Enhancing vocabulary mastery: The impact of learner-created digital flashcards on L2 vocabulary learning and self-regulation

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Acquiring and retaining vocabulary is a cornerstone of mastering a new language, and digital tools are playing an increasingly significant role in this process. This study investigated the role of Quizlet, a digital flashcard application, as a self-regulated learning (SRL) tool in enhancing vocabulary acquisition among upper-intermediate English learners. Specifically, it examined the effectiveness of self-created digital flashcards on second and foreign language vocabulary learning, alongside the SRL strategies used by learners throughout the process. A quasi-experimental pretest and post-test non-equivalent groups design was employed, involving 22 Turkish learners of English (12 in the experimental group and 10 in the control group). Participants were assessed through pre- and post-vocabulary tests, pre- and post-self-regulation questionnaire and semi-structured asynchronous written interviews. The findings revealed a statistically significant improvement in the post-test scores of the experimental group compared to the control group, highlighting the efficacy of self-created digital flashcards. Furthermore, correlations between SRL strategies, particularly metacognitive strategies and emotional regulation, and vocabulary learning gains highlighted the value of SRL principles in language education. The study concluded that integrating digital tools like Quizlet with SRL principles not only facilitates vocabulary retention but also promotes autonomous learning, providing valuable insights for digital language learning contexts.

Implications for practice or policy:

- Educators can integrate digital flashcard tools like Quizlet to enhance vocabulary learning and self-regulated learning skills.
- Instructional designers can use these tools to create interactive, learner-centred activities.
- Policymakers can promote learner autonomy by incorporating digital tools and SRL principles into language education policies.

Keywords: digital flashcards, Quizlet, self-regulated learning (SRL), second language (L2) vocabulary learning, quasi-experimental design

Introduction

English has firmly established itself as the dominant language in today's world driven by globalisation and digitalisation. It has become integral across various fields, including business, science, and technology, making proficiency in English a critical skill for effective communication and active engagement in a globally interconnected world. Among the key components of language acquisition, vocabulary knowledge serves as an essential aspect of linguistic competence, enabling individuals to express thoughts and emotions clearly, comprehend complex ideas and access academic and professional materials. For learners of English as a second language (L2) or foreign language (EFL) learners, vocabulary remains the foundation for mastering the language and developing overall proficiency (Nation, 2013). However, building an extensive vocabulary is not without its challenges. The sheer volume of target words can overwhelm learners (Schmitt, 2014). Furthermore, acquiring vocabulary requires more than mere memorisation – it necessitates forming meaningful connections between word forms and their meanings (Nation, 2013).

Traditional vocabulary instruction often relies on rote memorisation and passive learning, which can lack engagement and effectiveness, particularly in modern educational environments where interaction and participation are emphasised. The advent of the Internet and digital tools has significantly transformed the landscape of vocabulary learning by offering interactive and self-paced opportunities, thus overcoming the limitations of conventional classroom settings. Tools like Quizlet, a digital flashcard tool (https://quizlet.com/tr), have gained popularity for their ability to facilitate personalised and efficient learning experiences. They offer features such as multimedia integration, spaced repetition and progress tracking, aligning with self-regulated learning (SRL) principles.

SRL, a framework emphasising learners' proactive engagement in managing their learning processes, has gained prominence in language education research. It includes cognitive and metacognitive strategies that allow learners to plan, monitor and evaluate their progress (Zimmerman, 2002). In terms of vocabulary learning, SRL strategies include setting learning goals, employing effective study techniques and reflecting on performance. Research suggests that SRL enhances motivation, promotes autonomy and improves learning outcomes (Tseng et al., 2006) while fostering engagement with learning tasks (Teng, 2025).

Despite the potential benefits of integrating SRL with digital tools, many learners struggle to implement SRL strategies effectively. Moreover, although studies support technology-assisted learning, there is limited research exploring the intersection of SRL and digital tools like Quizlet in diverse educational contexts. Therefore, this study aimed to address these gaps by investigating the impact of self-created Quizlet flashcards on vocabulary learning among upper-intermediate L2 English learners. Additionally, it examined the SRL strategies employed by the L2 learners to gain deeper insights into the relationship between SRL and digital tools in vocabulary acquisition. Therefore, the research was guided by the following questions:

(1) What are the effects of generating and using self-created digital flashcards on Quizlet on L2 vocabulary knowledge?
(2) What SRL strategies do learners employ when using Quizlet for vocabulary learning?
(3) How do SRL strategies, both overall and across different subscales, correlate with vocabulary learning gains in the group using Quizlet?

Literature review

SRL and its role in vocabulary learning

This study is grounded in Bandura's (1986) social cognitive theory, which conceptualises learning as a dynamic process shaped by reciprocal interactions among personal factors, environmental influences and individual behaviours. A central concept in this triadic model is agency, learners' ability to make decisions, act intentionally and influence their own learning outcomes (Martin, 2004). Through active engagement with their learning environments, learners construct new knowledge that can affirm or challenge their existing strategies and beliefs. Bandura (2001) identified four core components of agency – intentionality, forethought, self-reactiveness and self-reflectiveness – which serve as the foundation for models of SRL.

SRL, as an extension of Bandura's (2001) theory, refers to the cognitive and metacognitive processes through which learners set goals, monitor their progress, regulate emotions and reflect on outcomes. Zimmerman's (2002) influential three-phase SRL mode, (forethought, performance and self-reflection) captures the cyclical nature of this process in educational contexts. In this framework, self-regulated learners take charge of their learning by planning strategically, managing their environment, applying cognitive strategies and evaluating their success. They not only adapt to challenges but also develop greater autonomy and self-efficacy over time. In the context of L2 learning, and particularly vocabulary acquisition, SRL provides a powerful lens to understand how learners take control of their development in a self-directed and reflective manner.

Specifically, SRL plays a key role in L2 vocabulary learning by allowing learners to set individual goals (e.g., mastering vocabulary for an upcoming assessment), adopt strategies that align with their needs and monitor their progress (Cheng et al., 2025; Zhao et al., 2025). These strategies typically fall into three categories: metacognitive (e.g., planning and monitoring), cognitive (e.g., rehearsal and organisation) and affective (e.g., emotion regulation and motivation management) (Oxford, 2017). Together, they enable learners to process and retain large amounts of lexical input more efficiently by forming meaningful form-meaning associations.

The integration of SRL with digital tools such as Quizlet has greatly enhanced vocabulary learning by offering learners autonomy in setting goals, using spaced repetition and receiving immediate feedback, features that support engagement and reduce distractions (Hromalik & Koszalka, 2018). Wang et al. (2020) found that learners who used SRL strategies more consistently through digital tools achieved better vocabulary outcomes and higher motivation. Recent meta-analyses have further emphasised the importance of SRL in digital learning environments, especially in higher education. Zhao et al. (2025) analysed data from 11,014 participants and found that strategies such as time management, metacognitive regulation and effort regulation positively influenced academic performance. Cheng et al. (2025) also reported a positive relationship between SRL and academic success in online higher education, noting that different SRL strategies played varied roles depending on learner characteristics. In vocabulary learning specifically, Teng (2025) validated a self-regulated vocabulary learning scale and demonstrated the impact of SRL capacity and working memory on vocabulary gains. Yang et al. (2025) further showed that embedding SRL schemes into a vocabulary app (Vocab+) improved vocabulary outcomes and enjoyment for younger EFL learners. Collectively, these studies provide strong evidence that technology-supported SRL improves vocabulary acquisition and fosters learner autonomy across age groups and educational settings.

In sum, SRL is a critical and evolving framework in the domain of vocabulary learning. It empowers learners to become active participants in their educational journey by fostering motivation, strategic awareness and independent learning. When paired with interactive digital tools like Quizlet, SRL can support both vocabulary acquisition and the development of long-term self-regulatory capacities, an increasingly important skill set in today's technology-enhanced language learning environments.

Flashcards and technology-assisted self-regulated vocabulary learning

Language learners adopt a variety of strategies to improve acquisition, with a focus on effectiveness, autonomy and adaptability (Boroughani et al., 2023; Goundar, 2019). Vocabulary learning strategies are particularly crucial for fostering learner autonomy (Nation, 2013; Schmitt, 2014), supporting form-meaning connections through paired-associate learning and enhance memorisation, sight-word recognition and assessment (Kupzyk et al., 2011). With the integration of digital technologies, flashcards have evolved into interactive tools offering multimedia features, spaced repetition and real-time feedback (Sage et al., 2019; Zung et al., 2022). These affordances enable flexible, anytime-anywhere learning, with studies confirming their superiority over paper-based tools in accessibility and engagement (Aksel, 2021; Nikoopour & Kazemi, 2014).

Self-created digital flashcards promote deeper cognitive processing as learners actively select and organise content (Pan et al., 2023). This approach aligns with SRL, which involves forethought, performance and self-reflection phases (Zimmerman, 2002). SRL strategies for vocabulary learning include planning, monitoring and managing motivation and learning environments. Although digital tools that embed SRL functions, like goal setting and progress tracking, enhance learner autonomy and outcomes, design flaws can hinder engagement, emphasising the importance of thoughtful tool implementation ((Panadero, 2017).

Recent studies have demonstrated the effectiveness of digital flashcards in developing academic and technical vocabulary. Yüksel et al. (2022) found that Turkish pharmacy students using digital flashcards outperformed peers using traditional materials, linking positive attitudes towards digital tools with academic success. Similarly, research by Xodabande et al. (2022) and Mohammadi et al. (2024) showed

significant gains in both receptive and productive vocabulary knowledge, with lasting effects. Boroughani et al. (2023) also highlighted the role of technology-supported SRL in sustaining engagement and vocabulary growth.

Furthermore, digital flashcards influence learners' motivation and attitudes towards technology use in education (Dodigovic, 2013). Learners value their convenience, personalisation and collaborative potential, though technical issues and device limitations remain challenges (Xodabande et al., 2024). These findings suggest that integrating SRL principles with digital flashcards not only improves vocabulary learning but also fosters autonomy, motivation and long-term engagement, highlighting the need for ongoing research and refinement.

Method

This study investigated how 22 upper-intermediate English learners enrolled in a private university's English preparatory programme used Quizlet as an SRL tool to enhance their vocabulary acquisition. Employing a pretest and post-test non-equivalent-groups design, the research compared an experimental group, who created and studied digital flashcards using Quizlet, with a control group that followed traditional instruction. Random assignment was not feasible due to institutional placement procedures; instead, intact classes were used to maintain ecological validity. Data were collected through pre- and post-vocabulary tests, pre- and post-self-regulation questionnaires and semi-structured asynchronous written interviews, incorporating both quantitative and qualitative approaches. This comprehensive framework allowed for an in-depth examination of the effects of self-created digital flashcards on vocabulary learning, the SRL strategies learners employed and the relationship between SRL and vocabulary development. The following section outlines the study's methodology in greater detail.

Setting and participants

This study was carried out during the spring semester of the 2021–2022 academic year in the English preparatory programme of a private foundation university in Istanbul, Turkey. The programme was structured around two 8-week modules per semester, and learners were required to achieve at least 60% on the module exit test to advance. Those who failed to meet this threshold repeated the level with alternative instructional materials.

Participants were selected through convenience sampling from two of my (S. Y.) classes. The experimental group, consisting of 12 learners by the end of the study, used Quizlet to create and study digital flashcards for target vocabulary. The control group, which completed the study with 10 learners, followed the standard curriculum without Quizlet access. Both groups initially had 25 students each, but due to attrition and late enrolment, only learners who completed both the pre- and post-tests were included in the analysis. The participants, aged 18–20, had comparable English proficiency levels based on the university's placement test, ensuring consistency across the groups. Ethical approval was granted by Yeditepe University, with voluntary participation, informed consent and strict confidentiality maintained throughout the study.

Instructional materials

The digital tool (Quizlet) and the main course book (Cambridge University Press's *Evolve*) designated by the university for the module were the instructional materials of the present study.

The mobile-based flashcard tool (Quizlet)

Quizlet, a widely used digital flashcard tool, served as the primary tool in this study to enhance vocabulary learning among the treatment group. Quizlet allows users to create and study flashcards featuring questions or prompts on one side and corresponding answers or information on the other. Additionally, learners can access numerous pre-made sets on various topics.

The tool offers two primary modes: Quizlet Live, which facilitates competitive activities suitable for both in-class and out-of-class use, and self-study options, including Flashcards, Learn, Test, and Match. Flashcards enable learners to flip through cards, listen to pronunciations and organise items for study, while the Learn mode supports multiple-choice and written questions, as well as spelling practice. The Test mode generates customisable quizzes with instant feedback, and the Match mode introduces gamification through timed challenges. Quizlet's versatile features, such as spaced repetition, multimedia integration and gamification, make it effective and engaging for vocabulary acquisition, offering learners the flexibility to study anytime, anywhere.

The main course book

This study used Cambridge University Press's *Evolve* 5, a B2-level course book aligned with the Common European Framework of Reference for Languages as the main instructional material. The *Evolve* series includes six levels and offers integrated grammar, writing, pronunciation and vocabulary activities, along with reading and listening passages, decision-making tasks and online resources via CambridgeOne. Learners primarily used printed books for classroom instruction and accessed the CambridgeOne platform for supplementary tasks, allowing instructors to monitor progress. Both the experimental and control groups used *Evolve* 5 during the 8-week module. However, the experimental group also used Quizlet to create and study digital flashcards for vocabulary learning, while the control group completed additional vocabulary homework from the teacher's edition and the worksheets I (S. Y.) supplied. This design ensured consistency in core content while varying the method of vocabulary instruction between the groups.

Data collection tools

The data collection tools for this study included pre- and post-vocabulary tests to assess vocabulary knowledge, Quizlet flashcards to support vocabulary learning in the experimental group, pre- and post-SRL questionnaires to evaluate the frequency and effectiveness of SRL strategies employed by the learners and semi-structured interviews to gather insights on learners' experience with Quizlet.

The pre- and post-vocabulary tests

The vocabulary tests in this study were designed around the 29 target nouns and adjectives taught during the module. These parts of speech were chosen due to their semantic and grammatical connection, and because they are easier for learners to visualise and recall. The vocabulary tests, adapted from Webb (2009), assessed multiple dimensions of vocabulary knowledge: orthography, recognition, recall and productive use. The tests were administered in separate sections to avoid cross-influence, and responses were collected after each part.

The tests consisted of the following components:

- Receptive Knowledge of Orthography – Learners selected the correct spelling from four options (e.g., *Anticipation*).
- Productive Knowledge of Orthography – Learners wrote the correct spelling of spoken words (e.g., *Authentic*).
- Passive Recognition – Learners chose the correct Turkish translation of English words from four options (e.g., *Surface → Yüzey*).
- Active Recognition – Learners selected the correct English translation for Turkish words (e.g., *Tesadüf → Coincidence*).
- Passive Recall – Learners wrote the Turkish translation of English words, given the first letter as a clue (e.g., *Satellite → Uydu*).
- Active Recall – Learners wrote the English translation for Turkish words, again using first-letter prompts (e.g., *Yanıltıcı → Misleading*).
- Productive Knowledge of Vocabulary – Learners filled in blanks in contextually appropriate sentences with target words (e.g., *When using glue, make sure the _____ is completely clean → Surface*).

Together, these sections comprehensively evaluated learners' passive and active vocabulary knowledge.

The Quizlet flashcards

The second data collection tool in this study was Quizlet, used by the experimental group to create and study digital flashcards for 29 target vocabulary items over an 8-week module. These words were divided into five weekly sets of five to seven words, shared through Microsoft Teams and WhatsApp for easy access. Learners were given flexibility in how they designed their flashcards, though an initial training session was provided to introduce Quizlet's key features, as most participants had not used it before. After creating their sets, learners uploaded them to a shared Quizlet classroom, allowing for peer access and collaborative study. They were also encouraged to use interactive features such as the Test function, which generates practice quizzes, and Classic Live, a gamified matching activity. These tools helped reinforce vocabulary learning and supported both independent and collaborative learning experiences throughout the intervention.

The pre- and post-SRL questionnaires

As part of the data collection process, participants completed a questionnaire designed to assess their self-regulating capacity in foreign language vocabulary learning. The instrument used was the Self-Regulating Capacity in Vocabulary Learning Scale developed by Tseng et al. (2006) to explore the role of self-regulation in EFL and L2 acquisition and provide a reliable psychometric tool for measuring strategic learning behaviour. The scale consists of 20 items rated on a 6-point Likert scale from *strongly disagree* (1) to *strongly agree* (6), with items grouped into five subscales: commitment control, metacognitive control, satiation control, emotional control and environment control. Each subscale includes items addressing distinct aspects of SRL, such as maintaining goals, managing concentration, handling boredom, regulating emotions and creating effective learning environments. The original scale reported an acceptable reliability coefficient of 0.77. For this study, permission was obtained from the original authors, and the items were translated into Turkish to improve accessibility. Back translation by two experts in translation and interpretation confirmed linguistic and conceptual accuracy. A pilot study with 19 B2-level Turkish learners helped to adapt the tool. The revised version achieved a Cronbach alpha of 0.86, indicating strong internal consistency. The final questionnaire was administered via Google Forms during class time, in both Turkish and English. Of the 22 participants, 13 completed the questionnaire, yielding valuable data on their SRL strategies.

The interview

At the end of the intervention, a semi-structured interview was conducted to gather qualitative insights into the experimental group learners' experiences with Quizlet. Due to time constraints and scheduling conflicts, the interviews were conducted asynchronously via email. Participation was voluntary, and to ensure clarity and comfort, the interviews were conducted in Turkish. The interview featured four open-ended questions exploring learners' perceptions of Quizlet's benefits, its role in vocabulary learning, its motivational impact through its interface and features and any challenges encountered during use. These questions aimed to elicit detailed reflections that quantitative tools might not fully capture. The responses provided a deeper understanding of learners' engagement with the tool, their self-regulatory behaviours and how digital tools influenced their motivation and vocabulary retention. By incorporating this qualitative component, the study adopted a mixed-methods approach, allowing for a more comprehensive and context-rich interpretation of the research findings.

Data collection procedure

The first step was the selection of target vocabulary most suitable for flashcard creation, specifically nouns and adjectives, which are generally easier to visualise and recall. Using the Language Summary section of the *Evolve 5* teacher's book, 112 words (60 nouns and 52 adjectives) were extracted across 12 units. A vocabulary familiarity test was created using Google Forms, where participants rated their familiarity with each word on a 4-point scale. Based on the responses, 46 words were identified as predominantly unfamiliar. These were then filtered using a coverage calculator (https://www.lextutor.ca/cover/) to ensure frequency appropriateness, resulting in a final list of 29 target words. The words were organised into five weekly sets of five to seven items, aligned with course content for practical learning. This

structured selection ensured a focused and manageable vocabulary load. The pretest was then administered to both experimental and control groups during regular class hours.

The second step was providing the experimental group with training on how to use Quizlet for creating and practising vocabulary flashcards. I (S. Y.) created a virtual class on Quizlet and guided participants through the process of creating accounts, accessing the tool and sharing their study sets. Quizlet features were demonstrated using a smartboard, and learners experimented with them on their smartphones.

Experimental group activities

During the 8-week module, the experimental group used Quizlet to create and study digital flashcards for target vocabulary, with weekly word sets and sample study sets shared for guidance. Learners worked independently, applying the Zimmerman (2002) SRL model's three phases: forethought, performance and self-reflection. In the first week, they focused on setting goals and motivation; in the second, they practised self-observation and time management; and in the final week, they engaged in self-evaluation and adaptive thinking. This structure aimed to help learners actively plan, monitor and reflect on their learning process, fostering both vocabulary development and autonomous learning skills.

Control group activities

The control group followed the standard curriculum without using Quizlet, completing vocabulary worksheets and assignments from Evolve 5 that focused on the same target words as the experimental group. These activities, such as sentence creation and fill-in-the-blank tasks, provided vocabulary exposure but lacked an SRL framework. At the end of the module, both groups took the post-test under the same conditions as the pretest, with some question order adjusted to reduce familiarity. Additionally, the Self-Regulating Capacity in Vocabulary Learning Scale developed by Tseng et al. (2006) was administered via Google Forms in both Turkish and English, with 13 participants completing it, offering further insight into their learning behaviours.

Data analysis

Following the 8-week module, all collected data were systematically organised and analysed using SPSS version 26.0 to address the research questions and derive meaningful insights. A variety of statistical techniques were used to assess vocabulary test scores, questionnaire responses and qualitative interview data. Prior to the main study, a pilot phase ensured the reliability of the data collection tools. The vocabulary test was piloted with 11 voluntary participants from B2-level classes not involved in the study; Cronbach's alpha revealed high reliability at .96 overall, with section scores ranging from .66 to .89. Likewise, the self-regulation questionnaire, translated into Turkish and modified to a 4-point Likert scale for clarity and efficiency, was piloted with 19 learners and yielded a Cronbach's alpha of .86, confirming strong internal consistency. Quantitative analyses included paired samples *t* tests to compare pre- and post-test scores of the experimental and control groups, measuring the impact of the intervention. Descriptive statistics from the questionnaire illustrated learners' use of strategies such as commitment, metacognitive, emotional, satiation and environment control. Additionally, thematic analysis of semi-structured interviews with experimental group participants revealed themes such as Quizlet's benefits, motivational features and usage challenges, providing rich qualitative insights that complemented the quantitative data.

Results and discussion

The study's results are presented in relation to the three research questions. First, the effect of using Quizlet for vocabulary learning was examined by comparing pre- and post-test scores of the experimental and control groups to determine the impact of self-created flashcards. Second, findings from the SRL questionnaire revealed learners' SRL strategies for L2 vocabulary learning. Lastly, the study explored correlations between overall and subscale SRL strategies and vocabulary gains, showing how these

strategies supported learning outcomes. Together, the results offer a comprehensive understanding of the role of SRL in digital vocabulary acquisition.

The effects of generating and using Quizlet on L2 vocabulary

To address the first research question, "What are the effects of generating and using self-created digital flashcards on Quizlet on L2 vocabulary knowledge?" a vocabulary pretest and post-test were administered to both the experimental and control groups at the beginning and end of the study. Descriptive statistics were calculated for each of the seven parts of the test to summarise learners' scores before and after the intervention, offering insights into central tendencies (e.g., mean, median) and dispersion (e.g., standard deviation, range). The vocabulary test was out of a total of 29 points, reflecting the number of target words introduced during the module.

The findings revealed a notable improvement in the experimental group's vocabulary test scores across all seven test sections following the Quizlet intervention. Their total scores increased from a pretest range of 76 to 145 (M = 102.75, SD = 26.01) to a post-test range of 115 to 183 (M = 155.17, SD = 22.56). The gains were consistent across sections, with mean scores rising from 19.58 to 25.00 in Part 1 (receptive knowledge of orthography), 13.42 to 19.50 in Part 2 (productive spelling), and 16.67 to 25.92 in Part 3 (passive recognition). Similarly, Parts 4 through 7 also showed substantial gains. The reduced standard deviations in some sections suggest increased performance consistency among learners after using Quizlet. These improvements provide strong evidence that creating and studying digital flashcards via Quizlet had a positive impact on learners' vocabulary recognition and recall.

In contrast, the control group also exhibited gains in their vocabulary scores from pre- to post-test, though to a lesser extent. Their scores increased from a pretest range of 71 to 123 (M = 105.50, SD = 15.22) to a post-test range of 93 to 159 (M = 128.70, SD = 20.69). Although this progress suggests that traditional methods, such as textbook-based vocabulary instruction and regular homework, contributed to vocabulary development, the degree of improvement was smaller and less consistent across test sections. For instance, although the control group showed progress in Part 1 (M from 19.10 to 23.40) and Part 4 (M from 20.80 to 25.10), other sections, such as Part 7 (productive vocabulary), saw a slight decline (M from 2.70 to 2.50). This variability indicates that while traditional instruction supports vocabulary learning to a certain extent, it may not provide the same level of reinforcement or learner engagement as self-regulated digital tools.

An initial comparison of pretest data showed that the two groups began the study with relatively similar vocabulary knowledge, supporting the validity of comparing their post-test outcomes. However, there were some differences: the control group slightly outperformed the experimental group in Part 5 (passive recall), while the experimental group had better results in Part 7 (productive use of vocabulary). These small differences were not substantial enough to undermine the comparability of the two groups, and they allowed for a fair evaluation of the Quizlet intervention's effectiveness.

Post-test results confirmed that the experimental group exhibited stronger vocabulary gains. Specifically, they improved their mean scores by 5.42 points in Part 1, 6.08 in Part 2, 9.25 in Part 3, 6.17 in Part 4, 11.09 in Part 5, 10.91 in Part 6 and 3.5 in Part 7. The control group's gains were more modest: 4.3 in Part 1, 0.5 in Part 2, 3.4 in Part 3, 4.3 in Part 4, 4.5 in Part 5 and 6.4 in Part 6, with a decrease in Part 7. These results show that the experimental group clearly benefited more from the vocabulary learning process, particularly in areas of recall and application, which are essential for long-term language retention.

To statistically analyse the significance of these findings, a two-step approach was employed. First, the Shapiro-Wilk normality test was used to assess whether the data were normally distributed. The significance value of .045 indicated a deviation from normality, justifying the use of non-parametric tests. Therefore, within-group improvements were examined using the Wilcoxon signed-rank test, and between-group comparisons were conducted with the Mann–Whitney U test.

The Wilcoxon signed-rank test showed that both groups experienced statistically significant improvements in vocabulary scores. For the experimental group, the results (T = 78.00, SE = 12.733, z = 3.063, p = .002) strongly supported the effectiveness of the Quizlet-based intervention. The control group also demonstrated a significant increase (T = 55.00, SE = 9.81, z = 2.80, p = .005), though the gains were smaller. These results confirm that both traditional and digital approaches support vocabulary growth, but that learner-generated digital flashcards offer a greater boost in performance.

Further statistical comparison through the Mann–Whitney U test confirmed a significant difference in post-test performance between the two groups (U = 23.00, Z = -2.44, p = .015). Descriptive statistics showed that the mean post-test score across participants was 143.14 (SD = 25.14), with values ranging from 93 to 183. This finding suggests that learners who engaged in the self-creation and use of digital flashcards on Quizlet experienced significantly greater vocabulary development than those in the control group.

In summary, the data indicate that integrating Quizlet into vocabulary instruction positively impacts learners' ability to recognise, recall, and apply new vocabulary. The SRL features of Quizlet, such as immediate feedback, spaced repetition and customisable study sets, likely contributed to increased learner autonomy, deeper engagement and enhanced retention. Although traditional instruction resulted in some gains, the greater magnitude of improvement in the experimental group highlights the potential of interactive digital tools to enhance second language acquisition when paired with SRL principles. These findings affirm Quizlet's value as an effective instructional tool for L2 vocabulary development in higher education settings.

The use of self-created digital flashcards for vocabulary learning has become increasingly significant in L2 and foreign language acquisition research, with tools like Quizlet offering interactive and customisable features that align with SRL principles. Although Dodigovic (2013) found that teacher-designed flashcards outperformed those made by learners, likely due to the latter's limited experience in producing well-structured materials, the present study suggests that when learners are guided by SRL strategies and given autonomy, their self-created flashcards can lead to notable vocabulary gains through active engagement and deeper cognitive processing. Supporting this, research by Hung (2015) and Reynolds and Shih (2019) showed that collaborative learning with learner-generated flashcards was more effective than individual study, emphasising the importance of guided vocabulary selection and scaffolded creation. Nikoopour and Kazemi (2014) further stressed the value of digital flashcards for accessible, portable and flexible vocabulary practice, particularly when used on mobile tools like Quizlet. Collectively, these findings point to the pedagogical advantages of combining interactive digital tools with structured SRL frameworks (Aksel, 2021; Kupzyk et al., 2011). This study builds on prior research by showing that self-created digital flashcards not only enhance vocabulary knowledge but also support learner autonomy, making them a valuable component in modern language instruction.

The SRL strategies used by EFL learners in learning L2 vocabulary

To address the second research question, "What SRL strategies do learners employ when using Quizlet for vocabulary learning?", a mixed-methods approach was adopted. This included a quantitative self-report questionnaire and qualitative interview data. The questionnaire, based on Tseng et al.'s (2006) Self-Regulating Capacity in Vocabulary Learning Scale, measured learners' use of SRL strategies across five subscales: commitment control, metacognitive control, satiation control, emotion control and environment control.

Descriptive statistics from the pre-questionnaire provided a baseline understanding of learners' self-regulatory behaviours. The results showed environmental control as the most frequently used strategy (M = 11.33), indicating learners' tendency to adapt physical settings for optimal study. Commitment control followed (M = 10.66), reflecting the learners' goal-setting efforts. Emotion control (M = 9.75) and satiation control (M = 9.41) were moderately used, showing attempts to manage emotional responses and boredom. Metacognitive strategies were least employed (M = 9.16), suggesting that learners used fewer techniques for planning, monitoring and evaluating their learning, highlighting a growth area.

To interpret self-regulation levels, participants were grouped based on their total scores. Pre-intervention scores yielded a mean of 50.33 (SD = 6.07), categorising learners into low (n = 2), medium (n = 7) and high (n = 3) levels of self-regulation. These distributions showed varied engagement with SRL strategies, with a clear need for support in developing metacognitive control.

Following the Quizlet-based intervention, post-questionnaire results revealed a shift towards improved self-regulation. The mean score increased to 53.08 (*SD* = 6.44) and the distribution changed: no learners remained in the low-level category, eight were in the medium-level group and four reached high-level SRL. This suggests that the Quizlet intervention supported learners in strengthening their self-regulation skills, especially in environmental and commitment control. Post-intervention scores showed environmental control again as the most prominent strategy (*M* = 12.83), followed by commitment control (*M* = 11.41). Satiation and emotion control strategies each averaged 9.83, and metacognitive strategies remained lowest (*M* = 9.16), showing consistent underuse despite the intervention.

To statistically assess this shift, the Wilcoxon signed-rank test was conducted. The test result (*T* = 78.00, *Z* = 3.08, *p* = .002) confirmed a significant improvement in learners' self-regulatory capacity. The movement of all learners out of the low-level category and the increase in high-level learners demonstrates the effectiveness of using Quizlet as a digital tool to foster self-regulation. The intervention, guided by Zimmerman's (2002) three-phase SRL model, likely contributed to learners developing greater awareness and control over their vocabulary study habits.

Additionally, qualitative data from the semi-structured interviews supported the quantitative findings. Participants highlighted Quizlet's flexible features, such as progress tracking and spaced repetition, as motivating factors. They noted that the autonomy in creating their own flashcards helped them focus and take ownership of their learning. These responses further reinforced the idea that digital tools, when combined with SRL principles, can effectively enhance both engagement and vocabulary retention.

In conclusion, this study demonstrates that incorporating SRL strategies into digital tools like Quizlet can positively impact learners' vocabulary acquisition and their ability to manage their own learning. The shift from lower to higher levels of self-regulation, especially in environmental and commitment control, underscores the potential of guided digital tools in developing autonomous and effective L2 learners.

To deepen the analysis, semi-structured interviews were conducted to explore the qualitative dimensions of SRL strategies. Coded responses identified recurring themes, which were categorised for detailed examination. This qualitative analysis complements the quantitative findings, providing a nuanced understanding of how learners integrate technological tools like Quizlet into their vocabulary learning strategies. Together, the quantitative and qualitative results paint a comprehensive picture of the transformative effects of digital tools on learners' self-regulation practices.

The second research question explored the SRL strategies employed by learners using Quizlet to improve their vocabulary knowledge. Findings revealed a clear shift from low to higher levels of self-regulation post-intervention, mirroring Çepni's (2021) study in which environmental control was the most frequently used strategy, reflecting learners' efforts to reduce external distractions. However, unlike Çepni's results where satiation control was least utilised, the current study identified metacognitive strategies, such as monitoring and sustaining concentration, as the least reported, indicating contextual differences in learners' strategic preferences. The use of Quizlet appeared to enhance self-regulatory behaviours, as demonstrated by improved post-questionnaire scores, consistent with Fathi et al. (2018), who emphasised that technology-enhanced environments can cultivate learner autonomy and foster SRL. Furthermore, Bilican and Yesilbursa (2015) noted that learners' age, educational context and targeted instructional support influence the development of self-regulation skills. Together, these findings suggest that although digital tools like Quizlet can support vocabulary learning through increased self-regulation, their impact is optimised when integrated with guided instruction tailored to learners' individual needs and contexts (Soleimani et al., 2018; Yüksel et al., 2022).

The relationship between SRL strategies and vocabulary learning

To explore the third research question "How do SRL strategies, both overall and across different subscales, correlate with vocabulary learning gains in the group using Quizlet?", non-parametric analyses were conducted using Spearman's rank correlation coefficient. This statistical method assessed the strength and direction of relationships between learners' overall SRL scores, subscale scores and vocabulary improvements. Additionally, thematic analysis of semi-structured interview responses enriched the findings by identifying common patterns of self-regulatory behaviour and linking them to vocabulary development.

The results revealed that overall SRL post-test scores moderately correlated with vocabulary score gains (ρ = .475, p = .119), suggesting that stronger self-regulation may contribute to improved vocabulary acquisition, although this was not statistically significant. Among the subscales, metacognitive strategies showed consistent moderate correlations in both pre- and post-test phases (ρ = .381), indicating that skills like planning and monitoring learning played a key role. Interestingly, emotional control in the post-test phase demonstrated a statistically significant and strong correlation with vocabulary gain (ρ = .924, p < .001), highlighting the importance of emotional regulation in sustaining motivation and reducing stress during vocabulary learning. In contrast, commitment and environment control showed weaker, non-significant correlations. These findings underscore the complex, multidimensional nature of SRL and suggest that metacognitive and emotional strategies are particularly impactful in supporting vocabulary development in digital contexts like Quizlet.

To complement the quantitative findings, semi-structured interviews were conducted with learners in the experimental group to explore their experiences using Quizlet. The interviews focused on four key areas: general perceptions of Quizlet, its impact on vocabulary acquisition, motivational aspects as a digital tool, and challenges encountered during use. This qualitative data offered deeper insights into the learners' perceptions and the practical implications of integrating Quizlet into vocabulary instruction.

Participants widely acknowledged the benefits of Quizlet, particularly for memorisation, convenience and retention. Learners appreciated its range of features such as study sets, flashcards and practice tests, which allowed them to tailor their learning to their needs. One learner noted, "The Quizlet application has different learning methods such as study sets, word cards and tests. In this way, I study according to my needs" (Learner 4). Others praised the tool's portability and mobile accessibility, with Learner 3 stating, "This provides the opportunity to learn anytime and anywhere". Collaborative and visual elements were also emphasised: "Some prepared fill-in-the-blank sets, others added visuals, this variety helped make learning easier" (Learner 1).

Quizlet's flexibility also enhanced engagement. Learner 1 remarked, "It made learning more interactive and fun, allowing everyone to study in a way that matched their style". The ability to create and share personalised flashcards was frequently highlighted. Learner 3 commented, "You can use flashcards offline and share them with others, which is very useful".

Despite its advantages, some limitations were noted. Learner 4 expressed confusion when words with multiple meanings were only represented with a single definition. Interface usability was also mentioned: "Adding visuals was limited, and the design could be more intuitive" (Learner 2). Learner 1 added, "I had minor technical issues editing or sharing sets, and it took time to understand all functions at first".

Overall, the interviews revealed that Quizlet was perceived as a practical, accessible and engaging vocabulary learning tool. Although some interface and design challenges were reported, its collaborative features and personalisation options supported vocabulary retention and learner autonomy.

To further expand on the third research question, semi-structured interviews were analysed to explore how learners' use of SRL strategies aligned with vocabulary gains in the digital environment. The findings revealed a meaningful correlation between overall post-test SRL scores and vocabulary improvements, with particular emphasis on metacognitive strategies, such as planning, monitoring, and managing focus,

and emotional regulation, underscoring their importance in the vocabulary learning process. Although commitment and environment control strategies showed some correlation, they were not statistically significant, aligning with Tseng et al.'s (2006) assertion that self-regulation indirectly supports vocabulary acquisition by enabling effective behavioural management. The strong correlation between emotional regulation and vocabulary gains, especially in the post-test phase, supports research highlighting the role of motivation and emotional engagement in L2 learning (Xodabande et al., 2024).

These findings reaffirm that vocabulary learning is a complex process involving the interplay of cognitive, linguistic and metacognitive components (Nation, 2013; Schmitt, 2008). Recent meta-analyses have also emphasised the importance of SRL in digital environments. Zhao et al. (2025) and Cheng et al. (2025) have highlighted how SRL strategies, especially metacognitive and time management, positively affect academic performance in online higher education. Furthermore, Teng (2025) and Yang et al. (2025) have demonstrated that SRL-enhanced vocabulary tools can improve learner engagement, outcomes and motivation across diverse age groups and digital tools.

Research has shown mixed results regarding this relationship: although Soleimani et al. (2018) reported minimal correlation, Şentürk (2016) and Bilican and Yeşilbursa (2015) found positive associations, especially in Turkish EFL contexts. These discrepancies may stem from learners' inconsistent application of SRL strategies, suggesting a need for targeted guidance and explicit instruction (Kistner et al., 2010). This study supports the view that metacognitive regulation, especially managing focus and avoiding procrastination, is a key predictor of vocabulary success in digital learning, while emotional regulation likely enhanced learner motivation and engagement through Quizlet's gamified, interactive features (Wang et al., 2025; Zung et al., 2022).

Conclusion

This study contributes to L2 vocabulary research by demonstrating the effectiveness of self-created digital flashcards on Quizlet, particularly when paired with SRL strategies. Unlike prior work, this research highlights learner-generated content within an SRL framework.

Learners using Quizlet showed notable vocabulary gains and improved self-regulation, consistent with recent findings on digital SRL in education (Cheng et al., 2025; Zhao et al., 2025). Tools that incorporate metacognitive scaffolding and emotional regulation, such as those examined by Teng (2025) and Yang et al. (2025), can support vocabulary growth and learner autonomy in both higher education and K–12 settings.

These findings also suggest that policymakers can support learner autonomy in higher education by encouraging the integration of SRL strategies and digital tools like Quizlet into national curriculum frameworks, institutional policies and teacher training programmes. In addition, instructional designers can apply these findings by designing vocabulary learning activities that integrate SRL strategies, such as goal setting and self-monitoring, into digital flashcard tools, promoting both engagement and learner autonomy.

Limitations include the small sample size, short duration and lack of delayed post-testing. Future studies should address these gaps by including diverse participants, longer interventions and examining other digital tools or SRL applications across language domains.

Overall, the findings emphasise that integrating SRL strategies with digital tools like Quizlet enhances vocabulary learning and learner autonomy. Continued research can refine these approaches to support more personalised, engaging and effective L2 instruction.

Author contributions

Author 1: Conceptualisation, Investigation, Formal analysis, Writing – original draft, Writing – review and editing; **Author 2**: Conceptualisation, Methodology, Writing – review and editing, Supervision.

References

Aksel, A. (2021). Vocabulary learning with Quizlet in higher education. *Language Education and Technology*, *1*(2), 53–62. http://www.langedutech.com/letjournal/index.php/let/article/view/19/6

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bilican, R., & Yesilbursa, A. A. (2015). Self-regulated capacity for vocabulary learning in Turkish high school students: An experimental study. *Procedia - Social and Behavioral Sciences, 197*, 83–87. https://doi.org/10.1016/j.sbspro.2015.07.393

Boroughani, T., Behshad, N., & Xodabande, I. (2023). Mobile-assisted academic vocabulary learning with digital flashcards: Exploring the impacts on university students' self-regulatory capacity. *Frontiers in Psychology*, *14*, Article 1112429. https://doi.org/10.3389/fpsyg.2023.1112429

Çepni, S. B. (2021). Self-regulatory capacity in vocabulary learning: Does it make difference? *Yıldız Journal of Educational Research, 6*(2), 136–142. https://yjer.yildiz.edu.tr/storage/upload/pdfs/1642617983-en.pdf

Cheng, Z., Zhang, Z., Xu, Q., Maeda, Y., & Gu, P. (2025). A meta-analysis addressing the relationship between self-regulated learning strategies and academic performance in online higher education. *Journal of Computing in Higher Education, 37*(1), 195–224. https://doi.org/10.1007/s12528-023-09390-1

Dodigovic, M. (2013). Vocabulary learning with electronic flashcards: Teacher design vs. student design. *Voices in Asia Journal*, *1*(1), 15–33.

Fathi, J., Alipour, F., & Saeedian, A. (2018). Enhancing vocabulary learning and self-regulation via a mobile application: An investigation of the Memrise app. *Journal of Modern Research in English Language Studies*, *5*(1), 27–46. https://doi.org/10.30479/jmrels.2019.10311.1282

Goundar, P. R. (2019). Vocabulary learning strategies (VLSs) employed by learners of English as a foreign language (EFL). *English Language Teaching, 12*(5), 177–189. https://doi.org/10.5539/elt.v12n5p177

Hromalik, C. D., & Koszalka, T. A. (2018). Self-regulation of the use of digital resources in an online language learning course improves learning outcomes. *Distance Education*, *39*(4), 528–547. https://doi.org/10.1080/01587919.2018.1520044

Hung, H.-T. (2015). Intentional vocabulary learning using digital flashcards. *English Language Teaching*, *8*(10), 107–112. https://doi.org/10.5539/elt.v8n10p107

Kistner, S., Rakoczy, K., Otto, B., Dignath-van Ewijk, C., Büttner, G., & Klieme, E. (2010). Promotion of self-regulated learning in classrooms: Investigating frequency, quality, and consequences for student performance. *Metacognition and Learning, 5*(2), 157–171. https://doi.org/10.1007/s11409-010-9055-3.

Kupzyk, S., Daly, E. J., & Andersen, M. N. (2011). A comparison of two flash-card methods for improving sight-word reading. *Journal of Applied Behavior Analysis*, *44*(4), 781–792. https://doi.org/10.1901/jaba.2011.44-781

Martin, J. (2004). Self-regulated learning, social cognitive theory, and agency. *Educational Psychologist*, *39*(2), 135–145. https://doi.org/10.1207/s15326985ep3902_4

Mohammadi, M., Valizadeh, M., Zohdi Jalal, P., & Xodabande, I. (2024). University students' academic vocabulary development through mobile-assisted learning: Exploring the impacts on receptive and productive knowledge. *Heliyon, 10*(7), Article e28103. https://doi.org/10.1016/j.heliyon.2024.e28103

Nation, P. (2013). *Learning vocabulary in another language*. Cambridge University Press.

Nikoopour, J., & Kazemi, A. (2014). Vocabulary learning through digitized & non-digitized flashcards delivery. *Procedia - Social and Behavioral Sciences*, *98*, 1366–1373. https://doi.org/10.1016/j.sbspro.2014.03.554

Oxford, R. L. (2017). *Teaching and researching language learning strategies: Self-regulation in context*. Routledge. https://doi.org/10.4324/9781315719146

Pan, S. C., Zung, I., Imundo, M. N., Zhang, X., & Qiu, Y. (2023). User-generated digital flashcards yield better learning than premade flashcards. *Journal of Applied Research in Memory and Cognition*, *12*(4), 574–588. https://doi.org/10.1037/mac0000083

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, *8*(422), 1–28. https://doi.org/10.3389/fpsyg.2017.00422

Reynolds, B. L., & Shih, Y.-C. (2019). The learning effects of student-constructed word cards as homework for the adolescent English language classroom. *System*, *81*, 146–162. https://doi.org/10.1016/j.system.2019.01.005

Sage, K., Krebs, B., & Grove, R. (2019). Flip, slide, or swipe? Learning outcomes from paper, computer, and tablet flashcards. *Technology, Knowledge and Learning, 24*(3), 461–482. https://psycnet.apa.org/doi/10.1007/s10758-017-9345-9

Schmitt, N. (2014). Size and depth of vocabulary knowledge: What the research shows. *Language Learning*, *64*(4), 913–951. https://doi.org/10.1111/lang.12077

Şentürk, B. (2016). Self-regulation strategies and vocabulary size of EFL Turkish University Students. *Procedia - Social and Behavioral Sciences, 232*, 90–97. https://doi.org/10.1016/j.sbspro.2016.10.023

Soleimani, H., Aghayani, B., & Ashari, N. (2018). The relationship among EFL learners' self-regulation, locus of control, and preference for vocabulary acquisition. *Applied Linguistics Research Journal*, *2*(1), 14–24.

Teng, M. F. (2025). Exploring self-regulated vocabulary learning strategies, proficiency, working memory and vocabulary learning through word-focused exercises. *The Language Learning Journal, 53*(1), 22–39. https://doi.org/10.1080/09571736.2023.2267575

Tseng, W.-T., Dörnyei, Z., & Schmitt, N. (2006). A new approach to assessing strategic learning: The case of self-regulation in vocabulary acquisition. *Applied Linguistics*, *27*(1), 78–102. https://doi.org/10.1093/applin/ami046

Wang, Z., Hwang, G. J., Yin, Z., & Ma, Y. (2020). A contribution-oriented self-directed mobile learning ecology approach to improving EFL students' vocabulary retention and second language motivation. *Journal of Educational Technology & Society, 23*(1), 16–29. https://www.jstor.org/stable/26915404

Webb, S. (2009). The effects of receptive and productive learning of word pairs on vocabulary knowledge. *RELC Journal*, *40*(3), 360–376. https://doi.org/10.1177/0033688209343854

Xodabande, I., Atai, M. R., & Hashemi, M. R. (2024). Exploring the effectiveness of mobile assisted learning with digital flashcards in enhancing long-term retention of technical vocabulary among university students. *Journal of Computers in Education*. https://doi.org/10.1007/s40692-024-00347-6

Xodabande, I., Iravi, Y., Mansouri, B., & Matinparsa, H. (2022). Teaching academic words with digital flashcards: Investigating the effectiveness of mobile-assisted vocabulary learning for university students. *Frontiers in Psychology*, *13*, Article 893821. https://doi.org/10.3389/fpsyg.2022.893821

Yang, Y., Song, Y., Yan, J., & Ma, Q. (2025). Bridging classroom and real-life learning mediated by a mobile app with a self-regulation scheme: Impacts on Chinese EFL primary students' self-regulated vocabulary learning outcomes, enjoyment, and learning behaviours. *System, 131*, Article 103671. https://doi.org/10.1016/j.system.2025.103671

Yüksel, H. G., Mercanoğlu, H. G., & Yılmaz, M. B. (2022). Digital flashcards vs. wordlists for learning technical vocabulary. *Computer Assisted Language Learning, 35*(8), 2001–2017. https://doi.org/10.1080/09588221.2020.1854312

Zhao, Y., Li, Y., Ma, S., Xu, Z., & Zhang, B. (2025). A meta-analysis of the correlation between self-regulated learning strategies and academic performance in online and blended learning environments. *Computers & Education, 230*, Article 105279. https://doi.org/10.1016/j.compedu.2025.105279

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zung, I., Imundo, M. N., & Pan, S. C. (2022). How do college students use digital flashcards during self-regulated learning? *Memory*, *30*(8), 923–941. https://doi.org/10.1080/09658211.2022.2058553

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Please cite as: Yaşar, S., & Koçoğlu, Z. B. (2025). Enhancing vocabulary mastery: The impact of learner-created digital flashcards on L2 vocabulary learning and self-regulation. *Australasian Journal of Educational Technology*, *41*(4), 17–31. https://doi.org/10.14742/ajet.10402