented below:

'I usually learn English words with my teacher. After using Quizlet alone, I sometimes feel afraid of making mistakes. Because I worry I may not understand well, I hope the teacher can still guide me and give me tips for each new word.' – [Student 7]

'I get distracted easily, so learning with the teacher helps me more than studying alone. If the teacher could guide me step by step in using Quizlet, I would stay more focused and learn better.' – [Student 12]

In conclusion, based on the students' interview comments, three main positive points about using Quizlet in a self-study setting emerged, including the various functionalities of the tool, its ease of use, and language learning potential. This indicated that Quizlet could not only enhance the students' vocabulary learning, but also increase their interest in studying, and was easy to use. However, a few of the students, particularly the low achievers and less frequent users, also noted that they desired the teacher to help them during the self-study learning process. As such, in order to improve the student concentration and outcomes, the teacher is recommended to offer more guidance for the students in need as they are in the self-study process.

Discussions

The present study examined whether the frequency of Quizlet use predicted vocabulary gains among elementary EFL learners in a self-directed context. Quantitative analyses revealed a strong positive correlation ($r = .91$) between Quizlet engagement and vocabulary improvement, indicating that consistent practice substantially enhanced word retention and recall accuracy. This finding supports extensive evidence that retrieval practice and spaced repetition strengthen long-term memory and accelerate vocabulary learning (Kim & Webb, 2022; Pan et al., 2023; Yanagisawa, 2024). Through repeated retrieval, learners consolidate durable memory traces and reduce forgetting when practice is distributed over time. Empirical studies consistently show that digital flashcards outperform traditional study methods. Do and Nguyen (2023) and Yüksel and Mercanoğlu (2022) found that interactive flashcards enhance retention and motivation compared with printed wordlists. Halamish and Elbaz (2022) and Zarrati et al. (2024) demonstrated that multimodal flashcards integrating text, audio, and self-testing promote dual coding and deeper encoding. Likewise, Özdemir et al. (2024) reported moderate-to-large effects for spaced-repetition algorithms. Together with the current findings, these results confirm that multimodal feedback and retrieval mechanisms embedded in digital tools strengthen both efficiency and sustainability in vocabulary learning. The strong correlation observed aligns with prior evidence that learning frequency predicts recall strength. Learners who generated and reviewed their own flashcards achieved greater gains than those relying on pre-made sets (Pan et al., 2023; Yaşar, 2025), indicating that generative engagement stimulates reflection and deeper processing. Similar patterns reported by Li et al. (2024), Xodabande et al. (2022), and Yan et al. (2023) confirm that active retrieval and distributed repetition foster

robust lexical memory. Frequent Quizlet use also supported metacognitive regulation and autonomy, consistent with research showing that sustained mobile-assisted practice enhances planning, persistence, and self-regulation (Boroughani et al., 2023; Koleini et al., 2024; Lai & Gu, 2024; Mohammadi et al., 2024; Zakian et al., 2022). These findings underscore that digital flashcards act as cognitive enhancers and behavioral regulators that promote vocabulary autonomy.

Retrieval practice benefits learners across ages and abilities. de Diego-Lázaro (2024) and Leonard et al. (2024) demonstrated that retrieval-based approaches improve vocabulary even among children with linguistic or hearing challenges, while Sevigny et al. (2024) found that regular Quizlet use facilitates progression from recognition to productive recall. Meta-analytic evidence (Kim & Webb, 2022; Webb et al., 2023) likewise supports spaced retrieval as an optimal retention strategy. The brief yet frequent sessions used in this study align with these principles, confirming that digital scheduling effectively operationalizes theoretical spacing effects in authentic learning contexts.

Consistent Quizlet engagement also improved enjoyment, confidence, and self-efficacy, reinforcing findings by Do and Nguyen (2023) and Koleini et al. (2024). According to Cognitive Load Theory (Sweller, 2020), Quizlet's multimodal design reduces extraneous processing demands, while Self-Determination Theory (Deci & Ryan, 2009) explains that autonomy, feedback, and competence sustain intrinsic motivation. The convergence of cognitive efficiency and affective engagement observed here parallels findings by Boroughani et al. (2023), Koleini et al. (2024), and Lai and Gu (2024), confirming that digital flashcards enhance both learning performance and motivation.

Qualitative data supported these quantitative results. Learners described Quizlet as enjoyable, cognitively supportive, and easy to use, reporting post-intervention gains in self-efficacy, self-regulation, and intrinsic motivation. These findings are consistent with research showing that mobile-assisted flashcard environments foster metacognitive engagement through immediate feedback, progress visualization, and adaptive pacing (Boroughani et al., 2023; Guo et al., 2022; Mohammadi et al., 2024). Such feedback loops act as cognitive reinforcers that consolidate vocabulary knowledge while maintaining motivation, particularly among younger learners.

Students valued Quizlet's gamified features, intuitive interface, and instant feedback. Similar perceptions were reported by Alwahoub et al. (2024), Yowaboot and Sukying (2022), and Zeitlin et al. (2023), who found that usability and perceived usefulness predict continuous engagement. These features function as motivational levers that sustain persistence and promote durable learning habits. The current results also align with Self-Determination Theory (Deci & Ryan, 2000), which posits autonomy, competence, and relatedness as foundations of intrinsic motivation. Quizlet enables control over pace and mode (autonomy), provides measurable progress (competence), and fosters peer interaction (relatedness). The observed gains in self-efficacy and regulation highlight the interaction between motivational and cognitive mechanisms, consistent with Boroughani et al. (2023) and Chiu et al. (2022).

Moreover, Quizlet's multimodal and gamified structure appears to reduce cognitive load and sustain attention, consistent with Cognitive Load Theory (Sweller, 2020). The integration of text, imagery, and audio supports dual coding, facilitates retrieval, and minimizes mental effort. Pan et al. (2023) found that multimodal, user-generated flashcards stimulate multiple processing pathways and enhance satisfaction. Although participants primarily used pre-made sets, their repeated self-testing and practice demonstrated emerging agency and autonomy core indicators of self-directed learning. Yaşar (2025) similarly observed that transitioning from pre-made to self-created flashcards deepens ownership and reflection, indicating a shift from consumption to creation in digital learning environments.

While frequency of use was decisive, individual variation also influenced results. Some learners achieved substantial progress through brief, focused sessions, suggesting that intentionality and reflection moderate motivational outcomes. This observation aligns with Pan et al. (2023) and Yowaboot and Sukying (2022), who noted that perceived challenge and learning depth sustain engagement. As Özdemir et al. (2024) emphasized, long-term motivation depends on structured reflection and progressively demanding tasks. Teachers can therefore integrate self-checklists or reflection diaries to help learners monitor strategies and optimize flashcard use.

Overall, the findings confirm that digital flashcards are not merely vocabulary aids but comprehensive cognitive-affective systems fostering retention, motivation, and autonomy. Quizlet's gamified, multimodal, and feedback-driven design transforms vocabulary learning from rote rehearsal into a reflective, self-regulated process. Structured, short, and repeated flashcard sessions can bridge classroom instruction and independent study, reinforcing competence and autonomy. Within Taiwan's Bilingual Nation 2030 framework, this integration offers a scalable model for developing early bilingual competence through sustained, technology-enhanced learning.

Conclusions

This study demonstrated that consistent and spaced engagement with Quizlet, a digital flashcard platform significantly enhanced elementary EFL learners' vocabulary performance while strengthening their motivation, self-efficacy, and self-regulation. Quantitative analyses revealed a strong correlation between Quizlet use and vocabulary gains, whereas qualitative data confirmed learners' positive perceptions of its interactivity, usability, and feedback-driven design.

These results are reinforced by a growing body of recent research showing that retrieval-based and spaced-repetition learning promotes long-term vocabulary retention and learner autonomy across diverse age groups (Franzoi et al., 2025; Pan et al., 2023; Yaşar, 2025). Mobile-assisted studies likewise report that multimodal input, feedback, and gamified practice enhance intrinsic motivation and self-regulatory strategies (Boroughani et al., 2023; Kolehini et al., 2024; Teymouri, 2024). Meta-analytic findings further confirm that digital flashcards implementing spaced scheduling yield medium-to-large learning effects by optimizing retrieval cycles and cognitive efficiency (Kim & Webb, 2022; Özdemir et al., 2024). Collectively,

these converging lines of evidence substantiate the present study's conclusion that regular digital-flashcard practice supports both cognitive retention and affective engagement in early bilingual contexts.

Pedagogically, short daily Quizlet sessions of 10–15 minutes can be integrated into classroom routines to strengthen retrieval practice, learner-generated flashcards, and peer-review tasks. Such design bridges formal instruction with self-directed learning and nurtures early autonomy.

In conclusion, digital flashcards grounded in cognitive and motivational principles and validated by recent empirical evidence offer a reflective, enjoyable, and scalable approach to vocabulary learning, aligning with Taiwan's Bilingual Nation 2030 vision for sustainable bilingual education.

Funding Declaration

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Consent to Publish Declaration

Consent to publish declaration: not applicable.

Ethics and Consent to Participate

The study was approved by the Research Ethics Committee of Universitas Islam Negeri Sumatera Utara (UINSU) approval code: UINSU-EDU-2024-014) and conducted in accordance with institutional ethical guidelines for research involving human participants. Written informed consent was obtained from all participants and their guardians before data collection, with approval valid from January to December 2024.

Competing Interests Declaration

The author declares that there are no competing interests.

Data Availability Declaration

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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