The Impact of Social Media and Gamification of a Mobile Vocabulary Learning App: Self-Regulation and Learning Persistence

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Abstract
Scholars indicated that learners who are strategic with their language learning (e.g., self-regulated learning [SRL], cognitive and meta-cognitive strategies) tend to be more efficient, resourceful, and flexible, and thus have better language learning outcomes (Oxford, 2016; Heo et al., 2012; Plonsky, 2011). Besides focusing on the knowledge, language learners, as L2 teachers already do, need to prepare themselves with self-regulated learning skills so they can achieve the target language learning outcomes. This study selected Shanbay Danci (SBDC), a popular mobile vocabulary application (Wang, 2020; Su & Su, 2015), as the intervention. SBDC allows learners to share not only information about their goals but also include badges (a gamification feature) demonstrating their learning outcomes. To explore the impacts of the badge-sharing feature on learners' perceived self-regulation level, vocabulary learning persistence, and self-regulated learning experiences, a total of 77 undergraduates, who were enrolled in college English courses at a Chinese institution, participated in the study. Results showed participants in the badge-sharing group (experimental) tended to have significantly higher SRL level (e.g., better management of time and the learning environment, more strategic in completing tasks, selecting appropriate learning environment, setting learning goals, and self-evaluating their learning progress) than those in the control group who were not enrolled in any badge-sharing group. Moreover, those in the badge-sharing group demonstrated higher persistence in learning vocabulary with a completion rate of 70% versus 56% in the control group. Qualitative results indicated that badge sharing enhanced learners' self and shared regulation (an emergent finding from the data analysis) capacity in the process of learning vocabulary.

Keywords: self-regulated learning, mobile learning, second language vocabulary acquisition, learning persistence

Xu, Q., Richardson, J. C. (2024). The impact of social media and gamification of a mobile vocabulary learning app: Self-regulation and learning persistence, *Online Learning*, *28* (4), (4-32). DOI: 10.24059/olj.v28i4.4592

Introduction

Vocabulary has been recognized as an essential component to second language (L2) learning (e.g., Anderson & Freebody, 1981; Schmitt, 1997, 2010; Schmitt & Schmitt, 2020). As Nation (2022) explained, unfamiliar words can increase L2 learners' cognitive load. This increased load can further slow or even stop the information process when using the target language for reading, writing, listening, and speaking. As Chujo and Oghigian (2009) noted, an English foreign language (EFL) learner needs at least 4,500 words to achieve 95 percent coverage on the TOEFL test. Thus, finding effective strategies to enhance vocabulary acquisition is necessary for L2 teachers, researchers, and learners. This is especially important considering that vocabulary learning is an incremental process that requires significant time investment. Moreover, given the fact that L2 teachers face the challenge of limited class time, it difficult to cover all necessary content alongside vocabulary instruction (Schmitt, 2010). Thus, most vocabulary learning activities happen outside of the class, informally. Learning vocabulary independently requires learners to have a high level of self-regulated learning (SRL) skills to obtain successful learning outcomes.

Based upon Bandura's social cognitive theory, self-regulation has been explored extensively within the educational psychology field (Zimmerman, 1989, 1990; Pintrich, 2000; Bembenutty et al., 2013), in addition to other contexts such as second language learning (Tseng et al., 2017; Oxford, 2016; Rose et al., 2018). According to Zimmerman's self-regulation theory, learners with self-regulated skills will metacognitively (e.g., plan, organize, self-monitor), motivationally (e.g., self-efficacious, autonomous), and behaviorally (e.g., structure and create a learning environment) regulate their learning process, which leads to better learning outcomes (Schunk & Usher, 2013). Previous studies reviewed the pivotal role of SRL in supporting successful learning (Broadbent, 2017; Zimmerman, 2002; Cheng et al., 2023).

With the rapid development of mobile technologies over the past decade, mobile learning has gained much attention from L2 educators and scholars for its flexibility, mobility, continuity of learning, social interaction affordance, and promotion of self-regulation skills (Al Khateeb, 2022; Chen et al., 2021; Yang & Song, 2024). In addition, mobile applications and social media platforms have been shown to support informal learning outside of the classroom and enhance L2 learners' affective learning experiences (Wrigglesworth, 2020; Hao et al., 2019; Viberg et al., 2023). Embedding mobile applications has garnered attention in both the practice and research of language learning. For example, Elaish et al. (2019) conducted a review related to mobile-assisted language learning (MALL) and found vocabulary acquisition is the most investigated domain (k = 15 out of 69), followed by listening (k = 5), reading (k = 5), and writing (k = 3). However, existing research tends to examine mobile apps as a whole to explore their effectiveness in facilitating self-regulated learning (SRL) and vocabulary learning outcomes (Yang & Song, 2024; Wu, 2018; Ou-Yang, 2017), without specifying which particular components of mobile learning (e.g., mobile learning modality, gamification, multimedia affordances, or social media involvement) impact L2 learners' learning experiences. This limitation is especially crucial given the current mobile technology trends, as mobile-assisted

vocabulary learning can afford numerous variables and features. In addition, previous studies mainly focused on mobile vocabulary acquisition and measured vocabulary learning performance (Poláková, 2022; Yu, 2023), rather than SRL skills and learning persistence. Given that vocabulary learning is an incremental learning process often occurring outside of classroom, developing SRL skills is crucial for L2 learners' long-term success. Thus, integrating technologies that effectively facilitate L2 learners' SRL skills and learning persistence is paramount in enhancing their overall language learning process. To address these gaps, the current study focuses on one specific gamification feature, "badge-sharing," supported by a mobile app, and aims to investigate its effectiveness on L2 learners' SRL capacity and vocabulary learning persistence.

Literature Review

Self-regulation and Vocabulary Learning

Self-regulation has been recognized as an essential skill and has gained increasing attention in educational research, and specifically in L2 learning areas. Rooted in social cognitive theory, Bandura (1991) explained that human behavior is regulated by both internal self-generated and external environmental influences. Bandura (1991) divided the self-regulatory system into three phases: forethought, performance control, and self-reflection. Zimmerman (2000) further defined self-regulation as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p. 14). Pintrich (2000) divided SRL strategies into five categories: cognitive, metacognitive, motivational, behavior, and environmental. Several studies have indicated that there is a close relationship between learners' online self-regulation capacity and academic success (e.g., Ariffin et al., 2021; Kuo et al., 2020; Zhang et al., 2023).

A large amount of research in the L2 area has been shifted to focus on learning strategies (Heo et al., 2012; Oxford, 2016; Lestari & Wahyudin, 2020; Kölemen, 2021). Scholars indicated that learners with strategic language learning approaches tend to be more efficient, resourceful, and flexible and thus have better language learning outcomes (Oxford, 2016). As a fundamental component of second or foreign language learning, vocabulary acquisition needs significant attention. Previous research has identified various barriers to effective vocabulary instruction. For example, beyond mastering the word form and meaning, vocabulary knowledge covers complex aspects such as pronunciation, spelling, word parts, grammatical usage, collocations, discourse function, and connotations, as well as receptive and productive use (Nation, 2022; Oxford, 2016). Furthermore, attaining a substantial vocabulary size is challenging for L2 learners. For instance, while native English speakers typically acquire approximately 1,000 word families annually, ultimately reaching 20,000 word families by university graduation, L2 English learners often struggle to have a vocabulary size of 5,000 word families even after several years of study (Nation & Waring, 1997). Given the difficulties in learning vocabulary, L2 learners must develop their self-regulation skills to achieve desired vocabulary learning outcomes.

To capture strategies that can better facilitate vocabulary learning, scholars in L2 vocabulary learning have sought to adapt the self-regulated learning (SRL) framework. Tseng et al. (2006)

developed the Self-Regulating Capacity in Vocabulary Learning Scale, providing a foundation to transfer the SRL concept from educational psychology to second language vocabulary acquisition. Building upon the widely used Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1993), the Self-Regulating Capacity in Vocabulary Learning scale has five facets: commitment control, metacognitive control, satiation control, emotion control, and environmental control (Tseng et al., 2006). Following this study, Tseng and Schmitt (2008) further developed a model that integrates vocabulary knowledge and motivation, finding that initial motivation and SRL capacity are both crucial in the vocabulary learning process. Subsequently, Barnard et al. (2009) developed the Online Self-regulated Learning Questionnaire (OSLQ), contextualizing SRL in an online environment. However, to the best of our knowledge, no instrument has been developed to measure SRL in vocabulary learning within a mobile learning environment. Thus, we adapted the OSLQ to the mobile learning context and specified the learning content as vocabulary knowledge. More details about how we adjusted the OSLQ will be introduced in the methodology section.

Vocabulary Learning Strategy and Persistence

Vocabulary learning is a complex process involving multiple learning constructs (Nation, 2022). Knowing a word has multiple layers, such as form, pronunciation, collocation, and meaning (Nation, 2022). Given the complexity of vocabulary acquisition for both L2 teachers and learners during the L2 learning process, researchers categorize vocabulary learning strategies into two types: implicit and explicit vocabulary learning strategies. Implicit strategies include obtaining new vocabulary from reading and listening, while explicit strategy involves intentional learning activities such as wordlist and stroke. However, both strategies need a large time commitment, so learning vocabulary is an incremental process (Nation, 2022). Mastering all the dimensions of vocabulary knowledge takes time and is not straightforward (Tseng and Schmitt, 2008). For L2 teachers, limited class time will not allow them to focus on vocabulary teaching in depth. For L2 learners, learning vocabulary is a boring process, which makes it difficult to persist. Thus, most vocabulary learning activities happen in a self-directed context, requiring a higher level of self-regulation skills (Cheng & Lee, 2018). As Tseng and Schmitt (2008) noted, L2 learners' motivation to learn vocabulary is dynamic, hard to sustain, and often decreases over time. Given the fact that L2 learners not only need to study for a considerable time to get enough vocabulary to function effectively (vocabulary size), but also need to master the necessary knowledge to use vocabulary in the correct context (depth of knowledge) (Nation, 2022; Tseng & Schmitt, 2008). Thus, developing strategies to facilitate long-lasting vocabulary learning is the key for both L2 learners and instructors to successfully obtain vocabulary knowledge.

Research in L2 learning has begun to explore the relationship between grid and learning outcomes (Shirvan & Alamer, 2022; Alamer, 2021; Sudina & Plonsky, 2021). "Grid" is defined as "perseverance and passion for long-term goals" and "Grit entails working strenuously toward challenges, maintaining effort and interest over the years despite failure, adversity, and plateaus in progress" (Duckworth et al., 2007, p. 1,087). Alamer (2021) emphasized the essential role of the grid in L2 vocabulary learning and found there is a significant relationship between the grid and L2 learning performance. In this study, the scholar found perseverance of effort was a

significant predictor of vocabulary learning performance. Thus, finding instructional strategies to maintain L2 leaner's persistence in pursuing long-term vocabulary learning goals is an important direction. By looking at persistence, this study aims to know if the gamification features accelerate L2 learners' vocabulary learning persist. However, there is also some debate in the field. Grid is criticized by researchers as "blaming the victim" (Mehta, 2015). As Mehta (2015) pointed out, learners persevere not due to an innate ability to persist, but because they perceive the knowledge is valuable for them. This perspective emphasizes the critical importance of designing engaging courses and connecting content to authentic use for learners.

Mobile Learning, Gamification, and Self-regulation

Mobile learning is recognized as an effective approach to bridging formal classroom instruction and informal situated learning experiences (Cochrane & Narayan, 2016; Wu et al., 2012; Criollo et al., 2021; Traxler & Kukulska-Hulme, 2007). Cochrane and Narayan (2016) explained mobile learning from an educational perspective:

> It is the potential for mobile learning to bridge pedagogically designed learning contexts, facilitate learner generated contexts, and learner generated content both personal and collaborative, while providing personalization and ubiquitous social connectedness, that sets it apart from more traditional learning environments. (p. 389)

Gamification features have been embedded in educational mobile applications to enhance learning from various perspectives. For example, Shortt et al. (2023) reviewed the gamification of the popular language learning app Duolingo between 2012 and 2020 and found that users had positive learning experiences regarding engagement, flexibility, and the community-oriented learning environment created by the app. The high level of satisfaction and enjoyment enhanced L2 learners' motivation for language learning. Similarly, Liu (2022) developed a mobile interactive blockade-running game to facilitate college students' English learning and found that collaborative and competitive gamification elements significantly improved learners' learning outcomes and collaborative skills. Further, Liu and Correia (2021) found several critical factors to improve learners' engagement in mobile learning applications, including usability, availability of learning experiences, features to facilitate learning, interpersonal interaction, and incentives for completion. As one of the digital incentives for completion, the digital badge-sharing feature on social media is a common gamification mechanism intended to motivate continued participation (Kwon et al., 2015). Through social media, users can share their learning goals, progress, and activities with their social groups or accounts. This social influence aligns with Bandura's (1991) social cognitive theory of self-regulation, which includes the social referential comparisons component. According to Bandura (1991), for learning activities without absolute measures of adequacy, learners evaluate learning outcomes in relation to the attainment of others. This form of social gamification, supported by social media, allows learners to engage with peers, observe, and monitor the learning progress of themselves and others.

With the rapid advancement of mobile technology, the gamification elements supported by mobile apps have become diverse and evolving. To design and explain the gamification feature in this study, we employed the goal-access-feedback-challenge-collaboration (GAFCC) gamification design model as a guiding framework. Grounded in flow theory, goal setting, social

comparison, self-determination, and behavior reinforcement theories, Huang and Hew (2018) proposed the GAFCC model and explored its potential as an instructional strategy to motivate students' participation in out-of-class activities. Their results indicated significant improvements in activity completion rates and work quality with the GAFCC gamification design. While calling for further empirical validation across diverse educational contexts, this study adopts the GAFCC model to design a badge-sharing activity, aiming to explore its effectiveness in a language learning context and mobile learning modality. Additionally, researchers in the mobile learning field (Bernacki et al., 2020; Mayer, 2020) have emphasized the need for more empirical studies investigating how mobile devices interact with constructs like motivation, self-regulation, and literacy across formal and informal learning contexts. For this study, we selected Shanbay Danci (SBDC), a top-rated mobile vocabulary application, that allows learners to share not only information about their goals but also include badges (a gamification feature) demonstrating their learning outcomes, as the intervention tool. Specifically, we aim to explore the impacts of the badge-sharing feature on learners' perceived self-regulation level, learning persistence, and self-regulated learning experiences, this study aimed to examine the following research questions:

1. Does the badge-sharing gamification feature improve college L2 learners' perceived self-regulation level in the English vocabulary learning process?
2. Does the badge-sharing gamification feature increase college L2 learners' English vocabulary learning persistence?
3. What are college L2 learners' perceived self-regulated learning experiences of using SBDC and the badge-sharing gamification feature?

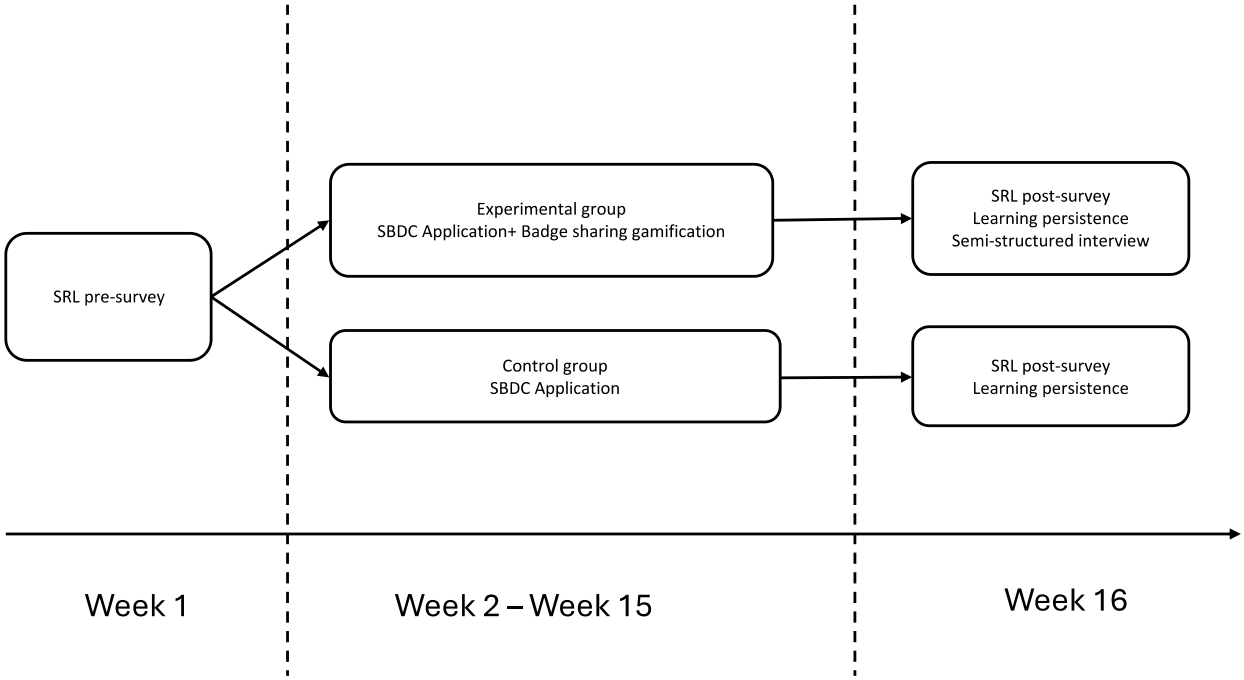
Methods

Research Design

To explore the impact of badge-sharing gamification on L2 learners' self-regulation and learning persistence, an explanatory sequential mixed methods design was adopted (Clark & Ivankova, 2016). The quantitative phase involved a quasi-experimental design to investigate the effects of badge-sharing gamification on L2 learners' self-regulation levels and learning persistence. This was achieved by using pre- and post-intervention self-regulation surveys, as well as the data from observational vocabulary task completion rates. Subsequently, qualitative data were collected through six semi-structured interviews to offer deeper insights into learners perceived learning experiences from an SRL perspective and to contextualize the quantitative findings. Refer to Figure 1 for the research design overview.

Figure 1

Research Design Overview



Research Context and Participants

Using a quasi-experimental design, this study invited 136 participants (75 in the experimental group and 61 in the control group) from a large university in Northern China. Participants were enrolled in two sections of a 16-week mandatory college English language course in 2023. While the course content was the same for both sections, they were taught by different instructors. Researchers randomly assigned one section as the experimental group and the other as the control group. However, 59 participants failed to complete both the pre-and post-surveys and were consequently excluded from the study. Several factors may account for the substantial attrition rate. Firstly, the pre-survey was distributed in week 1, when some registered students had not yet formally enrolled in the course. Additionally, student dropout throughout the semester contributed to attrition in both the course and the study. To ensure data consistency, this study only included those students who completed both surveys and remained enrolled for the entire 16-week semester in our analysis. All participants had previously passed the College English Test 4 (CET 4) and were currently preparing for CET 6, indicating a rank of intermediate level of proficiency in English. Participants were approached during the first week of the course and provided their consent to participate. The study consisted of 77 participants across two groups. The experimental group (N = 57) engaged in daily vocabulary learning tasks using the Shanbay Danci (SBDC) application and shared their badges via a QQ social media group. The control group (N = 20) also used SBDC for daily vocabulary learning tasks; however, they did not participate in any social media badge-sharing activities. The study followed the ethical guidelines and obtained approval from the Institutional Review Board (IRB-2021-265) to address any human subject concerns.

GAFCC Design Model and Badge-sharing Gamification Overview

The badge-sharing gamification followed the guidelines of GAFCC design model. The main features that SBDC supports include personalized plan, audio, Chinese translation, example sentences, learner dashboard, and badge-sharing. Within the application, learners can select different vocabulary books and create a personalized plan for the target words. After selecting a book, learners are asked to create a daily goal, including the number of new words and review words. When users accomplish their daily learning tasks, the system encourages users to share their digital badges on social media platforms. Appendix A displayed the interface of the SBDC features and badge-sharing activity interface. The authors obtained permission to publish the screenshots from the SBDC company. Proposed by Huang and Hew (2018), The Goal, Access, Feedback, Challenge, Collaboration (GAFCC) gamification model was tested in two empirical studies, demonstrating that courses that applied the GAFCC model had higher completion rates and produced higher quality work compared to those without it. The GAFCC model combines five motivation theories: flow theory, goal-setting theory, social comparison theory, self-determination theory, and behavior reinforcement theory. The present study is in alignment with the GAFCC model as described below:

Table 1

GAFCC Gamification Design Model (Huang & Hew, 2018) and Badge-sharing Gamification

Motivating elements	Definition	Indicators in the badge-sharing activity
Goal	To enable goal setting, it is helpful to reward students (e.g. with badges or points) and direct their attention to goal-relevant activities (Anderson et al., 2014).	Learners set their goals at the very beginning when they started to learn the vocabulary. They got a digital badge every time when they completed the daily vocabulary learning tasks.
Access	To enable access, it is helpful to provide a variety of optional challenges or tasks so that learners can choose a difficulty level that matches their own perceived skills (Csikszentmihalyi, 1978).	A leaner can set up their vocabulary study plan (i.e., including the amount of new vocabulary, review vocabulary, and completion duration) according to their perceived learning skills.
Challenges	Challenge means providing opportunities for learners to compete with themselves or their peers. This would meet individuals' need to excel themselves or surpass others, and raise participants' curiosity.	In the social media group supported by the QQ platform, learners shared their daily vocabulary learning badge and had the opportunity to observe and compare peers' learning progress.
Collaboration	Collaboration means providing	Learners were able to observe peers'

	chances for learners to work together to achieve a shared goal or interact with each other (e.g., commenting and replying). Creating chances for learners to interact with each other could make them feel relaxed and connected and help them to learn more from peers (e.g., Hew et al., 2016; Sailer et al., 2017). Positive reinforcements can be used to encourage individuals to participate in collaborative activities.	learning strategies and adjust their vocabulary learning plans. Within the social media group, learners were encouraged to ask questions and seek help from peers or instructors. Moreover, instructors sent positive feedback to students when they accomplished monthly learning goals.
Feedback	Feedback means providing instant or summative feedback to learners so that they know their own progress and achievements and the progress and achievements of their peers. (e.g., Hew, Huang, Chu, & Chiu, 2016). Participation-based badges can also be used to provide feedback on their efforts (Hew et al., 2016).	When learners share their badges with the social media group, summative feedback was automatically provided by the Shanbay App on the badge regarding learners' progress and the amount of learned vocabulary.

Data collection

Quantitative strand: mobile vocabulary learning self-regulation survey and vocabulary learning persistence

Quantitative data were collected using the pre- and post-self-regulation survey via Wenjuanxing, an online survey tool. The instrument used to measure learners' self-regulation levels was adapted from the Online Self-Regulated Learning Questionnaire (OSLQ) (Barnard et al., 2009). The original OSLQ survey included six factors: goal setting (α=.86), environment structuring (α = .90), time management (α = .78), task strategies (α = .67), help-seeking (α = .69), and self-evaluation (α = .78) (Barnard et al., 2009). It was a 24-item scale with a 5-point Likert-type response format, ranging from strongly agree (5) to strongly disagree (1). The survey demonstrated adequate internal consistency of scores with Cronbach's Alpha α = .90 (Barnard et al., 2009). We selected this instrument as the most suitable option because it measures learners' SRL capacity in an online environment, and most of its items can be adapted to a mobile learning modality. Thus, for this study, the survey was modified to fit a mobile learning environment and tailored specifically to vocabulary learning. For example, the item "I set standards for my assignments in online courses" was modified to "I set high standards for my English vocabulary learning" to better fit the scope of this study. Our study ended up having 21 items as three original items were excluded for not aligning with the study context. For the complete list of adapted survey items, please refer to Appendix B.

The completion rate was used as the indicator of learning persistence in our study. The task completion data was observed by researchers from the submitted report by learners at the end of the intervention in week 16. Participants in the control group used the CET 6 core vocabulary book as the learning material, which contains 2,787 words in total. Participants in the experimental group used the CET 6 full list vocabulary book as the learning material, which contains 7,818 words. This confounding variable potentially causes bias. The SBDC application automatically recorded and calculated the completion rate, which represents the percentage of expected vocabulary learned compared to the actual vocabulary acquired. This data was extracted from each student's learning report.

Qualitative Strand: L2 learners' perceived self-regulated learning experiences of using SBDC and the badge-sharing gamification feature

To better understand the perceived self-regulation learning experience during the badge-sharing activity, we further conducted six semi-structured interviews with participants from the experimental group. The interview questions were designed to explore learners' perceived self-regulation experience in terms of goal setting, time management, environmental structuring, task strategy, help-seeking, and self-evaluation (see Appendix C for interview questions). All interviews were conducted online via the Tencent Meeting conferencing tool, recorded and transcribed verbatim for analysis. Each interview lasted around 15 minutes.

Based on the survey, participants were classified into three levels of self-regulated learning (SRL): low, medium, and high SRL levels. This classification was based on quartile divisions of the SRL range (see Table 2 for interviewees' information). Employing purposeful sampling, a technique widely recognized in qualitative research for identifying information-rich cases (Patton, 2002), we intentionally selected interviewees from each SRL level. This approach aimed to capture a comprehensive range of perceived SRL experiences across the spectrum of self-regulation abilities.

Table 2

Interview Participants' Information

Perceived SRL level	Gender	Participant (Pseudonym)
High 102	Male	Zheng
High 94	Male	Ding
High 91	Female	Yang
Medium 88	Female	Zhou
Medium 83	Female	Feng
Low 76	Female	Shen

Data Analysis

Quantitative strand: mobile vocabulary learning self-regulation survey and vocabulary learning persistence

The one-way analysis of covariance (ANCOVA) was adopted to examine the group difference (control versus experimental) in vocabulary learning self-regulation while accounting for the potential confounding effect of participants' entry-level vocabulary learning self-regulation measured in the pre-survey. An independent sample t-test was used to examine the group difference in vocabulary learning persistence.

Qualitative strand: L2 learners' perceived self-regulated learning experiences of using SBDC and the badge-sharing gamification feature

For the qualitative data, a codebook for SRL learning was created based on previous research (Barnard et al., 2009; Barnard et al., 2010). A hybrid approach, including deductive and inductive coding, was used to analyze the interviews. Coding work was primarily completed by one researcher and checked by a second coder to enhance reliability (Merriam and Tisdell, 2016). NVivo software was used to analyze the qualitative data. Two cycles of coding were performed.

In the first cycle of coding, guided by the SRL framework (Barnard et al., 2009; Barnard et al., 2010), holistic coding was completed to grasp overall meanings, followed by descriptive coding (Saldaña & Omasta, 2016) to establish 23 first-level codes. Then 12 thematic categories were created from the first level codes.

In the second coding cycle, pattern coding (Saldaña & Omasta, 2016) was used to refine and summarize the initial codes into five themes: shared metacognition, metacognitive SRL strategies, behavioral SRL strategies, environmental SRL strategies, motivational and affective SRL strategies. The thematic patterns were then compared with the SRL framework to evaluate consistencies and discrepancies in participants' perceived SRL learning experiences (Miles et al., 2014). The coding scheme is available in Appendix D.

To enhance face validity, two additional researchers in the educational technology field were invited to review the adapted mobile vocabulary learning SRL survey and interview questions to ensure appropriateness and accuracy. In addition, three L2 learners with similar demographic backgrounds were invited to review the survey questionnaire and interview questions developing stage to ensure accurate representation (Polit & Beck, 2006).

Results

Among the 77 cases, three had standardized residuals more than ± 3 standard deviations. These three cases are considered outliers and were investigated individually. We found that the three participants completed the entire survey within one minute and selected extreme points for all survey questions. Consequently, the three cases were removed from the subsequent statistical tests, resulting in a final sample of 74 cases (18 in the control group and 56 in the experimental group) for conducting ANCOVA and t-test including normality, homogeneity of variance, homogeneity of regression slopes (for ANCOVA only) checked through the Shapiro-Wilk test, Levene's test, and testing interaction effects between the covariate and independent variable, respectively. Results from these tests indicated these assumptions were met. The minimum sample size for conducting multivariate analysis highly depends on the number of factors included in the analytic model (Bujang et al., 2017). According to their simulation results, a

sample size of 65 is required at minimum for conducting ANCOVA with one primary factor and one controlled factor.

RQ1: Does the badge-sharing gamification feature improve L2 learners' perceived self-regulation level in the vocabulary learning process?

For the SRL level, participants in the experimental (with badge-sharing) group tended to have higher level of SRL compared to the control (without badge-sharing) group. The survey is a 5-point Likert-type response format, ranging from strongly agree (5) to strongly disagree (1).

Table 3

Descriptive Results for Vocabulary Learning Self-regulation

Intervention	Pre_Mean	Pre_SD	Post_Mean	Post_SD	N
Control	3.2904	.0979	3.0303	.46824	18
Experimental	3.6055	.0581	3.6307	.51170	56
Total	3.5289	.4482	3.4846	.56178	74

Table 4

ANCOVA Results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	9.142[a]	2	4.571	23.354	<.001
Intercept	2.109	1	2.109	10.774	.002
Group	2.209	1	2.209	11.288	.001
Pre_SRL	4.232	1	4.232	21.621	<.001
Error	13.896	71	.196		
Total	921.601	74			
Corrected Total	23.038	73			

R Squared = .397 (Adjusted R Squared = .380)

RQ2: Does the badge-sharing gamification feature increase college L2 learners' English vocabulary learning persistence?

For learning persistence level, participants in the badge-sharing group tended to be more persistent in learning vocabulary from SBDC (vocabulary completion rate = 70%) than those in the control group (vocabulary completion rate = 56%).

Table 5

Descriptive Results for Persistence

	Intervention	N	Mean	Std. Deviation	Std. Error Mean
Post_persistence	Control	18	.5041	.20450	.04820
	Experimental	56	.5062	.23483	.03138

Table 6

T-test results

	t	df	Sig.
Persistence	-.033	72	.974

RQ 3: Perceived SRL experiences of using SBDC and the badge-sharing gamification feature

Our first theme, shared regulation, consists of peer learning strategies and peer monitoring. For peer learning strategies, we found the majority of interviewees mentioned observing peers' learning progress, goals, and strategies as reminders. As Feng said

> I sometimes checked my classmates' learning progress and plan, and I also discussed with them about their learning strategies, such as creating a notebook to keep track of unfamiliar words.

For peer monitoring, Zhou felt "motivated and rewarded when I checked the badge, which showed how many days I've persisted and how many words I have learned." She indicated the badge-sharing helped her persevere the learning, saying "I don't think I can persist in my learning goal without this badge-sharing activity . . . I forgot to learn vocabulary during the break, and I skipped two or three days. Then I found the social media group had many unread messages, and I realized I should catch up."

Zhou also created side groups for shared monitoring, stating "Besides participating in the badge-sharing activity within the English course, I also created another group with my close friends. I shared my vocabulary learning badge to that social media group as well. […] I feel like we [friends and classmates] are monitoring each other, which motivated me to keep learning."

Yang enjoyed using the activity to track the learning progress too, saying "When I shared my learning badge to the social media group, I felt like I was 'quantifying' my efforts. I feel very awarded to see these data [badges that I shared]."

Our second theme, metacognitive SRL strategies, consists of goal setting, goal adjustment, and learning awareness. For goal setting, Zheng said the badge-sharing activity helped him divide a long-term goal into short-term goals and was easier to accomplish:

> I think vocabulary learning is a long-term learning process, and the badge-sharing activity helped me divide it as a daily goal. Now I already started to learn another vocabulary book to preparing my IELTS test. The estimated accomplish date is one year, which is a very long-term goal. I feel if I have such a group to share the daily vocabulary learning badge could be helpful.

Feng described adjusting her goals to ensure the learning quality, stating:

> During the break, I had more time to spend on learning vocabulary. When the semester began, especially after the mid-term, I felt hard to follow the original plan, so I adjusted my daily goal for less vocabulary. I could learn it really quick with low quality, but I don't want. I think I do it [learn the vocabulary] to improve my vocabulary knowledge. Sharing the badge is not the ultimate purpose, it's just an activity.

The badge sharing activity boosted metacognitive awareness, with Shen realizing:

> I tried to learn vocabulary before for only two or three days, and I gave up. During this activity, one day I was doing a reading task, and I recognized several, like seven or eight words that I had just learned recently. I realized that I could fully understand the article. I felt so good. I realized this small task [daily vocabulary learning] had made such a big change for my English skill.

Yang echoed this, saying "When I saw a word from my textbook that I just learned in the App, I felt it was so worthy!"

The third theme, behavioral SRL strategies, included help-seeking, task strategy, and time management. For help-seeking, Feng said “I don't think it's necessary to ask instructors or classmates...most of the knowledge can be found on the internet.” Shen added, “I saw some words are very similar...I usually google them and find more example sentences, pictures or videos to help me better memorize them.”

Common task strategies included note-taking (“I created a notebook” said Feng), reading aloud ("I like the audio pronunciation...I will repeat after it" said Ding), and focusing on terminology that related to the major (“I collected some terminologies that related to my major so I can recall them when I was doing the reading task” said Shen).

For time management, all spent 15–30 minutes daily, using spare pockets of time. Zhou said “I had 30 minutes to kill between my two classes...Now I took advantage of this time...it's like a daily routine, and I found it is a great learning habit.”

For the fourth theme, environmental SRL strategies, we found students’ study environments varied, from Ding's library/classroom (“I know I cannot be focus when at the dormitory because there are too many distractions. I can only be focus when at the library or classroom”) to Feng's multi-location approach (“subway, bus, dorm...I will read loudly if noise”).
Yang and Shen liked learning before bed in the dormitory, Yang said “The half hour before I go to bed is an effective learning time for me. I wasted it before with chatting and playing. Now I use it to learn vocabulary” and Shen found her dormitory “the most relaxed, efficient environment for me.”

For the fifth theme, motivational and affective SRL strategies, some developed strong enjoyment, with Zheng describing the badges “helped me develop a daily routine and motivated me to persist.” Yang added, “I feel that I am not alone if I have peers...learning together.”

For Feng, it was more exam-driven: “I don't have a plan to study abroad, so I would not continue to learn English if I don't have to.”

Feng also noted peer comparisons could add pressure, preferring “learning independently” because:

> Some of my peers made me feel stressed. Especially those of peers who learned hundreds of the words, which I think it was impossible. I observed one of my peers in another class who kept pressing the ‘next’ button without really learning it. Because the instructor in that class requires them to complete the daily learning task, so students complete it only for course

credits. I don't like it.

Discussion

Language learning strategies have long focused on guiding learners toward becoming more self-regulated and effective in language learning (Oxford, 2017; Tseng et al., 2006). Self-regulation has been emphasized in the vocabulary learning field (Oxford, 2017) as vocabulary acquisition often occurs autonomously and passively (Wu, 2018; Chen & Chung, 2008), requiring learners to possess strong SRL abilities to persist in learning tasks (Oxford, 2017; Alamer, 2021). Previous scholars have investigated the relationship between SRL ability and language learning performance, finding that SRL ability can significantly predict learners' language learning outcomes (Seker, 2016). Specifically, studies have shown that learners with stronger SRL abilities are more likely to be successful in vocabulary acquisition (Oxford, 2017; Ping et al., 2015; Gu, 2003), which further leads to better overall language learning outcomes, as vocabulary is an essential component (Nation, 2022). In our study, we found significant SRL differences between the experimental and control groups, proving our hypothesis that the badge-sharing gamification feature has positively enhanced students' SRL skills. This finding echoes previous studies investigating how mobile apps potentially help learners develop their SRL skills. Chen et al. (2019) developed an English vocabulary learning app that follows a self-regulated learning mechanism, aiming to improve learning performance and motivation. Their study found the app successfully improved learners' vocabulary learning outcomes and motivation by incorporating SRL-related gamification features, such as encouraging learners to set daily learning goals, the number of notes to take daily, and daily exercises. Similarly, Ensmann and Whiteside (2022) used a social-media like platform to amplify the learning experience and improve engagement, finding that once the community norms are established, learners are empowered to be self-regulated.

However, From the qualitative analysis revealed contradictory attitudes toward the badge sharing activity within the social media group. While some participants appreciated the sense of community the activity fostered, others reported increased pressure and negative affective impacts (see Theme 5). This finding aligns with previous research on social media in education. Although social media can improve engagement and facilitate inclusive learning communities, it can also be overwhelming, misinformative, and distracting for some learners (Koehler & Vilarinho-Pereira, 2023). As the authors noted, social media doesn't automatically improve education, but needs instructors' meaningful planning, and intentionally facilitates collaboration and reflection (Koehler & Vilarinho-Pereira, 2023).

Previous studies have focused on mobile app gamification features and vocabulary learning performance, finding that mobile gamification can significantly improve students' vocabulary learning (Chen et al., 2019; Wu, 2018). However, these studies have been criticized for their methods of measuring vocabulary knowledge, as matching tests only assess receptive vocabulary knowledge, while vocabulary knowledge is complex and multidimensional. Vocabulary learning is an incremental process and sustained dedication toward a language learning goal is essential

for successful vocabulary acquisition (Alamer, 2021; Sudina & Plonsky, 2021). Thus, instead of focusing solely on actual vocabulary learning outcomes, our study examined students' vocabulary learning persistence.

While mobile gamification has been proven to improve L2 learners' motivation due to its engagement, flexibility, and enjoyment (Chen et al., 2019; Boyinbode, 2018), our results did not find significant differences in vocabulary learning persistence between the experimental and control groups. This echoes previous research by Alamer (2021), which found no statistical relationship between the consistency of interest in learning vocabulary and the perseverance of effort in vocabulary learning. The author suggested that a group of L2 students may hold a high interest in vocabulary learning but show low persistence. This could explain why, in our qualitative results, interviewees indicated positive vocabulary learning experiences with the mobile app and badge-sharing gamification, but their actual learning persistence did not significantly differ between the experimental and control groups. This finding shed light on the need for future research to focus not only on L2 learners' actual learning persistence but also on their sustained passion for the learning activity, as these two constructs are not necessarily correlated. In addition, it is important to note that the experimental group had 7,818 vocabulary items to learn, while the control group had 2,787 items. Even when using percentages to calculate the learning persistence, the substantial difference in the amount of learning material could have potentially prevented students in the experimental group from completing the learning task within the same time frame, as they had heavier learning tasks compared to the control group.

In addition to self-regulation, a new construct, named "shared regulation," emerged from the qualitative data results. This finding aligns with previous perspectives, as Hadwin et al. (2018) noted that early scholars interpreted the SRL concept with a focus on individuals, while recent research has expanded the concept to collaborative environments, emphasizing interaction, namely shared regulation. According to Hadwin et al. (2018), socially shared regulation refers to "groups taking metacognitive control of the task together through negotiated, iterative fine-tuning of cognitive, behavioral, motivational, and emotional conditions/states as needed" (p. 83).

In this study, the regulatory ownership transferred from an individual (self-regulation) to a group (shared regulation) by sharing their daily vocabulary learning badges and observing peers' badges. During the interviews, when students were asked about their perceived learning experiences with the SBDC and badge-sharing activity, they indicated their intention to observe and compare other students' learning strategies to their own, learn from these observations, and modify their goals and plans accordingly. For example, one interviewee was encouraged by peers and continued to pursue the vocabulary learning activity, demonstrating a change in behavior after interacting with peers within the social media group. Additionally, another learner felt rewarded by comparing their accomplishments to others', which further motivated them to continue learning.

Conclusion

As previous literature noted, encouraging vocabulary learning outside of the classroom has been a challenge for L2 teachers for several reasons (Nation, 2022). Firstly, it is difficult to monitor students' learning behaviors in self-directed contexts. Secondly, vocabulary learning is an incremental process that requires a massive time investment, making it challenging for learners to persist during the process (Nation, 2022). By combining the badge-sharing feature with social incentives and a sense of achievement, L2 teachers can potentially motivate learners and increase their persistence in vocabulary learning. For L2 learners, engaging with classmates enhances their engagement, providing opportunities to observe peers' learning strategies and potentially optimize their own approaches. Furthermore, being involved in a badge-sharing social media group increases vocabulary learning awareness, which can serve as reminders. This study provides potential implications for mobile educational app designers. Incorporating features that allow collaborative learning, network support, and social incentives can better motivate learners. Gamification does not automatically enhance language learning; rather, it needs intentional design and facilitation tailored to L2 learners' needs, enabling them to apply obtained knowledge in authentic communication contexts.

While numerous studies have investigated mobile vocabulary learning apps as interventions, examining their effectiveness (Poláková, 2022; Yu, 2023), engagement (He & Loewen, 2022), and learner satisfaction (Yu, 2023), our study highlights the need for a more nuanced approach. Mobile vocabulary learning apps typically incorporate multiple features (e.g., audio, multimedia, example sentences, leaderboards, goal-setting tools, and different formats of peer collaboration opportunities). We suggest that future research should be aware of these differences and examine specific features to provide more targeted strategies for best practices.

Moreover, shifting the focus from learning outcomes to how mobile language learning apps influence learners' learning attitudes, behaviors, and motivation could yield valuable insights. This approach would contribute to a more comprehensive understanding of the complex dynamics involved in the vocabulary and language learning process.

Limitations

The current study, while informative, had some notable limitations. Firstly, despite the English course curriculum being the same, the experimental group (assigned 7,818 words) and the control group (assigned 2,787 words) had different amounts of target words due to instructors' requirements. Secondly, the two groups had different instructors, and these variables could potentially impact the results. Future research would benefit from employing the same learning content and instructor across experimental conditions to minimize potential confounding variables. Thirdly, all participants were from the same educational institution and shared a common cultural background. Their target language was solely English. To build upon this research and broaden our understanding, future studies would benefit from including participants with diverse cultural backgrounds. Additionally, future research should explore beyond English,

incorporating L2 learners who are studying a variety of target languages.

Declarations

The authors declare no conflicts of interest.

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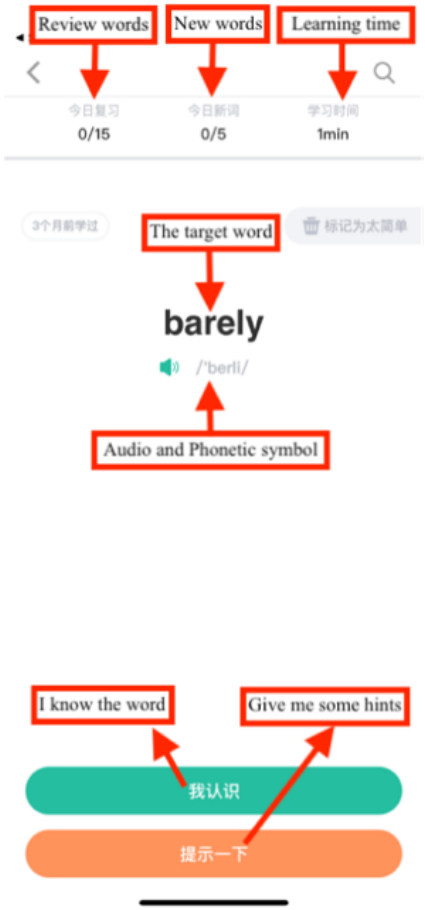
Acknowledgment

We wish to thank Zhuo Zhang for serving as consultant for the quantitative data analysis, providing methodology suggestions, and serving as a second coder.

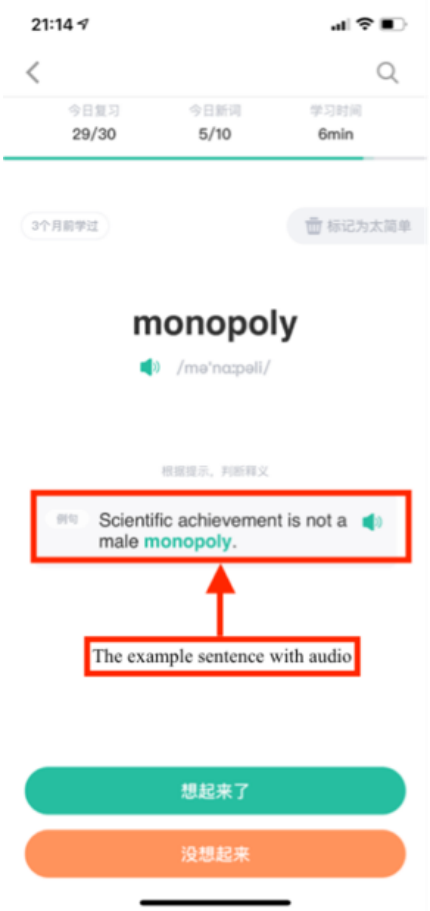
Appendix A

Shanbay Dan-Ci (Sbdc) Vocabulary Learning Mobile Interfaces and Involved Social Media Groups

Screenshot (a) Goal-setting page



Screenshot (b) Recognition test page

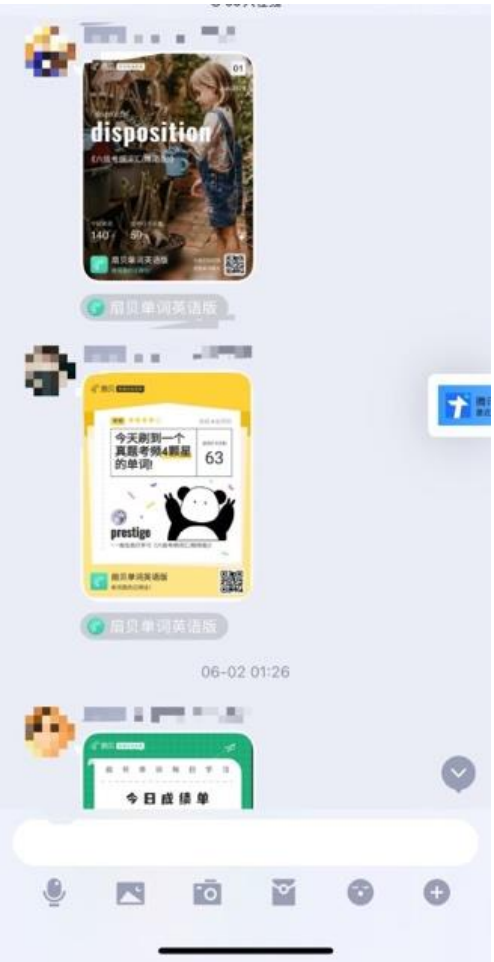


Screenshot (c) Recognition test page with example sentence as hint

Screenshot (d) Learning page with translations and example sentences

Screenshot (e) Learning progress dashboard

Screenshot (f) Daily accomplishment badge sharing



Screenshot (g) Social media group

Screenshot (h) Log data dashboard

Screenshot (i) Learning report

Appendix B

Adapted Survey of Self-Regulation in Online and Blended Learning Environments for Mobile Vocabulary Learning

Factor 1: goal setting—

1. I set high standards for my English vocabulary learning.
2. I set short-term (daily or weekly) goals as well as long-term (monthly or for the semester) goals when learning English vocabulary.
3. I set my personal goal for everyday vocabulary learning - a specific number of new words to be learned.
4. I set goals to help me manage study time for my English vocabulary learning.
5. I don't compromise the quality of my work in the English vocabulary learning process although it is an independent study.

Factor 2: Environment structuring—

6. I choose a good location for learning English vocabulary to avoid too much distraction.
7. I find a comfortable place to learn English vocabulary.
8. I know where I can learn English vocabulary most efficiently.

9. I choose a time with few distractions when studying English vocabulary.

Factor 3: Task strategies—

10. I read aloud the target vocabularies to fight against distractions and enhance my memorization when learning English vocabulary.
11. I do extra English vocabulary exercises to better master the vocabulary knowledge
12. I try to take more thorough notes for my vocabulary learning because notes are even more important for mobile vocabulary learning than in a traditional format.

Factor 4: time management—

13. I allocate (预留出) extra study time for learning English vocabulary because I know it is time-demanding.
14. I try to schedule the same time every day or every week to learn English vocabulary, and I observe the schedule.
15. Although the instructor doesn't check my vocabulary learning completion, I still try to distribute my vocabulary studying time evenly across days.

Factor 5: Help seeking—

16. I find someone who is knowledgeable (知识渊博的) in English vocabulary so that I can consult (请教）with him or her when I need help.
17. I share my English vocabulary learning problems with my classmates so we know what the problems are and how to solve those problems.
18. If needed, I try to discuss with my classmates face-to-face or in social media platforms (e.g. QQ and Wechat) on learning English vocabulary.

Factor 6: Self-evaluation—

19. I ask myself a lot of questions about the content while learning the English vocabulary.
20. I communicate with my classmates to find out how I am doing in learning English vocabulary.
21. I communicate with my classmates to find out what I am learning that is different from what they are learning.

Appendix C

Semi-structured Interview Questions.

Interview questions:

1. Can you describe your previous vocabulary learning strategies? What tools did you use?
2. Have you ever used any digital tools to learn English vocabulary before? If yes, can you describe it?
3. Can you share your perceived learning experience with the badge-sharing activity when you participate the badge-sharing activity? Did you like or dislike it? Do you think it helps with your vocabulary learning? If yes, from what perspective? If not, can you explain why?

4. By involving in the badge-sharing activity, did it inspire you to set up vocabulary learning goals? If yes, can you describe the goal? If not, can you explain why?
5. Where did you complete your daily vocabulary learning task? What study environment did you choose? Can you explain why?
6. What kind of vocabulary learning strategies did you employed when involve in the vocabulary badge-sharing activity? Did you follow the plan? Did you do some extra exercise to better master the vocabulary knowledge? Did you use any formats of notetaking?
7. In what time did you complete the daily vocabulary learning tasks? Why did you choose the time? Did you pick the same time of the day to complete the vocabulary learning task or not? Can you explain why?
8. Did you ever reach out to instructor or classmates when you have some questions regarding vocabulary learning? How did you seek the help (e.g. online chat or face to face)?
9. Did you communicate with your classmates regarding the vocabulary learning activity? Did you find any challenges with participating in the activity?
10. Will you continue to participate in the badge-sharing activity after this course? Why or why not?

Appendix D

The Coding Scheme

Codes	Code frequency	Categories	Themes
Peer reminder	3	Peers' learning strategies	Shared-regulation
Peers' goal	3		
Peers' progress	8		
Social comparison	9	Peer monitoring	
Long/short-term goal	2	Goal setting and accomplishment	Meta-cognitive SRL strategies
Vocabulary application goal	5	Goal adjustment and learning quality	
Goal adjustment	2		
Self-monitoring	13	Learning awareness	
Internet search	3	Help-seeking	Behavioral SRL strategies
Not necessary to ask peers/instructors	2		
Note-taking	2	Task strategy	
Read aloud	6		
Daily routing	9	Time management	
Learning time	13		
Time spent	6		

Classroom	4	Location	Environmental SRL strategies
Dormitory	5		
Library	2		
Flexible	2		
Satisfy and continue to use	3	Enjoyment	Motivational and affective SRL strategies
Not use after the exam	2	Exam driven	
Feel stressed	3	Learning pressure	