

## PAPER

# Effect of a Self-Regulated Vocabulary Learning Mobile Application on EFL Students' Vocabulary Learning Achievement and Motivation

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## ABSTRACT

The purpose of this study was to develop and evaluate the effectiveness of a self-regulated vocabulary learning mobile application (SRVL-MAPP) to improve English as a foreign language (EFL) students' English vocabulary learning achievement and motivation. To evaluate the effectiveness of SRVL-MAPP, an experiment was conducted with 60 fourth-grade students from a primary school in Henan Province, China. These students were divided into two classes and randomly assigned to either the experimental group, which used SRVL-MAPP, or the control group, which used a mobile vocabulary learning application (NSRVL-MAPP) without the SRL mechanism, with 30 students in each group. The experiment lasted for three weeks. The results revealed that students in the experimental group outperformed those in the control group in both vocabularies learning achievement and motivation. In addition, the results also indicated that SRVL-MAPP significantly improved the English vocabulary learning achievement and motivation of field-dependent learners, while no such effect was observed for field-independent learners.

## KEYWORDS

multimedia and virtual environments, mobile technologies, mobile learning applications, interactive mobile technology, self-regulated learning, vocabulary learning, learning achievement, learning motivation

## 1 INTRODUCTION

English has attracted a lot of attention as a widely used international communication language. Therefore, it is very important for people to have good English skills [1]. With the rapid development of globalized education, English as a foreign language (EFL) is still an important skill for students, especially in non-English-speaking countries [2]. Vocabulary acquisition is a fundamental element of language learning and is not only important for effective communication but also

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enhances a comprehensive understanding of different subjects and contexts [3]. EFL students often rely on memorization and repetition to acquire new vocabulary. However, this approach can be monotonous and lack meaningful language interaction, which can lead to students becoming disengaged from the learning process [4]. Meanwhile, there are limited opportunities to use newly acquired vocabulary in everyday life, hindering the retention and practical application of language skills [1], [5]. The combination of tedious learning methods, motivational barriers, and limited practical application poses a significant barrier to effective vocabulary acquisition by EFL learners.

In recent years, the rise of mobile technology and its integration into learning environments has opened up new perspectives for language learning [6]. Mobile technology has changed the traditional model of education and provides an innovative platform for language learning [7]. Learning English in mobile learning environments has become increasingly popular, and the proliferation of mobile devices such as smartphones and tablets provides opportunities to increase engagement and personalize the English learning experience [8]. Among these technological interventions, mobile apps designed specifically for vocabulary learning are becoming increasingly popular due to their convenience, utility, and accessibility [9]. Recent studies have emphasized the potential of mobile apps to enhance vocabulary learning among EFL students. For example, a study by Li and Hafner [10] found that mobile applications (apps) boosted students' vocabulary learning more than physical word cards. Polakova and Klimova's [11] study found that students who used a vocabulary mobile learning application in a blended learning classroom achieved better academic performance and showed higher motivation and overall satisfaction.

However, while vocabulary learning apps can be useful in helping EFL students learn and master new vocabulary, the effectiveness of these apps often depends on students' self-regulated learning (SRL) abilities [12]. This is important because students typically use these apps outside of school hours, which is an environment that lacks the formal structure and supervision of a traditional classroom. Without the ability to self-learn well, the potential benefits of mobile apps may not be fully realized, as learners may struggle to use learning materials consistently and effectively without supervision [9], [12].

The SRL model describes a process in which learners actively manage their own learning experiences by setting goals, monitoring their learning progress, and adjusting their strategies to achieve targeted goals [13]. It includes metacognitive strategies, motivational strategies, and behavioral strategies [14]. This cyclical model includes phases of forethought, performance, and self-reflection, in which learners prepare for learning, engage in learning activities, and reflect on their learning to improve future efforts [15]. Previous research has shown that teaching models based on SRL strategies help to increase language self-efficacy and performance self-efficacy levels [13], [16], and incorporating SRL strategies into foreign language teaching encourages the development of autonomous learners [17]. Other studies have shown that students' motivational beliefs determine the level of their use of SRL strategies, and high levels of SRL strategy use contribute to English learning performance [18], [19]. It is believed that improving students' self-regulation abilities in vocabulary learning has always been one of the teaching goals of language education.

The cognitive styles of learners significantly influence their performance in technology-assisted learning environments [20]. Cognitive style refers to an individual's preferred way of sensing, thinking, and memorizing. It can be categorized into field-dependent and field-independent types [21]. Field-dependent learners rely more on external factors and guidance during the learning process. They tend to

take context and the social environment into account when processing information. In contrast, field-independent learners are capable of learning more independently from the external environment. They engage in abstract thinking when processing information and are generally more analytical and logical, making them suitable for learning in independent or personalized settings [20, 21]. Research indicates that these differences significantly affect how learners interact with and benefit from technology-assisted educational tools. For example, a study by Graf et al. [22] demonstrates that incorporating individual differences in cognitive styles into technology-assisted learning tools can enhance educational outcomes. This finding highlights the significance of personalized learning experiences that are aligned with cognitive styles, thus optimizing their educational potential.

Following a literature review, it was found that there was a lack of research on the integration of self-regulatory mechanisms in mobile learning applications to support EFL learners' vocabulary acquisition. Moreover, the cognitive styles of EFL learners were not considered in the existing studies. In light of the above issues, this study designed and developed a self-regulated vocabulary learning mobile application (SRVL-MAPP) that could help learners set learning goals, monitor and evaluate their own performance, and reflect on their learning processes, with the expectation of improving the vocabulary acquisition and learning motivation of EFL learners. This study also explored the effects of the SRVL-MAPP on EFL learners with different cognitive styles. The use of this framework has some theoretical and practical implications.

From a theoretical perspective, self-regulated learning theory (SRLT) is combined with a mobile learning application to explore how this combination affects foreign language vocabulary learning. This cross-disciplinary study bridges the gap in existing research on the interaction between self-regulated learning and m-learning applications, particularly considering the impact of different cognitive styles (field-independent and field-dependent) on learning effectiveness and motivation.

From a practical perspective, this study provides a personalized learning experience for students with different cognitive styles through the development and application of a specially designed mobile application for self-regulated vocabulary learning. This application not only helps to improve students' vocabulary but also stimulates their motivation to learn and offers practical tools and methods for educational practice.

Therefore, the following research questions were formulated to assess the effectiveness of the proposed methods:

1. Can the developed SRVL-MAPP significantly enhance EFL learners' English vocabulary learning achievement?
2. Can the developed SRVL-MAPP significantly enhance EFL learners' English vocabulary learning motivation?
3. Does the developed SRVL-MAPP significantly affect the English vocabulary learning achievement of EFL learners with different cognitive styles?
4. Does the developed SRVL-MAPP significantly affect the English vocabulary learning motivation of EFL learners with different cognitive styles?

## 2 MATERIALS AND METHODS

### 2.1 Research architecture

This study investigated whether there is a significant effect of using the SRVL-MAPP or the Vocabulary Learning Mobile application without self-regulated

(NSRVL-MAPP) developed for EFL learners on their vocabulary learning and motivation to learn. Whether the Vocabulary Learning Mobile application integrates self-regulation mechanisms was used as an independent variable, while the dependent variables were academic performance and motivation in this study. Graf et al. [22] pointed out the differences in learning characteristics between field-dependent and field-independent learners in the technology-assisted learning environment. Therefore, cognitive style was considered as a background variable in this study.

## 2.2 Research participants

This study used one-stage cluster sampling to select participants from a primary school in Henan Province, China. Participants consisted of 60 fourth grade EFL students from two of the six classes available in the grade cohort. The classes were randomly selected by the school principal using a lottery system. One of the 30 students was assigned to the experimental group (the SRVL-MAPP group), in which the SRVL-MAPP was used to learn English vocabulary. The other class of 30 students was designated as the control group (NSRVL-MAPP group) and used the NSRVL-MAPP to facilitate their English vocabulary learning.

## 2.3 Research design

The study used a pretest-posttest control group design to assess the effectiveness of two different teaching strategies on the English vocabulary acquisition of fourth grade EFL students. As shown in Figure 1, the experiment was conducted over a period of three weeks and was divided into three distinct phases.

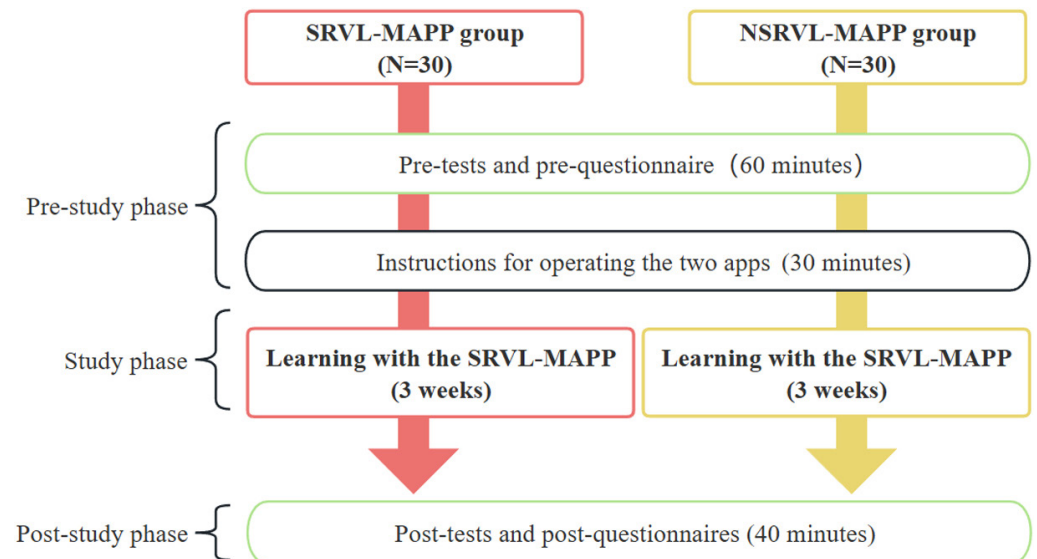


Fig. 1. Experimental procedure

**Pre-study phase:** Prior to the start of the experiment, initial assessments were carried out to establish a baseline for comparison. A 20-minute pre-test was conducted to assess the English vocabulary ability of the students in both groups.

The students' cognitive styles were then determined using the group embedded figures test (GEFT), which classifies individuals as either field-dependent or field-independent. This section also lasted 20 minutes. The final part of this phase involved the completion of the English learning motivation questionnaire (ELMQ) by all participants. This 20-minute questionnaire was designed to identify any significant differences in motivation to learn English between the two groups. For the next 30 minutes, both groups of students are given instructions on how to use the two apps to avoid experimental errors due to unfamiliarity with the system.

**Study phase:** Both groups of students can use SRVL-MAPP or NSRVL-MAPP (based on their groups) for self-directed learning at any time and place. Learners in both groups were allowed to design their own learning plan; however, they were expected to use the SRVL-MAPP or NSRVL-MAPP for at least five hours per week. The difference was that students in the experimental group could set their own learning goals and use self-regulation mechanisms in the SRVL-MAPP, whereas students in the control group could not.

**Post-study phase:** Conduct a post-test to evaluate English vocabulary learning and motivation immediately after the three-week study period.

As the study required the collection of data through questionnaires, informed consent was obtained from all participants prior to the start of the experiment in order to address ethical considerations. The consent form clearly explained the purpose of the research and assured participants that the data collection was for research purposes only. It also emphasized that participants could withdraw from the study at any time without consequence. In addition, to protect the confidentiality of the participants, their names would not appear on any of the research data or in any subsequent publications.

## 2.4 Design process of SRVL-MAPP

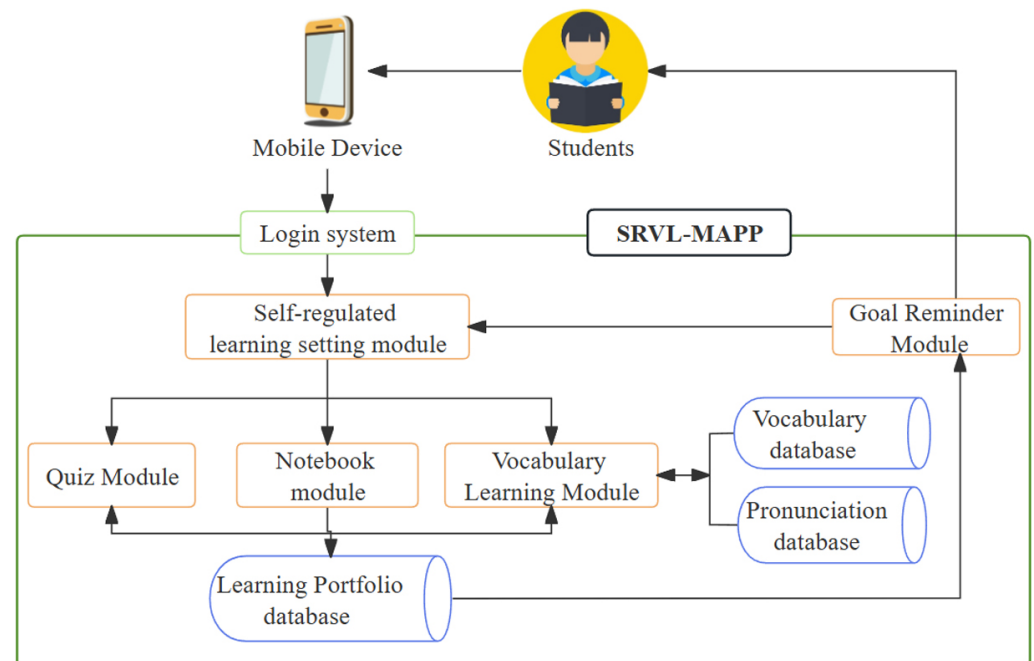


Fig. 2. System architecture

The SRVL-MAPP proposed in this study consists of five modules: the self-regulation setting module, the vocabulary learning module, the notebook module, the quiz module, and the goal reminder module, as shown in Figure 2. After logging into the SRVL-MAPP using their smart devices, students can set their learning goals using the SRL Settings module, as shown in Figure 3 (left). This includes setting daily goals for vocabulary learning. Once these SRL goals have been set, students can use the vocabulary learning module to study English vocabulary, as illustrated in Figure 3 (right). This module systematically retrieves data from both the vocabulary and pronunciation databases to ensure a structured learning experience. The vocabulary database used in both apps has been developed and designed according to the primary school English learning syllabus formulated by the MOE of the People's Republic of China. Following this syllabus, a total of 442 words were included in the vocabulary learning database of the self-regulated vocabulary learning mobile application.



Fig. 3. Interface of setting self-regulated learning goals (left) and vocabulary learning (right)

Throughout the process, students are able to monitor their progress in real time by tracking the number of words they have learned. In addition, the SRVL-MAPP provides an add-or-drop feature that allows students to categorize words into 'familiar' and 'unfamiliar' notebooks, respectively, facilitating personalized vocabulary management. The system reduces the frequency of familiar words and increases the frequency of unfamiliar words, based on the word records in the student's notebooks, until the student has completely mastered the word. When students have achieved



their vocabulary learning goals, they can evaluate their mastery through the quiz module. After logging into the SRVL-MAPP, all learning records are securely stored in the learning portfolio database. The Goal Reminder module, which is integrated into the various user interfaces, constantly reminds learners about progress and helps them achieve their vocabulary learning goals. It is important to note that the NSRVL-MAPP used by the control group only has vocabulary learning functionality.

## 2.5 Data collection instrument

A total of 3 data collection instruments were used in this study, and the details are as follows:

The GEFT used in this study was the Chinese version developed by Wu [23], which has been widely used in L2 studies. The reliability of the test was determined to be 0.82 with a Spearman-Brown prophecy formula.

Two teachers, each with more than ten years' experience in English teaching, selected 40 words from a total of 442 for the English vocabulary ability test. The test was divided into two sections: the first section required students to provide Mandarin translations for 20 given English words, while the second section presented students with 20 Chinese terms and asked them to select the correct English word from four options. Each question was worth 1 point, for a total of 40 points. In addition, three experts in the field were invited to score the item-content validity index (I-CVI) for both the pre-test and the post-test. The mean I-CVI score for both the pre-test and the post-test is 0.96.

The EMLQ used in this study was adapted from the Chinese version developed by Chen et al. [19], which was specifically tailored for primary school students. The original questionnaire consisted of 34 items in five dimensions: learning attitudes, learning needs, self-efficacy, self-esteem, and motivation. In consideration of the limited working memory capacity of 4th graders, 20 items were selected for this study. To assess the reliability of the questionnaire, a pilot study was conducted with 40 participants who were not involved in the formal study. The Cronbach's alpha coefficients for the dimensions were 0.88, 0.92, 0.93, 0.91, and 0.88, respectively, indicating high internal consistency. The overall Cronbach's alpha for the questionnaire was 0.95.

## 3 RESULTS

This study used SPSS 26 to examine whether there was a significant difference in English vocabulary learning achievement and motivation between the two groups of Chinese EFL students after using the SRVL-MAPP and the vocabulary learning mobile application without self-regulated.

### 3.1 Analysis of learning achievement of two groups of learners

ANCOVA was used to determine if there was a significant difference between the experimental and control groups, and students' pre-test scores were used as covariates. The results of the homogeneity of regression slopes ( $F = 0.025, p > 0.05$ ) and Levene's test for homogeneity of variance ( $F = 0.093, p > 0.05$ ) indicate that the assumptions for the use of ANCOVA were met. The ANCOVA results found significant

differences between the experimental and control groups, as shown in Table 1. This also means that students using SRVL-MAPP outperformed the control group in terms of English vocabulary learning ( $F = 85.106, p < 0.001$ ).

**Table 1.** ANCOVA result of the learning achievement for both groups

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	30	35.47	4.607	35.64	$F = 85.106, p < 0.001$
Control group	30	24.87	4.313	24.74	

### 3.2 Analysis of learning achievement of two groups of learners with different cognitive styles

The results of the homogeneity of regression slopes showed that field-dependent learners ( $F = 0.141, p = 0.710 > 0.05$ ) and field-independent learners ( $F = 0.183, p = 0.679 > 0.05$ ), and the results of Levene's test for homogeneity of variance showed that field-dependent learners ( $F = 1.307, p = 0.263 > 0.05$ ) and field-independent learners ( $F = 2.718, p = 0.110 > 0.05$ ), indicating that the assumptions of using ANCOVA were met. As shown in Tables 2 and 3, students who used the SRVL-MAPP for vocabulary learning – both field-dependent and field-independent learners – performed better in vocabulary learning than the field-dependent and field-independent learners in the control group who used the vocabulary learning mobile application without self-regulated.

**Table 2.** ANCOVA results for field-dependent learners in learning achievement

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	14	36.64	3.388	35.53	$F = 46.093, p < 0.001$
Control group	16	25.31	4.949	25.41	

**Table 3.** ANCOVA results for field-independent learners in learning achievement

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	16	34.44	5.354	34.77	$F = 42.203, p < 0.001$
Control group	14	24.36	3.565	23.98	

### 3.3 Analysis of learning motivation of two groups of learners

This study used an ANCOVA to determine whether there was a significant difference in learning motivation between students in the experimental and control groups. Pre-test scores were used as covariates. The assumption of homogeneity of regression slopes was tested, and the results indicate no significant violation ( $F = 1.063, p = 0.307 > 0.05$ ). Additionally, Levene's test for equality of error variances were conducted to assess the homogeneity of error variances across groups. The results from this test also showed no significant differences ( $F = 2.868, p = 0.732 > 0.05$ ), confirming that the assumptions necessary for the application of ANCOVA are satisfied. The ANCOVA results, as shown in Table 4, revealed that the experimental



group using SRVL-MAPP for vocabulary learning showed higher motivation than the students using NSRVL-MAPP ( $F = 5.884, p < 0.05$ ).

**Table 4.** ANCOVA result of the learning motivation for both groups

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	30	75.80	13.461	76.44	$F = 5.884, p < 0.05$
Control group	30	71.07	9.370	70.43	

### 3.4 Analysis of learning motivation of two groups of learners with different cognitive styles

An ANCOVA was used to test whether there was a significant difference in vocabulary learning motivation between experimental and control group students with different cognitive styles, using students' pre-test scores as a covariate. The analysis testing the homogeneity of regression slopes revealed no significant effects for both field-dependent learners ( $F = 0.722, p = 0.403 > 0.05$ ) and field-independent learners ( $F = 0.340, p = 0.565 > 0.05$ ). Similarly, Levene's test for homogeneity of variances confirmed that there were no significant differences among field-dependent learners ( $F = 6.211, p = 0.109 > 0.05$ ) and field-independent learners ( $F = 1.072, p = 0.309 > 0.05$ ). These findings collectively satisfy the assumptions required for employing ANCOVA.

As shown in Table 5, there is a significant difference in motivation between the field-dependent learners in the experimental group and those in the control group. The field-dependent learners in the experimental group scored higher in learning motivation ( $F = 12.924, p < 0.001$ ). However, the field-independent learners in both groups were not significantly different in their learning motivation ( $F = 0.230, p = 0.635 > 0.05$ ), as shown in Table 6.

**Table 5.** ANCOVA results for field-dependent learners in learning motivation

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	14	85.36	12.320	87.05	$F = 12.924, p < 0.001$
Control group	16	75.81	8.871	64.33	

**Table 6.** ANCOVA results for field-independent learners in learning motivation

Group	N	Mean	S.D.	Adjusted Mean	F
Experimental group	16	67.44	7.677	66.98	$F = 0.230, p = 0.635 > 0.05$
Control group	14	65.64	6.755	66.17	

## 4 DISCUSSION

This SRL ability allows students to facilitate their mobile learning process by autonomously setting learning goals, monitoring their own progress, adapting their learning strategies, and engaging in self-reflection. Therefore, this study developed an SRVL-MAPP to help EFL students learn English vocabulary after school with the expectation that it would help them improve their learning achievement and motivation. The results of this study showed that students in the experimental group

who studied with the developed SRVL-MAPP outperformed students in the control group who studied with the NSRVL-MAPP in terms of English vocabulary learning achievement and motivation.

This finding is consistent with the research conducted by Wang et al. [24], who developed a mobile-assisted system with a self-regulated learning mechanism to help EFL students' vocabulary learning. Their study showed that students using this system achieved significantly higher scores on vocabulary learning tests. An et al.'s [25] study identified a statistically significant positive correlation between the use of technology-based SRL strategies and students' English learning outcomes. The study also highlighted that both English language self-efficacy and enjoyment are associated with these technology-based SRL strategies. The findings of this study are also supported by Chen et al. [19], who found that incorporating SRL mechanisms into mobile apps not only increased EFL students' motivation but also improved their vocabulary acquisition. Yang and Song [26] developed and evaluated a mobile application with a self-regulation scheme to facilitate primary students' self-regulated vocabulary learning. The results of the study found that learners using the application demonstrated higher self-regulation skills and better English vocabulary learning outcomes.

The results of the present study confirm that field-dependent learners using the SRVL-MAPP show greater vocabulary learning achievement and motivation than those using the NSRVL-MAPP. One possible explanation is that the self-regulated learning (SRL) mechanism is particularly beneficial for field-dependent learners who rely greatly on external environmental cues. By incorporating SRL strategies, these learners can increase their autonomy and control over the learning process, thereby improving both motivation and learning performance [21]. Meanwhile, for field-independent learners, the use of the proposed SRVL-MAPP improved their learning performance but not their motivation. Characterized by self-motivation and independence from external cues, these learners benefit from the structured environments provided by SRVL-MAPP. In addition, a study by Davey [27] found that field-independent students outperformed field-dependent students in all five areas of reading. Conversely, Pashler et al. [28] study found no significant interaction between students' learning styles and their linguistic abilities in English achievement test scores. Naenah's [29] study also found that there was no correlation between the six learning styles and the academic performance of the respondents.

## 5 CONCLUSION

The results of a three-week experiment indicated that the SRVL-MAPP significantly improved both the English vocabulary learning achievement and motivation of these students. Furthermore, cognitive style was considered a background variable to assess differential effects on learning achievement, and motivation. The results demonstrated that both field-dependent and field-independent learners significantly benefited from using the SRVL-MAPP in terms of vocabulary learning achievement. In addition, this study examined the influence of cognitive style on students' motivation after using the SRVL-MAPP. It was found that the SRVL-MAPP significantly increased the motivation of field-dependent learners. However, this motivational effect was not observed in field-independent learners.

This study demonstrates the feasibility and effectiveness of integrating SRL into mobile apps for educational purposes. Based on the results of these studies, future research should aim to develop more advanced software platforms to support a wider range of curricula [30]. Meanwhile, future research could also consider

combining SRL with more advanced instructional tools, such as ChatGPT, to examine their effects on EFL students' English language learning [31]. Additionally, it would be beneficial to expand the study population and disciplines to fully assess the generalizability and adaptability of SRL-enhanced mobile apps.

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