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English Vocabulary with a Picture Application for Enhancing Thai EFL Students' Daily English Vocabulary Memorization

DANUCHAWAT SUWANASILP
Faculty of Humanities and Social Sciences, Rajamangala University of Technology Tawan-ok, Thailand
NUNPAPORN DURONGBHANDHU*
Faculty of Humanities and Social Sciences, Rajamangala University of Technology Tawan-ok, Thailand
Corresponding author email: nunppd@gmail.com

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Abstract

With the emergence of new technology, computers have been used for language learning. This experimental study aimed to develop English Vocabulary with a Picture Application (EVP) for improving students' daily English vocabulary memorization and examine the effectiveness of EVP used between an experimental group and a control group. EVP was designed on picture mnemonic technique based on a cognitive theory of multimedia learning. The participants were 48 undergraduate students who were randomly assigned to the experimental and the control group. Prior to the intervention, the participants of both groups were given a pre-test to determine their daily English vocabulary knowledge. Then, the experimental group received EVP, and the control group went through a traditional method. After the treatment, the post-test was administrated to both groups. The results manifested that the experimental group who received EVP noticeably outperformed their counterpart in the post-test. The participants also provided positive opinions regarding the use of EVP. In consequence, the findings implied that EVP could be an optional learning tool to enhance students' daily English vocabulary. Further study could investigate the achievement of EVP in teaching vocabulary for different purposes in various contexts.

INTRODUCTION

Vocabulary is deemed the most fundamental element of any language, and it is essential for foreign and second language (FL/L2) students to acquire for language mastery. Linguists and scholars in the field of FL/L2 acquisition assert that lexical competence, known as "vocabulary knowledge," plays a crucial role in FL/L2 learning because it is important to have a good memory to learn and retain words in the memory in order to help the FL/L2 learner achieve their communicative competence (Lewis, 2005; Nation, 2001; Schmitt, 2000). Vocabulary and lexical units are core components of language proficiency and they provide the foundation for how well learners speak, listen, read, and write (Johnson et al., 2016). Fittingly, the prominent quote proposed by Wilkins (1972, p. 111) states that "without grammar, very little can be conveyed, without vocabulary, nothing can be conveyed". Vocabulary shapes the largest array of any

language's meaning, and it seems to be the biggest problem for most students (Nation, 2001). The sufficiency of vocabulary knowledge enables the students to communicate with one another more freely and effectively. The FL/L2 student is required to know at least 3,000 words of FL/L2 vocabulary in order to have a basic conversation (Schmitt & Schmitt, 2014), approximately the most frequent 5,000-word families to watch movies (Webb & Rodgers, 2009) and the most frequent 9,000-word families to be able to read authentic texts such as newspaper and novels (Nation, 2006). However, acquiring vocabulary and gaining an adequate vocabulary size has become a struggle for EFL/ESL students due to several reasons such as learning disabilities, lack of memorization techniques, lack of self-confidence, and lack of target language exposure (Yunus et al., 2016).

One of the factors that hinder EFL/ESL students' vocabulary learning achievement is word memorization. Many students are tired of learning unfamiliar words because they are required to memorize the words, have word spelling, and inevitably do vocabulary exercises (Yip & Kwan, 2006). Moreover, some of them are unable to memorize the learned words after they have done all these required activities. In order to attain vocabulary knowledge, it is important to have a good memory to learn and retain the words in the memory. Memory strategy is one of the most effective tools in the vocabulary learning process. There are several ways to improve the function of memory. Mnemonic techniques are guided in the field of language learning as a device to memorize vocabulary (Akpan et al., 2021; Raugh & Atkinson, 1975). Mnemonic techniques help learners to learn faster, remember better, and retrieve memorized information easier (Amiryousefi & Ketabi, 2011; Hill, 2022; Oxford, 1990; Paivio & Desrochers, 1981; Searleman & Hermann, 1994; Thompson, 1987).

Mnemonics can be variously categorized; however, one of the interesting mnemonic techniques is a visual mnemonic which includes pictures and imagery. This technique helps students not only memorize the words but also retain and recall them effectively (Amiryousefi & Ketabi, 2011). The phrase "a picture is worth a thousand words" is well-known, and suggests that human memory capacity is greater for pictures than for words (Kobayashi, 1986), and pictures provide more information than words during the memory coding processes (Mayer & Sims, 1994). Therefore, it is believed that a picture could make it easier for learners to remember than a text alone. Importantly, a picture helps activate the cognitive process of the student's brain, so it will really motivate students to achieve vocabulary retention (Baxriddinova et al., 2020).

Beyond mnemonics, technology can also improve learners' memory. From the recent study of brain exercise's success, technology has the potential to gradually improve learners' overall memory and it can help learners become more engaged in what they have studied (Alfadil, 2020; Debabi & Bensebaa, 2016; Ely et al., 2014; Krokos, 2019) Over decades, technology has been broadly used in diverse educational contexts including FL/L2 teaching and learning. Nowadays, the proliferating use of computer-based devices and smartphones has become a part of our daily lives. These devices are equipped with an innovative, friendly multimedia design which makes them worthwhile to us as effective tools for our educational needs. As a result, since computer-assisted language learning (CALL) was initially commenced in 1960, the use of CALL has been gradually used for various educational purposes (Mohsen & Mahdi,

2021). CALL is the process of using a computer in learning which improves language proficiency of the learners (Beatty, 2013). This led to the widespread of multimedia, the internet, and various forms of remote learning used in the classroom. Through the use of multimedia, hypermedia, such as the internet, language application, and practice programs, students can partake in customized instruction designed to meet their specific needs and take part in cooperative projects that support communication with peers in their classroom or even in the global community (Hariyono, 2020; Wang, 2017). With the advantage of multimedia learning mentioned earlier, many language instructors are creative to encourage students to practice their language skills by using CALL (Philip et al., 2019). Similarly, a large number of students are familiar with the use of multimedia to improve their learning with a variety of CALL software. Several pieces of CALL software have been created and provided to use as supplemental materials or alternatives in the classroom.

For the reasons outlined above, the use of visual mnemonic techniques through CALL supports students' vocabulary acquisition. Consequently, the purpose of this study was to develop EVP based on the picture mnemonic technique and the generative theory of multimedia learning as computer-assisted vocabulary learning material and examine the effectiveness of EVP used in the classroom. This EVP may help students enhance their word memorization in vocabulary learning and encourage them to have a positive attitude toward vocabulary acquisition.

LITERATURE REVIEW

In this section, vocabulary teaching and learning which focuses on the principles of teaching vocabulary, and its teaching approaches, a vocabulary memorization strategy with mnemonic devices (visual mnemonic technique based on Mayer's cognitive theory of learning in a multimedia environment) and using technology in teaching vocabulary including previous studies of vocabulary acquisition with mnemonic instruction through multimedia learning aids were reviewed (Mayer, 2009; Thompson, 1987).

1. Approaches to vocabulary teaching

Teaching vocabulary is a challenging task for most teachers. The teacher should apply the appropriate ways to keep words in the learner's long-term memory and help them to understand types of words, from idioms to expressions (Kayaaltı, 2018). The teacher needs to facilitate the learner to use the memorized words in their communication fluently and accurately via various settings with the appropriate approaches. Implicit and explicit vocabulary teaching instruction may be taken into the prior teacher's consideration while the appropriate vocabulary teaching approach was being sought (Dakhi & Fitria, 2019). Implicit vocabulary teaching refers to the teaching process in which learners learn the language indirectly, unconsciously, and contextually. On the contrary, explicit teaching is a conscious process of vocabulary mastery. It tends to be accomplished by cognitive strategies, note-taking, a dictionary, and other learning methods, such as the mnemonic and semantic methods (Alfadil, 2020; Debabi, 2016; Ely et al., 2014).

There have been many vocabulary teaching strategies proposed by worldwide linguists from the past to the present, and a number of vocabulary learning strategies have been investigated, such as guessing from context (Alqahtani, 2015), rote repetition (Singer et al., 2013), using mnemonics keyword method (Siriganjanavong, 2013), including other techniques used such as teaching vocabulary using objects (Takač & Singleton, 2008), using drilling, spelling and active involvement (Thorbury, 2002), and using gestures and pictures (Andrä et al., 2020). Although there are many techniques to teach vocabulary as mentioned earlier, another effective technique used to increase learners' vocabulary memorization is the mnemonic technique. It is used to assist students in keeping learned words in their long-term memory, which has an unlimited capacity compared to short-term memory (Kayaaltı, 2018), so the mnemonic technique was emphasized, and given in detail in the next subsection.

2. Mnemonic method and cognitive theory of multimedia learning

2.1 A vocabulary memorization strategy with mnemonic devices

The aim of vocabulary teaching is to have students keep the learned lexical information in short-term memory and transform them into long-term memory (Farrokh et al., 2021). Mnemonics are memory techniques or devices, either verbal or visual in nature, that serve to improve the storage of new information, and the recall of information contained in memory (Amiryousefi & Ketabi, 2011; Solso, 1995). Various benefits of using a mnemonic technique were provided by many scholars. For example, mnemonic instruction is one way that teachers can help students learn to retain information, and it could be effective for students facing difficulty in remembering the information taught. Moreover, mnemonic devices are proven to be effective for all ages (Levin, 1993; Wright, 1989).

Mnemonic techniques have been differently classified by many researchers in the education field. For instance, Bellezza (1981) divides it into two categories: organizational and encoding mnemonics. Oxford (1990) proposes four strategies including creating mental linkage, applying images and sounds, reviewing well, and employing action. Likewise, mnemonic tools are categorized into two types: visual imagery strategies and verbal strategies raised by Baddeley (1999). The most comprehensive type of mnemonics seems to be Thompson's classification (Thompson, 1987). Five primary parts included linguistic mnemonics, spatial mnemonics, visual mnemonics, the verbal method, and physical response method.

Although there are many kinds of mnemonic methods explained above, the one that has been widely used to teach vocabulary for a long period of time is the visual mnemonic method. Visual mnemonics are mnemonics that work by associating an image with characters or objects whose name sounds like the item to be memorized. The visual mnemonics cover both pictures (visual images) and visualization (visual imagery). For a picture, new words are associated with proper pictures (Thompson, 1987). The pictures can activate inter-hemispheric communication and enhance vocabulary retention. If new words are boosted with relevant pictures, they will be processed in the long-term coding (Sert, 2006).

However, the use of pictorial forms in vocabulary must be limited because of the inability to express the intricate meaning clearly. To put it another way, pictures may be vague when used with abstract words. Therefore, visualization which is the way for acquiring new words through a picture or scene in one's imagination can be an aid in vocabulary learning, especially, learning abstract words. An abstract word is metaphorically conceptualized through a more concrete word (Lakeoff & Johnson, 1980). If an intangible meaning of a word needs to be taught through a picture of a tangible object, it should be a metaphorically related object (Oxford & Crookall, 1990). For example, the intangible word "cooperation" could be pictured as a physical act (e.g. two people lift a table). Although the picture is not a strong visual presentation of the referent word, a picture can help the student understand intangible words, as shown by Chapelle (2003).

The basic theory of the visual mnemonic techniques is that memorization of an L2 word can be facilitated by visual links which help encode and decode data from the word presentation (picture/text) into a sensory store (or sensory memory) via eyes. Later, it will be transferred to the short-term memory store (or working memory) before being loaded into the long-term memory which is all the process of cognitive activity (Baddeley et al., 2009). A key effect of vocabulary learning is memory. In order to establish visual mnemonics, the cognitive theory of multimedia learning can be used to explain about retention.

2.2 Cognitive theory of multimedia learning

When multimedia learning is emphasized for FL/L2 pedagogy, the Cognitive Theory of Multimedia Learning (CTML) is frequently used to describe the benefits of a multimedia learning setting. A theoretical concept of CTML (Mayer, 2009) must be grounded in three main assumptions; the dual channels, limited capacity, and active learning processing. First, the dual channels assumption was originally introduced by the Dual Coding Theory (Paivio, 1986). There are two separate channels to process visual and verbal information. Two channels work separately to create each their own presentation. The visual channel processes information through pictures' presentation by the eyes, and the verbal channel processes the information through spoken words' presentation via the ears. This dual-mode presentation can help the learner increase their working memory capacity effectively.

The second assumption is the limited capacity which is based on the Cognitive Load Theory (Chandler & Sweller, 1991). This theory is aligned with the working memory model proposed by Baddeley and Hitch (1974). Incoming data received in auditory and visual channels, with auditory information processed in the phonological loop and visual information processed in the visuo-spatial sketchpad, were first kept in the working memory which has a limited capacity, and then they were transferred to the long-term memory. The limited capacity of working memory curbs the amount of information the learner can encounter at once. The overwhelming cognitive load brings about an impediment to learning. To avoid the heavy cognitive load, learning conditions should be in line with human cognitive structure and dual-mode presentation (Sweller, 1988). In that, new information was concisely provided in order not to overwhelm the learner.

The last assumption is active learning processing which emphasizes the whole information processing from the first stage (at the multimedia presentation/sensory memory) to the last stage (at the long-term memory). A meaningful learning process takes place when a learner is involved in learning conditions that include three processes as follows: (1) reducing extraneous processing (sensory memory) by the selection of relevant words/images for processing in verbal and visual working memory, (2) managing essential processing (working memory) by the organization of select words/images into a verbal/visual modal, and (3) fostering generative processing (the combination between working memory and long term memory) by integrating both visual/pictorial and auditory/verbal information between new incoming information and existing knowledge in language learning (Mayer, 2008). It is affirmed by various studies (Harter & Ku, 2008; Yoshii & Flaitz, 2002) that the simultaneously-presented pictures and words help the learner to relate the two representations mentally because they are both stored in working memory and decrease the learner's cognitive load.

3. Empirical studies of vocabulary acquisition through multimedia learning aids

Due to the advent of technology, the widespread use of multimedia in teaching and learning vocabulary has increased (Ma, 2017). The role of EFL/ESL teaching with technology was provided that technology acts as a tutor or tool (both teaching and learning tools) (Levy, 2009). To elaborate, technology assuming the role of a tutor which is similar to a teacher can guide the learner to achieve their academic purpose by boosting learners' learning process with their positive learning attitude (Kühl & Wohninsland, 2022). With the popularity of technology, an umbrella term of pedagogy of technology integration in language teaching and learning is commonly known as CALL (computer-assisted language learning) and MALL (mobile-assisted language learning). MALL refers to mobile phones, media players, and tablet computers (Duman et al., 2015). A plethora of studies which have been dedicated to how CALL and MALL can facilitate learners' vocabulary knowledge in both EFL and ESL settings were examined by many scholars (Fageeh, 2013; Yang et al., 2021). The majority of findings show a positive result and great potential for teaching/learning English vocabulary with CALL and MALL. Finally, it is undoubted that using computers and different types of technological aids affects the learner's behavior in a positive way, and it may give the learner the opportunity to keep in touch with the real world. Furthermore, the learner must be motivated by any kind of technological aid; they might be active, eager, and involved in classes due to their interest in the technology used.

As reviewed above, the English vocabulary learning application designed by the integration of visual mnemonic devices, especially picture presentation with multimedia learning has not been comprehensively studied. Moreover, little research has explored the effectiveness of English vocabulary learning through technological aids, especially, the implementation of vocabulary learning applications which are particularly adopted by the integration between multimedia learning and visual mnemonic instruction in a Thai environment. With the aim of filling the gap mentioned earlier and shedding more light on this area. This study attempted to address the following questions:

1) Does English Vocabulary with a Picture Application (EVP) improve learners' vocabulary achievement?
2) What are the learner' attitudes toward EVP used in their vocabulary acquisition?

METHODOLOGY

1. Research design

The research was a quasi-experimental study designed by a randomized pre-test and post-test control group design (McMillan & Schumacher, 2010) with 2 intact groups: a control group and an experimental group. The independent variable of the study was EVP, and dependent variable was the students' ability in daily vocabulary memorization.

2. Participants

The subjects of this study comprised 48 Thai undergraduate students at Rajamangala University of Technology Tawan-ok. These participants, who were all studying in majors outside of the English major program, enrolled in a general English course in the second semester of the 2021 academic year. They were all native speakers of Thai, and they were homogeneous in terms of English learning experiences with the same number of years they had been exposed to EFL instruction. None of them had lived in an English-speaking country prior to conducting the study. Their English proficiency level was low-intermediate, a score ranging from 21-40, according to Ordinary National Educational Test (Thai standardized test for university admission). These subjects were selected through Simple Random Sampling. Two intact classes were randomly assigned to the control and the experimental group, with 24 students serving as the control group and 24 students as the experimental group (EVP). The characteristics of participants are presented in Table 1

Table 1

Demographical summary of the participants

Demographic aspects	*EVP group (n = 24)*		*Control group (n = 24)*		*Total (n = 48)*	
	N	%	N	%	N	%
Gender						
Male	3	12.50	5	20.83	8	16.67
Female	21	87.50	19	79.17	40	83.33
Total	24	100.00	24	100.00	48	100.00
Age						
18	3	12.50	5	20.83	8	16.67
19	19	79.17	14	58.34	33	68.75
20	2	8.33	5	20.83	7	14.58
Total	24	100.00	24	100.00	48	100.00

As shown in Table 1, there were twenty-four participants in EVP group: three males (12.50%) and twenty-one females (87.50%) while the participants in the control group included five males (20.83%) and nineteen females (79.17%).

Research participants were recruited on voluntary basis through an announcement. The recruiting process began after the researchers received approval from the ethical review board of the researchers' home institution. Participants were informed about the important details of the research including the overview, objectives and data collection methods before signing a consent form.

3. Research instruments

The main instruments included EVP, the daily English vocabulary pre-and post-test, and a questionnaire of students 'opinions toward learning vocabulary with EVP.

3.1 EVP application

EVP application used in this study was developed and designed systematically using the ADDIE model comprising 5 steps; analysis, design, development, implementation, and evaluation (McGriff, 2000). There were two phases involved in conducting the research. The two phases were explained in detail as follows.

Phase 1: Development process of the application (Analysis, Design, and Development)

This phase emphasized the gathering of the relevant information required for developing EVP. At this point, three major steps were taken. First, related theoretical concepts of memory in language learning (Thompson, 1987) and multimedia learning (Mayer, 2009) were investigated. Activities employed for practicing daily English vocabulary memorization in the application were developed with the combination of mnemonic techniques for language learning and vocabulary learning strategy with pictures (Wright, 1989).

This step aimed to obtain beneficial information to design an effective application for vocabulary learning. Second, daily English vocabulary suitable for EFL undergraduate students were selected from a list of 3,000 daily English vocabulary from EF Education First, an international educational organization that combines language training with cultural exchange, academic achievement, and educational travel (EF Education First, 2020). The total vocabulary items were chosen from only three types of content words (i.e., common nouns, verbs, and adjectives), and a total of 2,832 words were obtained. The target words used for application design were selected by the word selection method by twenty EFL undergraduate students who were not a study group. In other words, twenty undergraduate students were asked to select and underline the vocabulary items of which the meanings were unknown without time constraints from 2,832 words, and eventually, a total of 138 vocabulary items were obtained. Then, the 138 words were used to design needs analysis questionnaires in the development of a vocabulary learning strategy that promotes the student's English vocabulary memorization. Needs analysis was initiated to survey students' English vocabulary learning styles and undergraduate students were required to complete the questionnaire. The questionnaire included two main topics which were 1) selecting the unknown English vocabulary items which were used as Target Words in the program, and 2) surveying the students' interest in vocabulary learning such as using objects, drawing objects, using illustrations and pictures, guessing from context, and

translation (Elmahdi & Hezam, 2020). Consequently, 70 words out of 138 target words were chosen by the students' interest, so only 70 target words were used, and they were assessed for word appropriateness by three English language experts before EVP application design. The vocabulary learning that was the most interesting to the students was those using illustrations and pictures.

For each target word's picture and meaning shown on the application screen, the researchers provided pictures and the Thai meanings of the words to be used as target words in EVP application by selecting a picture chosen by a group of twenty undergraduate students. In other words, 20 undergraduate students who were not an actual study group were asked to select a picture that was considered to be the most appropriate picture associated with the target word's meaning. Last, the application was designed by setting ten activities for the student's self-learning. EVP application's screen details, such as instructions, a word presentation, and exercises' practice with time duration, were created by PHP, HTML, CSS, and PHP Myadmin.

EVP application includes ten activities with a 50-minute time duration of practice per activity. Seventy target words are displayed in the application with seven words per activity. The creation of word presentation shown in EVP application is adopted from the memory of language learning concept (Thompson, 1987). Each target word includes three slides: 1) the English target word, 2) the pictorial presentation meaning with its pronunciation, synonym, and example sentence in English with L1 meaning, and 3) example of word collocation. The participants were mainly informed to focus the L1 meaning of the target word with its picture in order to remember the L1 meaning of the target word. The rest of the target word information is optional if the participants need to practice. A forty-minute supplementary exercise provided at the end of each activity is composed of a *Quiz Game*, given to the student for guessing a word's meaning via a picture, and a *Timer Game*, provided for the student to find the meaning of a word with time count (See Appendix A and B for web application screen).

Phase 2: Application's implementation (Implementation and Evaluation)

Before actual implementation, EVP was assessed by the content validity index (CVI) which was not less than 0.80 (Di Iorio, 2005). The total CVI rated by 6 experts of this study was 0.94 which was reliable enough to be employed. The trial version of EVP was made as a pilot study with a sample group of twenty-five EFL undergraduate students. Then, EVP was implemented in the experimental group to evaluate the effectiveness of the application.

3.2 Daily English vocabulary pre and post-test

3.2.1 Pre-test

The daily English vocabulary pre-test required participants to choose the appropriate words in an English sentence, with four choices for each question and a total of seventy questions. The target words were the vocabulary items to be learned with EVP from activities 1-10. For construct test validity, the test items were sent to three English language experts to evaluate the appropriateness of CVI, which must not be less than 0.80 (Di Iorio, 2005). The CVI of pre-test was 0.94 which showed the appropriate standard to employ.

3.2.2 Post-test

To measure participants' vocabulary memorization gains achieved through EVP, the daily English vocabulary post-test consisted of the same 70 target words measured in the pre-test. However, the order of these 70 words was made different from that which was displayed in the pre-test to prevent the participants from remembering the test that they had taken before.

3.2.3 Questionnaire

A questionnaire was designed to investigate participants' opinions toward EVP used for enhancing students' daily English vocabulary memorization. The questionnaire comprised eight items that were ranked in accordance with a 5-point Likert Scale from 1 (Strongly disagree) to 5 (Strongly agree). Items in the questionnaire were either created or revised from the study of Questionnaire Design and Research in Education (Best, 1981). The questionnaire was checked for the acceptable internal reliability using Cronbach's Alpha Coefficient (Best, 1981) which showed Cronbach's α: Presence ($\alpha = 0.97$). Items in questionnaires were assessed through content validity testing with the IOC index at 0.87. The mean range of scale was interpreted and the results for these items were calculated using descriptive statistics to determine the strongest opinions that the students have toward vocabulary learning with EVP.

4. Procedures

At the beginning of the study, forty-eight participants were two intact groups that were equally and randomly divided into one control group and one experimental group. Afterward, participants were given the daily English vocabulary pre-test to ensure their homogeneity regarding their daily vocabulary knowledge before intervention. During the treatment period, EVP was used in the experimental group, and none of the programs were used in the control group. EVP was employed during the first semester in August 2021 as shown in the detail of the application's instruction. The participants in the control group did not have experience working with EVP. Instead, they were taught vocabulary through a traditional method used in many Thai schools for teaching English to students. The vocabulary was taught by a teacher, and participants had time to memorize the words and write them down on the paper. The teacher then repeated the words and encouraged them to visualize the words and meaning. At the end of the class, the participants were given dictation practice.

Upon the completion of the treatment, the daily English vocabulary post-test was given to both the control group and the experimental group without prior notice to find out how their vocabulary memorization ability has improved after being treated by EVP and if there was any difference between the vocabulary memorization competence of the two groups. The post-test was taken by both groups for 30 minutes. At the end of the study, a total of twenty-four questionnaires were distributed to participants in the experimental group. Each recipient of the questionnaire was asked to select answers corresponding with their feelings towards EVP. All replies were received, and the information was scored to examine the EFL undergraduate students' vocabulary learning opinion toward EVP.

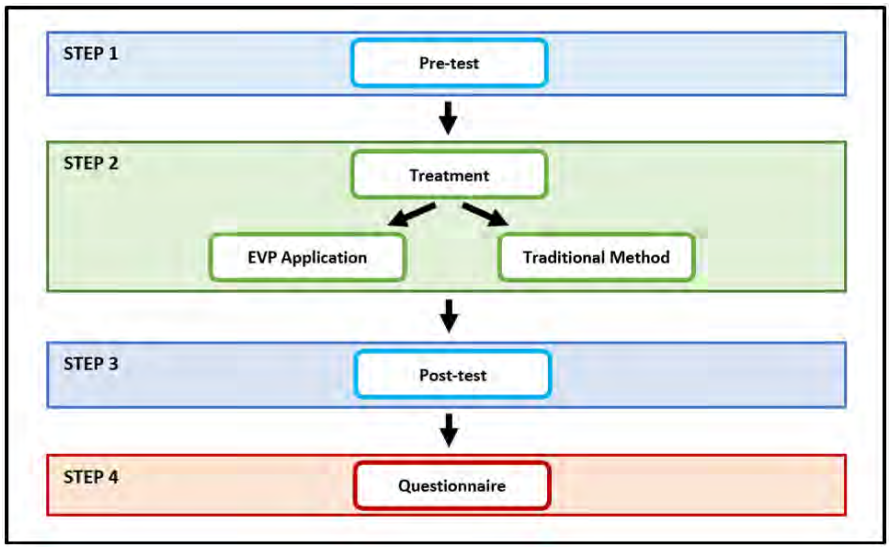

Figure 2 Procedures

5. Data analysis

In order to answer the research questions, SPSS software (Version 23) was used to analyze the collected data. To answer the first research question, the learners' ability in daily English vocabulary memorization was measured by means of the multiple-choice daily English vocabulary pre-and post-tests, which were scored 1 point for a correct answer, and 0 points for an incorrect answer. A paired-sample t-test was used to analyze the pre-test and post-test's scores in each group to distinguish any significant differences between the means of the pre-test and post-test's scores. For the second research question's answer, descriptive statistics including mean and standard deviation were conducted for the analysis of the EFL undergraduate students' opinions toward EVP via questionnaire.

RESULTS

1. Differences between the pre-test and the post-test's scores of each group

1.1 The group with EVP treatment

Table 2

Descriptive statistics and paired-sample *t*-test of the experimental group's scores treated by English Vocabulary with a Picture Application (EVP)

Dependent variable	*n*	Before treatment		After treatment		*t*	*p*
		$\bar{X}$	S.D.	$\bar{X}$	S.D.		
The score received by the daily English vocabulary test	24	28.17	4.34	44.58	6.77	-14.24*	.00

*$p < .01$

As illustrated in Table 2, the mean and standard deviation (SD) of students' daily English vocabulary test scores before the experiment were equal to 28.17, and 4.34. After the treatment, the mean was 44.58, and the standard deviation was 6.77 respectively. The differences in students' mean scores between before and after treatment considerably increased by 16.41. Paired-samples t-tests were run to investigate students' vocabulary achievement from pre-test to post-test. The finding showed that there was a significant difference in the students' scores received by the daily English vocabulary test since t = -14.24 (p = .00). Therefore, it can be indicated that using English Vocabulary with a Picture Application (EVP) may enhance their vocabulary memorization ability.

1.2 The control group with no treatment

Table 3

Descriptive statistics and paired-sample *t*-test of participants' scores in the control group

Dependent variable	*n*	Before treatment		After treatment		*t*	*p*
		$\bar{X}$	S.D.	$\bar{X}$	S.D.		
The score received by the daily English vocabulary test	24	28.29	3.65	29.42	5.71	-1.35*	.190

*p < .01

As shown in Table 3, the insignificant vocabulary gains (t = -1.35, p = .190) were demonstrated by the participants with a mean score 28.29 (SD = 3.65) in the pre-test (before treatment) and 29.42 (SD = 5.71) in the post-test (after treatment). The mean scores convincingly show quite a similarity in the control group (mean scores' differences = 1.13) These results suggested that the differences between pre-test and post-test were not statistically significant.

1.3 Differences in the post-test score between the experimental and control group

Table 4

The comparison of participants' mean scores between the experimental and control group after treatment

Group	N	$\bar{X}$	S.D.	*t*	*p*
EVP Group	24	44.58	6.77	8.39*	.00
The Control Group	24	29.42	5.71		

*p < .01

The mean scores of daily English vocabulary post-tests of the two groups were compared to find out the effect of EVP on the students' daily English vocabulary learning achievement. The result in table 4 showed that there were significant differences as t = 8.39 (p < 0.01) between the post-test of the control and that of the experimental group. The mean scores of students' post-test in the experimental group is 44.58 which was higher than the mean scores of students' post-test in the control group. Additionally, as shown in Table 2 and Table 3, the mean scores

of pre-test of both groups were very similar to each other (the experimental group = 28.17, the control group = 28.29). It is assumed that both groups had similar knowledge about the target daily vocabulary before they were exposed to the treatment.

From the statistical point of view, it can be concluded that EVP helped participants learn target vocabulary and perform well in the post-test better than participants who did not use any application in the control group. Therefore, using EVP may have enabled the participants to achieve their daily vocabulary learning.

2. Learners' opinions toward daily English vocabulary learning with EVP

The participants from the experimental group were given the questionnaire to complete and required to rank eight questions of learners' opinions toward EVP use to enhance their daily vocabulary memorization on a scale of 1-5 (1 = Strongly disagree, 5 = Strongly agree). The results of the questionnaires' responses are illustrated in Table 5.

Table 5
Descriptive statistics of learners' opinions toward EVP

Item	Learners' opinions toward EVP	$\bar{X}$	S.D.	Criteria of the rating scale
1.	I am interested in learning daily English vocabulary through EVP.	4.54	0.71	Strongly Agree
2.	I am eager to learn daily English vocabulary by using EVP.	4.25	0.83	Strongly Agree
3.	I think learning English vocabulary via EVP facilitates me to make English sentences easily.	3.67	1.14	Agree
4.	I like the classroom setting with the use of EVP more than a normal class.	4.42	0.76	Strongly Agree
5.	I can memorize more daily English vocabulary after learning vocabulary by using the application.	4.46	0.76	Strongly Agree
6.	I enjoy using EVP to memorize daily English vocabulary in the classroom.	4.33	0.94	Strongly Agree
7.	I think the application can improve learners' English vocabulary learning skills well.	4.21	0.96	Strongly Agree
8.	I think I can learn daily English vocabulary by myself without being taught by an instructor.	3.92	1.00	Agree
	Means	**4.22**	**0.15**	**Strongly Agree**

As Table 5 shows, the list concludes the corresponding descriptive statistics, which revealed that the participants regarded EVP as an interesting application for them to learn daily English vocabulary (M = 4.54, SD = 0.71), followed by using EVP which helps them memorize everyday English vocabulary with a slightly lower mean of 4.46 (SD = 0.76), and the participants enjoy using EVP to memorize everyday English words in the classroom with the mean of 4.33 (SD = 0.94) respectively.

DISCUSSION

The first research question asked if the EVP had been proficient for learners' vocabulary achievement. The pre-to post-test gain achieved by the EVP group was significant but the control group was not statistically different, meaning that the former group outperformed the latter group. EVP can be used to increase the undergraduates' ability to learn English vocabulary in daily life by using visual mnemonic techniques (Thompson, 1987) with the theory of multimedia interactions (Mayer, 2009) to develop teaching aids for enhancing English language learning because it will help students have the opportunity to learn the language more easily (Basoglu & Akdemir, 2010; Zhao & Lornklang, 2019; Zhonggen, 2018). The technology in foreign language learning can help low-achieving students flexibly adopt and foster a positive attitude towards effective English learning. This is consistent with Cavus and Ibrahim (2009) who found that the use of mobile teaching aids gives students the opportunity to learn anytime and anywhere. This will foster learning interest and increase motivation for students' learning (Chen et al., 2018). This finding is also in line with the benefit of language learning through mobile application. Using the application promotes foreign language learning because it is a suitable method for students from individual learning to cooperative learning. Moreover, it also builds confidence in learning and also promotes a positive attitude toward learning English as a Foreign language because it is easier for students to learn vocabulary items that are quite similar or from the same category with the help of mobile teaching tools (Hao et al., 2019). Technology may reduce learners' anxiety as they can learn and practice languages without interacting with others (Kühl & Wohninsland, 2022). The student can study through the application, which helps foster learning motivation (Ebadi et al., 2022; Sandberg et al., 2011).

Students who use EVP for enhancing their daily English vocabulary recognition were more able to memorize daily English vocabulary than the control group. The application was used as a computer-aided teaching material that helps students increase their opportunities to practice learning English vocabulary more than a traditional learning approach which is in accordance with the study of Farrokh et al. (2021). The study explored the impact of visual mnemonic technique on young and adult Iranian English learners' vocabulary learning. The result showed that the participants who were taught via the visual mnemonic technique proved to be more successful in retaining the words' meanings in their long-term memory.

Despite the benefit of teaching vocabulary through a visual mnemonic technique, its teaching implementation is still limited. To increase the usefulness of visual mnemonic technique given the limitation of their academic time period, educators should supplement it with technology to support learning. There are many studies that have investigated the effect of using technology in vocabulary lessons such as virtual reality games (VR) in FL vocabulary acquisition, technology application with visual glosses for increased L2 vocabulary learning, and vocabulary learning via the CALL program (Alfadil, 2020; Hirschel & Fritz, 2013; Sato, 2016).

This study utilizes a new combination of technology with the visual mnemonic technique to serve as a new aid in teaching learners vocabulary. The result of the current study demonstrated that the group treated by EVP program outperformed the control group. The EVP program may also result in an enhancement of the students' vocabulary learning which is in line with

the research question. Schmitt (2000) describes the benefits of computer-assisted instruction as being more useful than using traditional vocabulary learning methods because computers are a tool that can be repeated many times. Besides that, the computer is also a useful tool for learners to perform tasks independently according to their needs (Motlagh et al., 2020; Sagarra & Zapata, 2008). This is in line with a study by Hirschel and Fritz (2013) who used a computer-assisted language learning method for first-year undergraduate students in Japan studying English as a second language. The results showed that the experimental group using computer-aided teaching of English vocabulary had higher scores on the English vocabulary test during the post-test than before. In addition, Alfadil (2020) has developed a game that uses innovative virtual reality technology to teach English vocabulary to high school students studying English as a foreign language. The comparisons between the experimental and control groups showed that students who used virtual games to learn English words were able to learn more English words than students who used traditional vocabulary learning methods. In conclusion, the use of technology in teaching vocabulary is a way to promote and encourage learners to learn vocabulary more effectively.

The second research question asked what the learner' attitudes had been toward EVP. It was found that students had opinions on the use of EVP to promote the recognition of daily English vocabulary items for students studying English as a foreign language at a good level. This is consistent with a study by Thornton and Houser (2005) showing that applications stimulate students' interest in learning and give them more opportunities to learn. Therefore, the integration of mobile technology with teaching methods will enable students to be more enthusiastic to engage in learning activities. Learners are encouraged to take part in learning with other students and interact with teachers as well. In addition, from the analysis of the data in this study, it can be concluded that using an English learning application can help learners to recognize more English vocabulary in daily life by commenting that "I can memorize more daily English vocabulary after learning vocabulary by using the application." and "I think the application can improve learners' English vocabulary learning skills well." This is consistent with the study by Ou (1997), which concluded that using appropriate vocabulary learning strategies can greatly raise students' communicative competences in listening, speaking, reading, and writing and the study by Jafari and Chalak (2016) which stated that developing active language learning environments is a key element to support L2 learners who have difficulty satisfying their language acquisition needs within the limited class hours during their language learning years.

CONCLUSION

This study highlights the core focus of integrating picture mnemonics with interactive multimedia when designing and creating a learning media application called English Vocabulary with a Picture Application (EVP). EVP was used as CALL materials for learners to help them recognize the target words. The application consists of ten daily English vocabulary activities, including content and supplementary exercise in each activity. After learners' exposure to the application, the learners substantially improve the ability to memorize daily English vocabulary items compared to the group of learners who did not use any method. Furthermore, as demonstrated

by the finding of the questionnaire, the learners' opinions toward EVP are strongly positive. Consequently, it is recommended by learners that the application is beneficial for EFL learners who wish to practice memorizing daily vocabulary through their mental images.

It can be concluded that using the learning media application of EVP may enhance EFL learners' memorization of daily English vocabulary because the application is considered to be the mnemonic device that facilitates learners to have imagery and visualization of the vocabulary items learned. Pedagogically, the study may provide guidelines to language education scholars regarding how to create appropriate and satisfactory applications for foreign language learners who have difficulty in learning other foreign languages. The findings in this study support the advantage of using games to promote the students' active learning in the FL learning context. From the learners' perspective, EVP can provide motivation for Thai learners to practice memorizing words on their own and help them practice their memorization by visualization. For educational policy-makers, it would be an idea for them to create the innovation to improve student learning or use the application as an alternative material to help learners achieve their vocabulary learning goal.

However, a caveat is the time limitation of this research. The study should be reassessed after the completion of an experiment in three months and six months to investigate how much learners' vocabulary memorization can be retained in a certain period of time. Further study should be made to compare the effectiveness of using the application with other mnemonic devices or other approaches to determine which method works better.

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THE AUTHORS

Danuchawat Suwanasilp is a full-time instructor at the English for International Communication Department, Faculty of Humanities and Social Sciences, Rajamangala University Tawan-ok, Chonburi, Thailand. He holds a certificate in TEFL from University of California, San Diego, and received his MA (TESOL) from Alliant International University, USA. His specialty emphasizes vocabulary instruction and teaching communicative grammar.
danuchawat@gmail.com

Nunpaporn Durongbhandhu is a full-time instructor at the Department of English for International Communication, Faculty of Humanities and Social Sciences, Rajamangala University of Technology Tawan-ok, Chonburi, Thailand. She received her M.A. (English for Communication), and Ph.D. (Research and Statistics in Cognitive Science) from Burapha University. Her areas of research interest include reading instruction in EFL classrooms and the CALL technique.
nunppd@gmail.com

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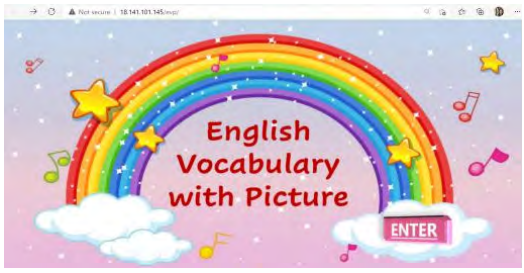
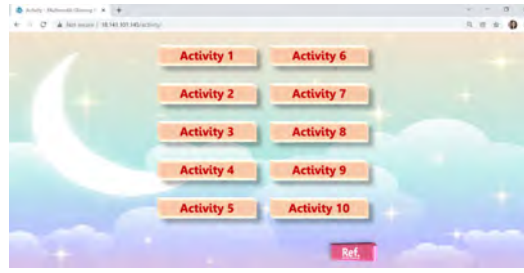
APPENDIX A

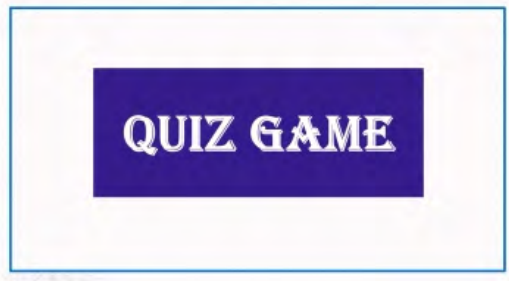
English vocabulary with a picture application screen

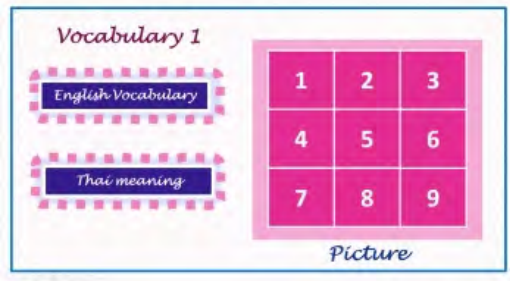


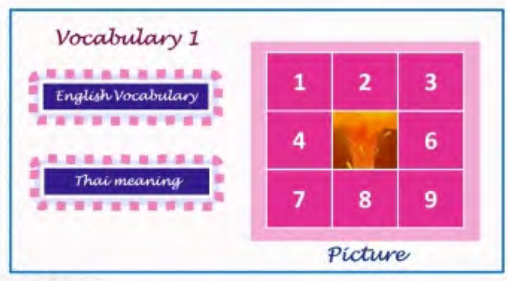


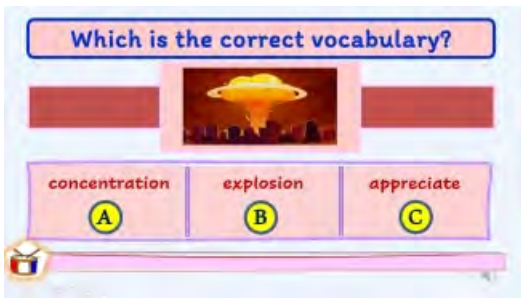
APPENDIX B

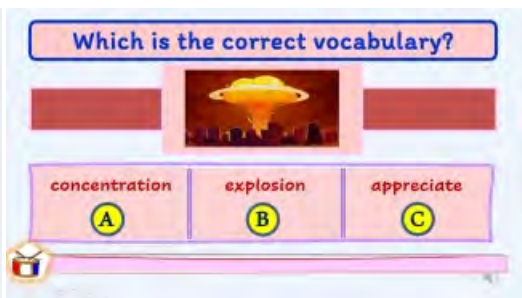
Example of “Quiz Game” and “Timer Game”





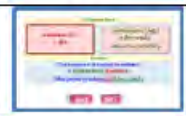
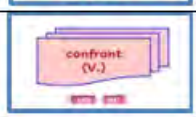
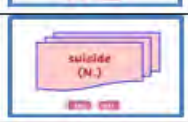






APPENDIX C

Example of the content and supplementary exercise of EVP

Activity	Content (50 minutes)			Supplementary Exercises (40 minutes)	
	Slide 1 The English Target Word	Slide 2 The Pictorial Presentation meaning	Slide 3 Example of Word Collocation (Optional)		
1				Quiz Game	Timer Game
2				Quiz Game	Timer Game
3				Quiz Game	Timer Game
4				Quiz Game	Timer Game
5				Quiz Game	Timer Game
6				Quiz Game	Timer Game
7				Quiz Game	Timer Game
8				Quiz Game	Timer Game
9				Quiz Game	Timer Game
10				Quiz Game	Timer Game