Mobile Learning Application Integration in the English as a Foreign Language Classroom to Improve College Students' Learning Outcomes

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Abstract

Background and Aim: Mobile Learning Application seems to facilitate the learning process by allowing teachers and students to have more interaction regardless of time and space, thus creating a broader field for the scope of learning. This research explored whether mobile learning application integration in the English as a Foreign Language Classroom helped improve college students' learning outcomes and further analyzed the psychological factors that worked with mobile applications to influence learning outcomes. The purpose of carrying out the research is to help vocational college students develop better English learning outcomes, this research also aims to explore whether the technology integration of mobile learning applications can effectively improve college students' learning outcomes.

Materials and Methods: A quasi-experiment was carried out with 224 college students and a survey followed. The findings revealed that MosoTeach as the mobile learning application, improved college students' learning outcomes in terms of vocabulary& grammar scores, reading scores, and writing scores. Also, the survey with the 224 students revealed that system use together with student self-efficacy, behavior engagement, and social engagement positively influenced the learning outcomes. The aforementioned factors explained 80.0% of the variance in students' progress.

Results: Although the research result showed that cognitive engagement and affective engagement did not present a significant role in learning outcome improvement, students made progress with the use of MosoTeach. The result affirms that mobile learning application breeds an interactive learning environment, where students learn through both direct experience and observation.

Conclusion: Mobile Learning Application effectively improves college students' English as a Foreign Language performance.

Keywords: College students; English as a foreign language classroom; Learning outcomes; Mobile learning application; MosoTeach

Introduction

Mobile Learning Application seems to facilitate the learning process by allowing teachers and students to have more class interaction regardless of time and space, thus creating a broader field for the scope of learning(Chen et al., 2020; Karakaya & Bozkurt, 2022). With its use, mobile-assisted language learning (shortened as MALL) has been concluded to have typical and advantageous features of accessibility, continuity, flexibility, and adaptability (Kukulska-Hulme, 2009). For the learning environments of MALL, past studies stated that there were four common types, which included the mobile alone type, face-to-face + mobile type, distant learning + mobile type, or a combination of the previous three types —mobile devices, face-to-face, and distant learning(Duman et al., 2014). To narrow down the scope of the research, the study would focus on the face-to-face + mobile-type learning environment, because vocational college students mostly learn English through face-to-face classes. Additionally, to help students learn, this study integrated MosoTeach as a mobile application to test if this was effective in improving learning outcomes.

MosoTeach application used in this research is a popular teaching and learning management tool commonly used in China and it is currently the recommended application in some Chinese colleges. It has over 7 million registered users, 6.8 million of whom are students and 0.22 million are teachers (Zhu & Wang, 2020). It is a classroom interactive teaching application with four major functions, namely resource sharing, classroom interactive activities, performance record and formative evaluation, etc.

Chinese vocational college aims to cultivate applied skilled talents(Education, 2020). As the labor

market becomes more specialized and 21st-century globalization demands more skilled professionals who acquire more technical skills with a global vision, higher vocational education needs to shoulder the responsibility to cultivate college students with better language skills to communicate with the world (Lv et al., 2022).

Objectives

To help vocational college students develop better English learning outcomes, this research aims to explore whether the technology integration of mobile learning applications can effectively improve college students learning outcomes. In addition，the research tries to explore the psychological factors, which may potentially influence students' learning outcomes. Therefore, two research questions have been developed as follows and the literature review part explains why these dimensions were chosen.

1) What are the effects of MosoTeach application on English learning outcomes, in terms of vocabulary & grammar, reading, and writing?

2) How do system use, engagement, and self-efficacy influence learning outcomes in mobile-assisted language learning classes?

Literature review
Theories relating to the research

The integration of mobile applications in English as a Foreign Language (shortened as EFL) Class is guided by the approach of Constructivism, which was founded by Dewey(Dewey, 1930). In classroom settings, Constructivism maintains that learners actively construct new ideas or concepts based on both their previous and current knowledge. (Akour, 2010).

Developed from Constructivism, the Experiential learning model was created to explain learning as a process by David Kolb (Kolb, 1984). In his theory, learning is defined as the process whereby knowledge is created through the transformation of experience (Kolb, 1984). The learning process is composed of four circular procedures, namely concrete experience, reflective observation, abstract conceptualization, and active experimentation. This circular model enables learners to deepen their understanding and produce learning outcomes with engagement of experience in the learning process (Kolb, 1984). Similarly, EFL learning requires students to engage in the experience so that they learn with both mind and hand. Consequently, the purpose of using mobile learning applications is to propel students to take active learning experiences.

If Experiential Learning theory focuses on taking direct experience, then social cognitive theory focuses on indirect experience. The Social cognitive theory, also regarded as social learning theory, maintains that besides taking direct experience, learning also takes place by observing others (Bandura, 1982). In the Social Cognitive Theory, learning behavior is regulated by some factors. The primary factor among them is self-efficacy and this is concerned with people's belief to perform an action and attain a desired outcome(Bandura, 2012) Besides, other factors such as goals, outcome expectancy, and social-structural factors are also influencing learning behavior (Bandura, 2012). In a nutshell, the experiential learning model and social learning model focus on two kinds of learning: taking direct experience learning and observation learning respectively.

In the language learning domain, the output hypothesis by Swain (Swain, 2005) combined both direct experience learning, and observation learning. It maintains that successful second language learners (shortened as L2 learners) do not only need to have comprehensible input but also produce comprehensible output (Swain, 2005). It is not enough to get only input, but a process of output practice needs to be included in the EFL learning to propel students to shift from a passive learning mode to an active one, where EFL learners tend to have more interaction with the world and would have more self-efficacy in the learning process. Consequently, in an EFL class, students need to speak and write in English for language output, instead of being just passive listeners.

Mobile Assisted Language Learning improves the learning outcome.

Mobile Assisted Language Learning (MALL) is defined as the use of mobile technologies in language learning, especially in situations where device portability offers specific advantages (Duman et al., 2014). Past research indicated that mobile-assisted language learning was superior to non-technology-assisted instruction in linguistic aspects. Students' retention of vocabulary in the experimental group was enhanced with the adoption of mobile devices (Al-Ahdal & Alharbi, 2021). Students with full access to the mobile system score higher than those who do not in learning English grammar (Wang et al., 2021). With the use of mobile devices in EFL classes, students learned reading comprehension more efficiently than in conventional classes based on Meta-analysis findings (Li, 2022). WhatsApp application was described as a helpful tool for developing practical output abilities for speaking and writing (Saritepeci et al., 2019). Besides the linguistic improvement, there are other benefits brought by mobile devices such as increased class interaction, enhanced active learning (Han & Lu, 2020), and critical thinking skills (Chen & Hu, 2018). In general, a meta-analysis based on 80 past quasi-experiments revealed that the outcome of using mobile devices for language learning is more effective than traditional methods and produced a medium-to-high overall effect size of 0.722(Chen et al., 2020).

To sum up, mobile technology has been effectively used in language learning inside and outside of the classroom to improve students' test performance, participation, critical thinking, and cooperative learning. However, there is a research gap in how mobile applications work together with other physiological factors to improve the learning outcomes in EFL classrooms.

Psychological factors

Past bibliometric research shows that, whereas there has been a large amount of research around the linguistic factors in the MALL, non-linguistic elements have been mostly overlooked in the field (Karakaya & Bozkurt, 2022). Therefore, this current research adopted the experiential learning approach, which views student direct learning experience and action as a crucial part of learning and extracted the learner engagement dimension. In addition, this research also applied social cognitive theory, which maintains that observing others helps the learning process and self-efficacy derives from observation and thus extracted the self-efficacy dimension. As a result, the two educational psychological concepts which included engagement and self-efficacy were taken as the dimensions for data analysis.

Language engagement research has received increasing attention since Dörnyei and Kormos proposed that all instructed language learning should prioritize active learner engagement (Dörnyei & Kormos, 2000). Student engagement has also been defined as students' involvement and interest in learning, and how they relate to each other, the class, and the institution (Axelson & Flick, 2010). One of the most important features of engagement is action (Philp & Duchesne, 2016). In this sense engagement denotes how actively involved a student is in a learning activity (Handbook of Research on Student Engagement, 2012).

Engagement is a construct with multidimensional interpretations (Marks, 2016). Philp and Duchesne define engagement in language learning as a state of heightened attention and involvement, in which participation is reflected not only in the cognitive dimension, but in social, behavioral, and affective dimensions as well (Philp & Duchesne, 2016). Therefore, this research followed the four dimensions of engagement: cognitive engagement, behavioral engagement, affective engagement, and social engagement when doing their research (Liu et al., 2020; Wang et al., 2016). Students' cognitive engagement refers to students' mental effort in the process of learning (Hiver et al., 2020). Behavioral engagement refers to students' attention to class activities and attempts to participate (Isiaq & Jamil, 2018; Philp & Duchesne, 2016). Affective engagement reflects students' positive emotions toward participation in class activities, such as interest, satisfaction, self-confidence, and enjoyment (Lam et al., 2014). In a language learning setting, social engagement reflects the learner's active interaction with speakers of the society and the learning environment (Hiver et al., 2020).

Meaningful learning cannot take place without engagement. High learner engagement results in positive learning outcomes and without engagement meaningful learning is impossible (Hiver et al., 2020). This includes high levels of academic persistence, effects, and achievement (Chase et al., 2014); increasing academic aspiration and mental health (Archambault et al., 2009); and reduced dropout rates and misbehavior (Griffiths et al., 2012). Thus, educators today need to help students with engagement to make sure they learn with heart, mind, and actions (Hiver et al., 2020).

In Bandura's words, self-efficacy is concerned with people's beliefs in their capabilities to produce given attainment (Bandura, 2006). In comparison to competence, self-efficacy is concerned with a person's belief to do things and learn (Feng et al., 2023). Students with high self-efficacy show great effort in the face of difficulty, whereas learners with low self-efficacy avoid challenging barriers (Bandura & Adams, 1977).

Academic self-efficacy has been seen as an important factor influencing the learning outcome (Bandura et al., 2001). Students with high self-efficacy think their effort will produce good learning performance (Graham, 2022) and they have more motivation to take on challenging tasks, regardless of difficulty (Talsma et al., 2018). In second language learning (shortened as L2), some studies have proved a positive relation between self-efficacy to overall L2 achievement (Kyo, 2022). Moreover, the specific skills in L2 learning such as reading (Giladi et al., 2022), writing, listening (Shen & Bai, 2022), and speaking (Harris, 2022) have been confirmed to improve with increasing self-efficacy. Also, self-efficacy was confirmed to significantly predict learning behavior and test scores (Wang & Bai, 2017). Self-efficacy does not work alone but interacts with other factors, such as engagement to determine the L2 achievement (Cai & Xing, 2023)

Conceptual Framework

The conceptual framework as shown in Fig. 1 was based on the previous literature review. This was quantitative research with two stages. The first step was a quasi-experiment to test if the mobile device (MosoTeach application) had any effects on improving the learning outcome in EFL classes of college students. Pre-test and post-test with one treatment group were used. The study evaluated students' vocabulary & grammar scores, reading scores, and writing scores before and after the treatment was given. After the performance test, the scores from the pre-test and post-test were to be compared in each dimension to explore how much progress was made by students with the mobile device used in EFL class.

The second step was to use a survey to explore students' attitudes toward how the use of mobile devices together with other physiological factors affected their learning outcomes. Students were given questionnaires to reflect their attitudes towards mobile-assisted language learning. The Independent variable contained MosoTeach application use, cognitive engagement, behavior engagement, affective engagement, social engagement, and student self-efficacy, while the dependent variable was learning outcome, which indicated how the EFL learners made progress with the effects of MALL.
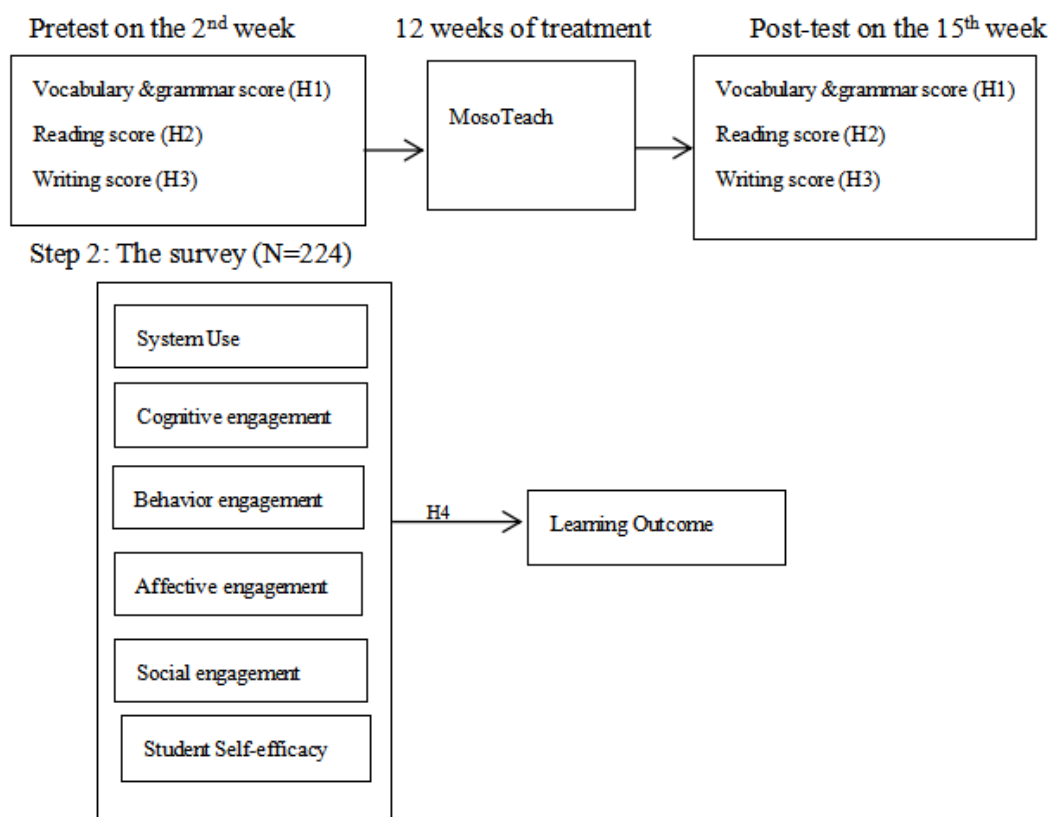
Figure 1 Conceptual framework

Methodology

Population and sample

In this research, the population was the non-English major college students who take EFL classes at the vocational and technical college. By the time they entered the vocational and technical college, they had been learning English for many years, so they were mostly intermediate learners of English, in that they had acquired the basic grammar and around 2,000 basic words after the college entrance exam ("College English Curriculum Standards for Higher Vocational Education," 2021).

The sample was 224 students from a vocational college in Chengdu City, Sichuan province, China. They were first-year or second-year non-English major students who took College English classes. The same instructor with EFL teaching experience of 12 years, taught all these 224 sample students during one semester. A purposive sampling strategy was used to select the sample students from the population as these sampled students matched the characteristics of the population. G-power application was adopted to calculate the required sample size for the paired sample T-test and multi-linear regression. The T-test showed the minimum required sample size was 54, while the linear regression with 6 predictors showed 98, which meant that the 224 sample size sufficiently confirmed to statistical power requirement.

The 224 students who participated in the study were told that their participation was voluntary and that they would remain anonymous. Verbal consent was obtained from the students and it was explained in the survey introduction that students might choose to participate. Therefore, those students who did not consent to participate in the research did not hand in their performance tests or surveys and 224 volunteer students agreed to participate by cooperating with the researchers. Also, the research got written permission from the Ethical Approval Committee of Chengdu Polytechnic with the code 22CZYR008. The data

collection period extended from February to June 2023 and the data collection involved the instruments of performance tests and surveys.

Treatment

According to the college curriculum, 3 weeks of classes are assigned to one unit and each week comprises 4 sessions of classes with each session lasting 45 minutes. To take a 90-minute reading class for example.

Before the class, complementary learning resource is uploaded to the MosoTeach application for students to make a preview. The resource includes relevant video clips, website articles, text recordings, glossary list recordings, and so on.

During the 90-minute class, the teacher starts with a roll call to check students' attendance with the application. Then he moves on to comment on the homework that students handed in on the MosoTeach application or invites students to give an oral report on the understanding of uploaded material on the MosoTeach application for a review.

To be followed, after presenting the lesson's objectives, the teachers invite students to have a global reading of the material and share their understanding of the reading while rewarding students with bonus points on the MosoTeach application. Based on the group division function of the application, students are assigned to different small groups with designated tasks for further discussion of the passage, such as summary and translation, so that each of the members contributes their ideas to the cooperative tasks. Later, two representatives from each group are to be elected to report their understanding of the designated part, while the teacher gives an oral comment and scores the group's performance on the application. This process of teamwork assisted with the MosoTeach application facilitates students' cooperative spirit and creates a class environment with more communication opportunities.

Finally, after the group work presentation, the teacher would prepare some post-reading comprehension questions in the form of multiple choice questions on the MosoTeach application to see how much students understand the article. As the questions are automatically corrected with the application and analysis of the score report is given instantly, the teacher can find out students' confusing points and give further explanations.

As for the homework, students need to prepare a team speech-making on the given topic of the unit, and the speech-making can be carried out in different forms such as formal group presentation with PowerPoint, TV interview, press conference, and so on. Students are obliged to arrange their roles in the team presentation, prepare the manuscript that they need to use for the speech-making, and hand in the group PowerPoint on the MosoTeach for the teacher's evaluation. Also, there is going to be a Q&A design on the MosoTeach application. If students find any remaining questions in their review, they may post questions in this session and invite peer answers on the application. If no one can answer that specific question, the teacher will explain the application.

Research instruments

Two research instruments i.e., performance test and questionnaire were utilized in this study. The vocabulary & grammar tests and reading tests were designed in the form of multiple-choice questions and the full score was 100 points respectively. Vocabulary and grammar were tested as a whole in this study because in most authoritative exams these two parts are put together in one part in the form of multiple-choice questions. The writing tests were automatically evaluated by the MosoTeach built-in function with a full score of 100. The performance test questions were all taken from the provincial undergraduate exam. This provincial undergraduate examination is designed by the Education Office of Sichuan Province every year to select college students for further study in undergraduate school for another 2 years, so it is an authoritative exam.

Questionnaires were also applied to collect quantitative data in this research to detect the relation between the variables. The 7 variables tested in the research included system use, cognitive engagement, behavior engagement, affective engagement, social engagement, self-efficacy, and learning outcome in the learning process. The 5-Level Likert scale was applied to collect samples' attitudes ranging from Strongly

Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, to Strongly Disagree = 1. The questionnaire items of each variable were adapted from authoritative resources of past research. The self-efficacy variable questionnaire scales were taken from the work by Pintrich (Pintrich, 1991), while the other 6 variable scales relied on the classical or recent research scales published in the Web of Science core collection database, namely system use (Ain et al., 2016; Davis, 1989; Ngai et al., 2007), cognitive engagement (Tirado-Morueta et al., 2019), behavior engagement (Tirado-Morueta et al., 2019), affective engagement (Tirado-Morueta et al., 2019), social engagement (Tirado-Morueta et al., 2019) and learning outcome (Dahleez et al., 2021).

The questionnaires were tested for content validity and reliability. This pilot survey was carried out before the quasi-experiment. For content validity, three experts in College English teaching were invited to evaluate the content validity of the question items with the IOC test. Only item 40 did not pass the IOC test and thus it was deleted from piloting. Consequently, the total number of the final version of the questionnaires was 45.

For the reliability test, 66 students with MosoTeach experience were invited to the piloting for internal consistency reliability, in which Cronbach's alpha was used. The question items with Cronbach's alpha value of more than 0.7 can be recognized as accepted items (George & Mallery, 2003). Table 1 shows the results of Cronbach's alpha of the questionnaire. The results of Cronbach's alpha value confirmed that all the constructs of the research were above 0.7 respectively, thus indicating good internal consistency reliability. The formal survey procedure was implemented at the end of the quasi-experiment and students took around 10 to 15 minutes to complete it in class.

Table 1 Results of Cronbach's Alpha of the questionnaire

Variable	Number of Items	Cronbach's Alpha
System use	5	0.882
Cognitive engagement	4	0.938
Behavior engagement	7	0.951
Affective engagement	3	0.943
Social engagement	4	0.937
Self-efficacy	8	0.965
Learning outcome	8	0.976

To make sure all students fully understand the survey questions, all the questionnaire items were translated into Chinese, and back translation was also offered to compare with the original English version for a check. The first translation was to be done by the researcher, who held a master's degree in Foreign Linguistics and Applied Linguistics. The back translation was done by her colleague, who specialized in Foreign Language Translation Studies with a master's degree.

Research analysis

Descriptive analysis was employed to illustrate the centrality and dispersion (Salkind, 1997; Weiss & Weiss, 2017) of the scores obtained from performance tests and questionnaires. The mean score, standard deviation as well as the maximum and minimum scores will be reported for the pre-test and post-test.

For inferential analysis, the paired sample T-test was used to compare the mean difference between the pre-test scores and the post-test scores in the three sub-dimensions forms to reflect student's progress after the treatment. Multiple Linear Regression was used to identify the relation between variables from the questionnaire. System use, cognitive engagement, behavior engagement, affective engagement, social engagement, and student self-efficacy were the independent variables, meanwhile learning outcome acted as the dependent variables.

Results

Demographic information

From Table 2, it can be seen that male students dominated the sample size, accounting for 68.8% of the total, and students studying engineering occupied 79.9% of the sample. Students from grade 1 and grade 2 were approximately evenly divided. The sample students also reported different years of English learning experience, 67.9% of the sample students stated that they learned English around 7 to 10 years, which meant that most of them started to learn English in the third grade of elementary school or the first grade of junior middle school.

Table 2 Demographic Information of the Sample Students

Variable	Category	Frequency	Percentage
Gender	Male	154	68.8%
	Female	70	31.2%
	Total	224	100%
Grade	Grade 1	107	47.8 %
	Grade 2	117	52.2 %
	Total	224	100%
Discipline area	Engineering	179	79.9%
	Liberal arts	45	20.1%
	Total	224	100%
Years of study for English (choose the closest number of years)	4 years	45	20.1%
	7 years	86	38.4%
	10 years	66	29.5%
	13 years	27	12.1%
	Total	224	100%

Performance test results

Table 3 presents three pairs of performance tests before and after the treatment. For the first pair, it showed that there was a significant difference between pre-test and post-test scores on vocabulary and grammar performance tests (t (223)=-12.07, p<0.05). Inspections of the two group means indicated that the average score of students' pre-tests on grammar& vocabulary (45.76) was significantly lower than the post-test scores (65.12). The difference between the means was -19.95 on a 100-point test.

For the second pair, it showed that pre-test scores on reading are significantly different from post-test scores (t (223) =-8.47, P<0.05). Comparison of the two group means showed that the average reading score of students' pre-tests (56.38) was significantly lower than its post-test score (73.13). The mean difference was -16.74 on a 100-point test.

For the third pair, the table showed that pre-test scores on writing were significantly lower than the post-test scores (t (223) =7.81, p<0.05). Observation of the two group means indicated that the average writing score of students' pre-tests (72.30) was significantly lower than its post-test score (80.11). The mean difference was -7.81 on a 100-point test.

Table 3 Difference in English learning performance (N=224)

Performance Test score	Pre-test		Post-test		MD	t(223)
	M	SD	M	SD		
Vocabulary & Grammar score	45.76	20.91	65.71	25.12	-19.95	-12.07*

Performance Test score	Pre-test		Post-test		MD	t(223)
	M	SD	M	SD		
Reading score	56.38	22.94	73.13	26.02	-16.74	-8.47*
Writing score	72.30	13.77	80.11	13.17	-7.81	-8.10*

Effects of system use, student engagement, and student self-efficacy on learning outcome

Multiple linear regression was conducted to determine the best linear combination of system use, self-efficacy, cognitive engagement, behavior engagement, affective engagement, and social engagement for predicting students' learning outcomes. Statistical assumptions, such as the normal distribution of residuals and the non-linear correlation between predicted variables and residuals were all met in the analysis as shown in Fig 2 scatter plot. The means, standard deviation, and correlation coefficients can be found in Table 4. The regression methods of "stepwise" showed that the combination of the four independent variables among six variables including self-efficacy, social engagement, system use, and behavior engagement significantly predicted students' learning outcomes ($F_{(4, 219)} = 128.718$, $p<0.05$), while the other two variables including social engagement and affective engagement' contributions were not significant, therefore not included in the stepwise analysis. The beta weights presented in Table 5 suggested that self-efficacy and social engagement contributed most to predicting learning outcomes, The R square value was 0.800, which indicated that 80.0% of the variance in students' learning outcomes was explained by the model. For multicollinearity diagnostics, the tolerance of each independent variable was above 0.204, which was the result of "1-adjusted R^2" (adjusted $R^2 =0.796$) and this showed that there was no multicollinearity among the independent variables. The standardized regression formulation was learning outcome=0.539* self-efficacy+0.221* social engagement+ 0.123* system use+ 0.105* behavior engagement.
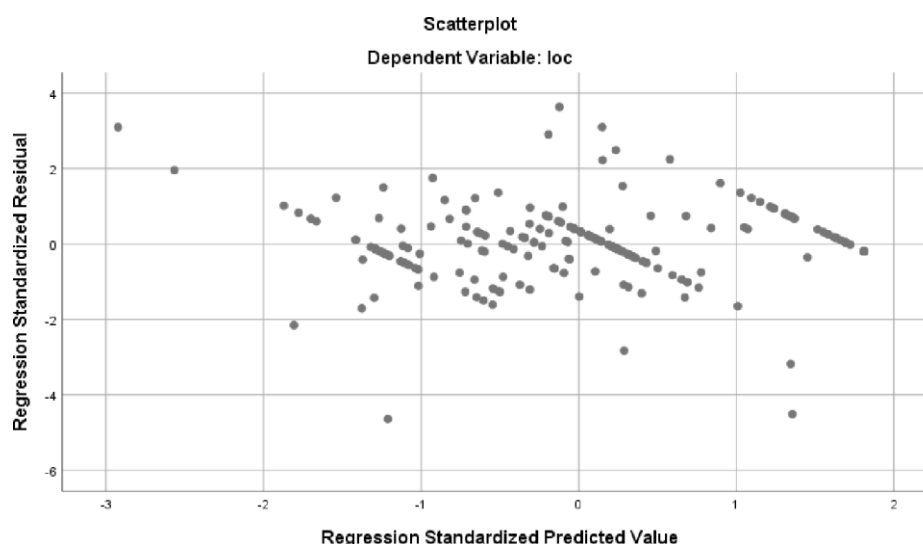

Figure 2 Scatter plot

Table 4 Descriptives and Correlation Coefficients of Variables (n=224)

	Variable	Descriptive s		Correlation Coefficients					
		M	SD	1	2	3	4	5	6
D V	Learning outcome	3.88	0.73	0.676*	0.863*	0.639*	0.742*	0.779*	0.784*
I V	1. System use	3.69	0.75	-	0.636*	0.677*	0.669*	0.668*	0.632*
	2. Self-	3.86	0.73		-	0.689*	0.738*	0.833*	0.763*

Variable	Descriptive s		Correlation Coefficients					
	M	**SD**	**1**	**2**	**3**	**4**	**5**	**6**
efficacy								
3. Cognitive Engagement	3.95	0.64			-	0.723*	0.675*	0.637*
4. Behavior Engagement	3.84	0.58				-	0.800*	0.708*
5. Affective Engagement	3.82	0.69					-	0.807*
6. Social Engagement	3.88	0.71						-

*p<0.05

Table 5 Multiple Linear Regression: Important Statistics (N=224)

	Variable	R	R^2	Adjusted R^2	F (4, 219)	Beta	T (217)	Tolerance	VIF
D V	Learning outcome	0.894	0.800	0.796	218.718*				
I V	Self-efficacy					0.539	10.248*	0.331	3.024
	Social Engagement					0.221	4.367*	0.358	2.792
	System Use					0.123	2.853*	0.490	2.042
	Behaviour Engagement					0.105	2.106*	0.364	2.744

*p<0.05

Discussion

Discussion on performance test results

Observation of the three pairs of pre-test and post-test showed that all three dimensions of scores increased significantly after 12 weeks of treatment, among them vocabulary &grammar scores showed the largest disparity before and after the treatment on a 100-point scale (MD=-19.95, p<0.05). This was because there were 15 question items on this part with each item accounting for 6.67 points, and thus students got an average of three more correct answers in this part. In the National College Entrance examination, multiple choice questions on vocabulary& grammar were not included, so students were less trained to focus on this type of exam. With some vocabulary and grammar exercises designed and integrated with the MosoTeach Application for students to practice, they made improvements quickly. These results correlated with the previous research which showed that mobile-assisted language learning helped students to learn vocabulary and enhance their memory and retention (Xodabande & Hashemi, 2022). Also, this result met with the past research on grammar which stated that there was a positive influence of mobile devices on EFL grammar learning(Wang et al., 2021).

Reading scores witnessed the second most increase after the intervention (MD=-16.74, P<0.05). As there were 10 multiple choice reading question items with each item scoring 10 points on a 100-point scale, students averagely made 1.5 more correct answers in their posttest. EFL reading ability has never been ignored in the educational system and always constitutes an important part of exams. The research result went in line with the past meta-analysis findings which showed that the overall effect size was significantly large for the effectiveness of Mall application adoption in EFL reading comprehension(Li, 2022).

Student writing scores also saw a significant increase after the treatment (MD=-7.81, P<0.05). The writing was assessed with the automatic evaluator with the MosoTeach application. Students were given the writing task to complete as homework during the treatment and provided with feedback by the

MosoTeach application for correction. This function increased students' flexibility in writing and reduced teachers' workload in correcting students' essays. Similar results had also been found in past research which stated that mobile devices improved students' writing outcomes (Chen & Hu, 2018; Saritepeci et al., 2019).

In a nutshell, student vocabulary & grammar scores, reading scores, and grammar scores have been proven to increase significantly before and after the treatment.

Discussion on survey results

In the multiple linear regression analysis, only 4 independent variables among the 6 entered the final regression equation. The standardized regression formula was learning outcome=0.539* self-efficacy+0.221* social engagement+ 0.123* system use+ 0.105* behavior engagement. The other two independent variables − cognitive engagement and affective engagement did not enter into the regression formula because their coefficients betas were not significant.

The results that cognitive engagement and affective engagement effects were not as strong as social engagement and behavior engagement aligned with the previous study which stated that students maintained a higher level of social and behavior engagement than cognitive and affective engagement(Yang & Hu, 2023).

Mobile devices may have their limitations in terms of cognitive engagement for helping students to improve because of the interruption of their other functions. As has been mentioned in the past literature, learners may be disturbed by the use of mobile devices in the process of learning(Hoi & Mu, 2021), such as phone calls or popup messages. Also, in the psychological aspects, learners usually prefer to use mobile devices for pleasure instead of instructional purposes(Hoi & Mu, 2021). So, this helps to explain the reason why the cognitive engagement variable did not show significant results.

The affective engagement variable also did not show a significant influence on the learning outcome. This may be caused by the fact that this college authority required that teachers try to use MosoTeach for all subjects taught, so students might feel a bit tired of using it again in EFL class.

For the significant predictors, self-efficacy had the greatest influence on learning outcomes with a coefficient Beta of 0.539. This research results were consistent with past research. As Bandura enunciated in his article learners with high self-efficacy showed great effort when confronting difficulty, whereas learners with low self-efficacy avoided challenging tasks (Bandura & Adams, 1977). So, if an EFL learner wants to improve his learning outcome, he needs to take on constantly challenging tasks and be confident in his learning process. Also, self-efficacy has been proven to be an important factor influencing the learning outcome (Bandura et al., 2001) by past research. In second language learning, some studies proved a positive relationship between self-efficacy and learning achievement (Kyo, 2022). Since students' self-efficacy is their belief in the capability to learn (Feng et al., 2023), teachers need to try to protect and help develop students' self-efficacy in the EFL teaching process.

The social engagement variable came to be the second most influential predictor in the regression equation with a coefficient Beta of 0.221. This result was in line with past research which stated that self-efficacy did not work alone but interacted with other factors such as engagement to influence the learning outcome(Cai & Xing, 2023). Also, past research proved that learner engagement determined the learning outcome and academic achievement of learners(Finn & Rock, 1997). Social engagement is an essential aspect of engagement in language learning (Philp & Duchesne, 2016) and classroom social interaction gives students a chance to make an output of English with their classmates. Through the various MALL class activities designed by teachers, students cooperate to complete a certain task and learn from each other. This alternative direct experience learning and observation learning process makes students learn through social interaction. Meanwhile, the speech or written output from students drives them to make more progress in learning outcomes.

The system use variable was the third influential dimension with a significant coefficient Beta of 0.123. The correlation coefficient between system use and learning outcome was 0.676, which signaled a medium-level correlation. This showed that the use of mobile applications did cooperate with other psychological factors to improve the learning outcome. Therefore, it was fair to say that system use of

MosoTeach assisted the language learning process to some extent and acted as a moderate predictor. This result was consistent with past meta-analysis based on 80 quasi-experiments which stated that there was a medium-to-high overall effect size of 0.772 on the mobile application effectiveness of language learning(Chen et al., 2020).

Behavior engagement was also a significant predictor for learning outcomes, with a coefficient Beta of 0.105. This can be explained by the fact that behavior engagement is closely associated with taking action such as speaking, making interactions, and class discussion (Yang & Hu, 2023) and that learning starts with taking direct experience (Kolb, 1984). So, if students actively participate in various class activities in the MALL environment, they start to make efforts to produce better learning outcomes.

On the whole, the system uses variables cooperated with psychological factors such as self-efficacy, social engagement, and behavior engagement to predict the learning outcome in mobile-assisted language learning.

Conclusion

Answers to research questions

To address the research questions 1: What are the effects of MosoTeach application on English learning outcomes, in terms of vocabulary & grammar, reading and writing? This research used the quasi-experiment to prove that MosoTeach could be integrated to motivate students to produce better English learning outcomes in the aspects of vocabulary& grammar, reading, and writing, which clearly showed the effectiveness of mobile-assisted language learning.

To address the research question 2： How do system use, engagement, and self-efficacy influence learning outcomes in MALL class? Multiple linear regression indicated that system use cooperated with psychological factors such as self-efficacy, social engagement, and behavior engagement to positively influence the learning outcome in Mall class, which could explain 80.4% of the variance. This learning outcome variable came from students' subjective evaluation of themselves, so from the survey, it could also be concluded that MosoTeach use helped to enhance the learning outcome. Meanwhile, the dominant role of the self-efficacy variable indicates that teachers need to create a good classroom atmosphere (Wang, 2023) to protect students' language learning confidence. Social engagement emphasizes the importance of interaction and communication. Behavior engagement gives empirical support to experiential learning theory.

Significance of the research

The research results can benefit teachers who Teach English as a Foreign Language (shortened as TEFL). Students learn better if they are more engaged in an interactive learning environment. The mobile application can play a part, in that it allows all students to produce a response directly to the teacher and it collects students' records of learning behavior.

The research results can directly benefit EFL learners who are currently in college. With the deepening globalization in China, young people need to consolidate their English skills for their career, so that they may have a broader vision and more opportunities for future development. With the use of mobile applications, they may learn English more effectively, while producing better learning outcomes.

Besides, the research also benefits college administrators and textbook designers. College administrators may keep track of teachers' class teaching with the MosoTeach application monitoring system, as every move of the class is recorded, with which they can better manage the school teaching staff and give teachers support or suggestions for improvement. For a textbook designer, if a mobile device works, they may add more digital resources such as tests, documents, video clips, and activities to the textbook to help build a multimedia platform for teachers and students in their ubiquitous learning. So, the two-dimensional textbooks evolve to be multi-dimensional ones and are used according to the aptitude of the EFL learners.

The research result offers empirical evidence for the classical theoretical framework of the experiential learning model and social cognitive theory. It reaffirms that mobile learning application breeds an interactive learning environment, where students learn through both direct experience and observation.

Also, the research verifies that mobile learning application effectively improves college students' English as a Foreign Language performance through objective performance tests and subjective self-evaluation in the survey. Therefore, triangulation is formed to consolidate MosoTeach's effectiveness in a mobile-assisted language learning environment.

Future direction

This research only focused on the population of vocational college students in the EFL learning subject. In the future mobile device applications can be applied and extended to students of different age groups or characteristics. Also, the mobile application usage from different subjects can be compared to see if there is some difference in its effectiveness.

References

Ain, N., Kaur, K., & Waheed, M. (2016). The influence of learning value on learning management system use: An extension of UTAUT2. *Information Development,* 32(5), 1306-1321.

Akour, H. (2010). *Determinants of mobile learning acceptance: an empirical investigation in higher education.* Oklahoma State University.

Al-Ahdal, A., & Alharbi, M. A. (2021). MALL in Collaborative Learning as a Vocabulary-Enhancing Tool for EFL Learners: A Study Across Two Universities in Saudi Arabia. *Sage Open*, 11(1), Article 2158244021999062. https://doi.org/10.1177/2158244021999062

Archambault, I., Janosz, M., Fallu, J. S., & Pagani, L. S. (2009). Student engagement and its relationship with early high school dropout. *Adolesc,* 32(3), 651-670. https://doi.org/10.1016/j.adolescence.2008.06.007

Axelson, R. D., & Flick, A. (2010). Defining student engagement. *Change: The magazine of higher learning,* 43(1), 38-43.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American psychologist*, 37(2), 122.

Bandura, A. (2006). Guide for constructing self-efficacy scales. *Self-efficacy beliefs of adolescents,* 5(1), 307-337.

Bandura, A. (2012). Cultivate self-efficacy for personal and organizational effectiveness. *Handbook of Principles of Organizational Behavior: Indispensable Knowledge for Evidence-Based Management,* 179-200.

Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive therapy research in Higher Education,* 1(4), 287-310.

Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development,* 72(1), 187-206. https://doi.org/10.1111/1467-8624.00273

Cai, Y. Y., & Xing, K. K. (2023). Examining the mediation of engagement between self-efficacy and language achievement. *Journal of Multilingual and Multicultural Development.* https://doi.org/10.1080/01434632.2023.2217801

Chase, P. A., Hilliard, L. J., Geldhof, G. J., Warren, D. J., & Lerner, R. M. (2014). Academic achievement in the high school years: the changing role of school engagement. *J Youth Adolesc,* 43(6), 884-896. https://doi.org/10.1007/s10964-013-0085-4

Chen, J. P., & Hu, J. (2018). Enhancing L2 Learners' Critical Thinking Skills Through a Connectivism-Based Intelligent Learning System. *International Journal of English Linguistics,* 8(6), 12-21. https://doi.org/10.5539/ijel.v8n6p12

Chen, Z. Z., Chen, W. C., Jia, J. Y., & An, H. L. (2020). The effects of using mobile devices on language learning: a meta-analysis. *Etr&D-Educational Technology Research and Development*, 68(4), 1769-1789. https://doi.org/10.1007/s11423-020-09801-5

College English Curriculum Standards for Higher Vocational Education. (2021). *English and Information Technology for Higher Vocational Education (2021 Edition.* Retrieved from: http://www.moe.gov.cn/srcsite/A07/moe_737/s3876_qt/202104/t20210409_525482.html

Dahleez, K. A., El-Saleh, A. A., Al Alawi, A. M., & Abdel Fattah, F. A. M. (2021). Student learning outcomes and online engagement in time of crisis: the role of e-learning system usability and teacher behavior. The International Journal of Information and Learning Technology, 38(5), 473-492. https://doi.org/10.1108/ijilt-04-2021-0057

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dewey, J. (1930). *Democracy and education: An introduction to the philosophy of education*. Macmillan New York.

Dörnyei, Z., & Kormos, J. (2000). The role of individual and social variables in oral task performance. *Language Teaching Research*, 4(3), 275-300.

Duman, G., Orhon, G., & Gedik, N. (2014). Research trends in mobile-assisted language learning from 2000 to 2012. *Recall,* 27(2), 197-216. https://doi.org/10.1017/s0958344014000287

Education, G. O. o. t. M. o. (2020). *Temporary Measures for the Naming of Colleges and Universities.* Retrieved from: http://www.moe.gov.cn/srcsite/A03/s7050/202008/t20200827_480729.html

Feng, L., He, L., & Ding, J. (2023). The Association between Perceived Teacher Support, Students' ICT Self-Efficacy, and Online English Academic Engagement in the Blended Learning Context. *Sustainability*, 15(8), Article 6839. https://doi.org/10.3390/su15086839

Finn, J. D., & Rock, D. A. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology,* 82(2), 221-234. https://doi.org/10.1037/0021-9010.82.2.221

George, D., & Mallery, M. (2003). *Using SPSS for Windows step by step*. A simple guide and reference.

Giladi, A., Koslowsky, M., & Davidovitch, N. (2022). Effort as a Mediator of the Relationship between English Learning Self-Efficacy and Reading Comprehension Performance in the EFL Field: A Longitudinal Study. *International Journal of Higher Education,* 11(1), 114-125.

Graham, S. (2022). Self-efficacy and language learning - what it is and what it isn't. *Language Learning Journal,* 50(2), 186-207. https://doi.org/10.1080/09571736.2022.2045679

Griffiths, A.-J., Lilles, E., Furlong, M. J., & Sidhwa, J. (2012). The relations of adolescent student engagement with troubling and high-risk behaviors. *In Handbook of research on student engagement (pp. 563-584).* Springer.

Han, L. F., & Lu, Z. B. (2020). Enhancing student participation in information literacy course based on Rain Classroom: a case study. *Library Hi Tech,* 38(3), 522-536. https://doi.org/10.1108/lht-08-2019-0155

Handbook of Research on Student Engagement. (2012). https://doi.org/10.1007/978-1-4614-2018-7

Harris, J. (2022). Measuring listening and speaking self-efficacy in EFL contexts: The development of the Communicative SE Questionnaire. *Language Teaching Research*, Article 13621688221091608. https://doi.org/10.1177/13621688221091608

Hiver, P., Al-Hoorie, A. H., & Mercer, S. (2020). *Student engagement in the language classroom (Vol. 11).* Multilingual Matters.

Hoi, V. N., & Mu, G. M. (2021). Perceived teacher support and students' acceptance of mobile-assisted language learning: Evidence from Vietnamese higher education context. *British Journal of Educational Technology*, 52(2), 879-898, Article e13044. https://doi.org/10.1111/bjet.13044

Isiaq, S. O., & Jamil, M. G. (2018). Enhancing student engagement through simulation in programming sessions. *The International Journal of Information and Learning Technology*, 35(2), 105-117. https://doi.org/10.1108/IJILT-09-2017-0091

Karakaya, K., & Bozkurt, A. (2022). Mobile-assisted language learning (MALL) research trends and patterns through bibliometric analysis: Empowering language learners through ubiquitous

educational technologies. *System,* 110, Article 102925. https://doi.org/10.1016/j.system.2022.102925

Kolb, D. (1984). *Experiential Learning: Experience As The Source Of Learning And Development (Vol. 1).* Englewood Cliffs, NJ: Prentice Hall.

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? *Recall,* 21(2), 157-165.

Kyo, O. Y. (2022). The growth trajectories of L2 self-efficacy and its effects on L2 learning: Using a curve-of-factors model. *Applied linguistics,* 43(1), 147-167. https://doi.org/10.1093/applin/amab005

Lam, S. F., Jimerson, S., Wong, B. P. H., Kikas, E., Shin, H., Veiga, F. H., . . . Zollneritsch, J. (2014). Understanding and Measuring Student Engagement in School: The Results of an International Study From 12 Countries. *School Psychology Quarterly*, 29(2), 213-232. https://doi.org/10.1037/spq0000057

Li, R. (2022). Effects of Mobile-Assisted Language Learning on EFL/ESL Reading Comprehension. *Educational Technology & Society,* 25(3), 15-29. <Go to ISI>://WOS:000835711200002

Liu, R., Wang, L., Lei, J., Wang, Q., & Ren, Y. (2020). Effects of an immersive virtual reality-based classroom on students' learning performance in science lessons. *British Journal of Educational Technology,* 51(6), 2034-2049. https://doi.org/10.1111/bjet.13028

Lv, S., Chen, C. M., Zheng, W., & Zhu, Y. J. (2022). The Relationship Between Study Engagement and Critical Thinking Among Higher Vocational College Students in China: A Longitudinal Study. *Psychology Research and Behavior Management,* 15, 2989-3002. https://doi.org/10.2147/prbm.S386780

Marks, H. M. (2016). Student Engagement in Instructional Activity: Patterns in the Elementary, Middle, and High School Years. *American Educational Research Journal*, 37(1), 153-184. https://doi.org/10.3102/00028312037001153

Ngai, E. W. T., Poon, J. K. L., & Chan, Y. H. C. (2007). An empirical examination of the adoption of WebCT using TAM. *Computers & Education,* 48(2), 250-267. https://doi.org/10.1016/j.compedu.2004.11.007

Philp, J., & Duchesne, S. (2016). Exploring Engagement in Tasks in the Language Classroom. *Annual Review of Applied Linguistics,* 36, 50-72. https://doi.org/10.1017/s0267190515000094

Pintrich, P. R. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).* Ann Arbor, MI: University of Michigan.

Salkind, N. J. (1997). *Exploring research.* Pearson Educación.

Saritepeci, M., Duran, A., & Ermiş, U. F. (2019). A new trend in preparing for foreign language exam (YDS) in Turkey: Case of WhatsApp in mobile learning. *Education Information Technologies,* 24, 2677-2699.

Shen, B., & Bai, B. (2022). Chinese university students' self-regulated writing strategy use and EFL writing performance: influences of self-efficacy, gender, and major. *Applied Linguistics Review.* https://doi.org/10.1515/applirev-2020-0103

Swain, M. (2005). The output hypothesis: Theory and research. *In Handbook of Research in Second Language Teaching and Learning (pp. 471-483).* Routledge.

Talsma, K., Schuz, B., Schwarzer, R., & Norris, K. (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences,* 61, 136-150. https://doi.org/10.1016/j.lindif.2017.11.015

Tirado-Morueta, R., Berlanga-Fernández, I., Vales-Villamarín, H., Guzmán Franco, M. D., Duarte-Hueros, A., & Aguaded-Gómez, J. I. (2019). Study of a sequence to stimulate engagement in one-to-one iPad programs at elementary schools. *Education and Information Technologies,* 25(1), 509-532. https://doi.org/10.1007/s10639-019-09974-4

Wang, C., & Bai, B. (2017). Validating the instruments to measure ESL/EFL learners' self-efficacy beliefs and self-regulated learning strategies. *TESOL Quarterly,* 51(4), 931-947.

Wang, M.-T., Fredricks, J. A., Ye, F., Hofkens, T. L., & Linn, J. S. (2016). The math and science engagement scales: Scale development, validation, and psychometric properties. *Learning Instruction,* 43, 16-26.

Wang, X., Chen, J., & Zhang, T. (2021). Facilitating English Grammar Learning by a Personalized Mobile-Assisted System With a Self-Regulated Learning Mechanism. *Front Psychol,* 12, 624430. https://doi.org/10.3389/fpsyg.2021.624430

Wang, Z. (2023). Psychological factors and production behaviors of Chinese undergraduate EFL learners. *Plos One,* 18(7), e0288014, Article e0288014. https://doi.org/10.1371/journal.pone.0288014

Weiss, N. A., & Weiss, C. A. (2017). *Introductory statistics.* Pearson London.

Xodabande, I., & Hashemi, M. R. (2022). Learning English with electronic textbooks on mobile devices: Impacts on university students' vocabulary development. *Education and Information Technologies.* https://doi.org/10.1007/s10639-022-11230-1

Yang, X. M., & Hu, J. (2023). Chinese college students' preferences for mobile-assisted language learning classes and their effects on student engagement in English language classrooms. *Innovation in Language Learning and Teaching.* https://doi.org/10.1080/17501229.2023.2207564

Zhu, Q. L., & Wang, M. J. (2020). Team-based mobile learning supported by an intelligent system: A case study of STEM students. Interactive Learning Environments, 28(5), 543-559. https://doi.org/10.1080/10494820.2019.1696838