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Designing a smartphone app to teach English (L2) vocabulary

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设计智能手机app用于英语词汇教学



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ABSTRACT

The researcher developed a Basic4Android smartphone app (named as Word Learning-CET6) and investigated its effectiveness as a tool in helping English as a Foreign Language college students learn English vocabulary. The app, containing 1274 English words, was designed to be installed into smartphones with Android operating system. To test the program's effectiveness, two groups of students were set up as a test group (those with Word Learning-CET6) and a control group (those without Word Learning-CET6). Knowledge of the vocabulary was tested before and after the study to assess the impact of the program. The study showed that the students using the program significantly outperformed those in the control group in acquiring new vocabulary. At the conclusion of this study, the researcher designed an app and established a pedagogical paradigm which can be followed as a way of mobile learning.

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设计了一个app，采用设置对照组的方式来检验它的有效性，并建立了使用它的移动学习范式

1. Introduction

1.1. English as a foreign language (EFL) vocabulary learning strategies 英语词汇的学习策略

Vocabulary acquisition strategies are generally categorized into two types: 英语词汇学习的两种方式

- a) Incidental vocabulary learning, and; 附带学习
 b) Intentional vocabulary learning (Nation, 2001). 有意学习

Researchers (Hulstijn, 1992; Laufer & Yano, 2001; Nation, 2001) found that intentional vocabulary learning is responsible for most of EFL learners' vocabulary expansion because new words are difficult and slow to acquire without ambiguity out of contexts. Studies (Hulstijn, 2003; Mehrpour, 2008; Qian, 1996) that compared these two strategies clearly indicated that intentional learning is more effective than incidental learning. However, other studies showed results that contradict the argument (Ahmad, 2011; Horst, 2005; Pitt, White, & Krashen, 1989). 有一些研究表明，有意学习效果好于附带学习，但有一些研究得出相反的结论

Word lists and/or word cards methods, which simplify the learning process so as to increase repetitions with words, are the prevailing techniques for intentional vocabulary learning. In a conversation about the ten best ways for EFL students to learn vocabulary, Batia Laufer and Paul Nation suggested word lists and word cards, respectively (Editorial, 2005). Read (2000, p40) elaborated on the wordlist learning method with "by working through a list of L2 words together with their L1 translations and memorizing the word-gloss pairs." Studies by Waring and Takaki (2003), Webb (2007) concluded that there are a minimum number of encounters or repetitions needed with a word to recognize its morphological form. Xue et al. (2010) detected the neural mechanism of repetition to advance better memorization and stated that "repeated study improves memory".

单词表和词卡是当前有意学习英语的流行方式

通过阐述他人研究得出有意学习的策略 重复学习能够提高记忆

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1.2. English education in the Chinese colleges 中国大学中的英语教育

Schmitt (2008) concluded that a vocabulary size of 8000–9000 word families is necessary for reading and a quantity of 5000–7000 word families for oral address is required in English. Whereas, the Chinese college students plateau at 3934 English words (Dai, 2013) by the end of their second academic year. The 3934 words were calculated from a glossary pool that included simple words like “I”, “in”, “one”, etc. Song and Yu (2004) discovered that the productive vocabulary amount for sophomores was 2000 words in a top Chinese university. Most Chinese college students receive 11 years of English education (3 years in elementary school, 6 years in junior and senior high schools and 2 years in college), in other words, they are taught English for a total of 1672 class hours (based on an estimate of 38 class weeks per year, 4 English class hours each week). On top of that, they probably spend twice as many hours doing homework and learning on their own. A research (Gao & Wang, 2011) discovered that Chinese college students spent more than 50% of their self-study time on learning English. Compared to Schmitt's (2008) requirements, the daunting gaps in vocabulary size and the tremendous amount of time spent on learning the language propel many Chinese English learners to look for shortcuts if there are any, and spur teachers on to search for useful vocabulary acquisition techniques. 1.对中国大学生英语学习的时长较长、词汇量较少的情况等进行介绍 2.学生在寻求学习英语的捷径,先进的教师在寻求有用的词汇学习技术

The importance of passing College English Test-Band 6 (CET6) is not emphasized enough. Some universities will not issue his/her diploma until the student passes CET6. The biggest obstacle for students to overcome is to master the 6674 words designated by the Chinese Ministry of Education. An astounding number of vocabulary books are printed in order to help students learn these words. A keyword search returned 23,817 results when “CET6 vocabulary book” was typed in an e-commerce website (www.taobao.com) on October 15, 2013. In searching for a new way to help learners memorize English words, and for this project, the researcher referred to eight CET6 vocabulary books and the handbook of College English Curriculum Requirements (Wang, 2004) to collect 1274 words to form a database which was then incorporated into a smartphone vocabulary acquisition app, also designed by the researcher, called Word Learning-CET6.

移动学习的理论和实践

通过六级考试对大学生的重要性,六级词汇的种类很多,

1.3. Mobile learning: Theories and practice

为了寻找一种帮助学习者学习词汇的新方法 本研究设计了一种英语词汇学习app 后台参考单词书形成一个单词库

In searching for new vocabulary acquisition techniques, researchers (Thornton & Houser, 2001, 2004, 2005; Stockwell, 2007, 2008, 2010) turned to mobile phones and conducted many studies. They proposed “pushing” and “access” theories. By sending short text messages at spaced intervals, EFL students are pushed to learn English vocabulary. Since a mobile phone is always in one's pocket, its convenient accessibility is superior to that of textbooks and computers, etc. 为寻求一种新兴的单词学习方法,研究者基于智能手机进行了很多实践。

That EFL college students learn English vocabulary or idioms via mobile phones was empirically investigated by Thornton and Houser (2005) in Japan, Lu (2008) in Taiwan, Cavus and Ibrahim (2009) in Turkey, and Hayati, Jalilifar, and Mashhadi (2013) in Iran. Their studies showed that mobile technology improved learning, however, all their experimental designs utilized very small texts or several idioms sent via short message service (SMS), e.g., there were merely 14 words in one week (Lu, 2008). The obvious deficiency in SMS is the size of the message. Even where mobile carriers allow subscribers to send large files, few learners will have enough patience to scroll down a small screen and keypad to study large content without a format for any length of time. Another deficiency in SMS method is in delivering and receiving messages. Thornton and Houser (2005) admitted that only 10% of participants read messages at the time of reception. Mobile-assisted language learning (MALL) should be “anytime, anywhere” (Kukulka-Hulme & Shield, 2008). The third deficiency is that traditionally with mobile technology, learners have no learning choice. They wait to receive their lessons; they have no choice of content, and no way to access further material when they have mastered what they have received to date. The usefulness of any design with these three shortcomings should be questioned. Burston (2014) regards their SMS studies and other MALL researches as class trials, deems the value of these designs as marginal in practical implementation and believes there is technological foundation to pull MALL in from the fringes to the mainstream of foreign language learning. It is the functional shortcomings of mobile phones that limited their researches in employing mobile phones for foreign language learning to be conducted with specifically tailored small content in artificial environments.

通讯服务的缺点是消息的尺寸

另一个缺陷是学习者接收消息的时候只有10%的人查看

第三个缺陷是学习者没有选择权

有研究表明,移动技术能够提高学习效果但是他们的研究只是利用短消息发送很少的单词和短语

没有为学习者定制的碎片化内容

1.4. Language learning with smartphones 利用智能手机进行语言学习

开发智能手机app的研究很多,但用于英语学习的app很少

A smartphone can execute a third party application since it is built with an operating system. Although the field of development of smartphone apps has been widely explored, the smartphone apps for foreign language learning are “rare” (Burston, 2013). In particular, no smartphone app designed for EFL curriculum learning can be found in China yet. Of the few researches involving smartphones for MALL, they were positioned at either interacting instructors with learners in a Q/A type simple design through MSN and SMS (Tai, 2012), or tutoring kids to look for a word at smartphone's online dictionary (Bromley, 2012). One possible reason for this absence is most EFL English teachers do not venture to code because they have limited knowledge of computer sciences. For these with some knowledge, they often think they have to be experts in complicated Objective-C programming language to create an Apple iOS app and Java to design an Android app. Given the advances in mobile technology, software and hardware, MALL designs should be application based (Godwin-Jones, 2011). This researcher designed an app with broad practical usage to exploit MALL with smartphones in a normal way, without much modification and intervention, in a naturalistic setting.

1.5. Selection of smartphones and Basic4Android programming language 智能手机和安卓程序的选择

The selection of smartphones to conduct this study was based on four criteria: First, the technology; smartphones are designed with fast operating systems, big display screens, large internal storage, and touchscreen technology with a zoom function. Touchscreen with zoom allows users to react to what is displayed and to control how it is displayed by zooming (i.e. expanding or shrinking text size). Second is the popularity of smartphones; the majority of students possess smartphones (personal survey: all 143 students attending the researcher's classes carry smartphones). China Mobile, the largest wireless carrier with the most subscribers in the world, goes to the Chinese universities to offer free smartphones for a low price subscription plan. A student can obtain a smartphone on a subscription plan of 30 Yuan/month (1 USD = 6.10 Yuan). Third, custom made apps such as the one this researcher designed can be installed into smartphones. Regular

mobile phones, without operating systems, do not support third party apps. Finally, with extensive searching this researcher found few experiments conducted with smartphones to **teach/learn vocabulary** in the field of language learning.

There are many simple programming languages (e.g., HyperNext Android Creator, Simple, Basic4Android and HTML5 in PhoneGap framework) that are easy to learn and use. Basic4Android (B4A), very similar to Visual Basic, is a simple programming language designed to be easy to learn and use. B4A is the simplest and most powerful rapid application development tool available for the Android platform (Graham-Smith, 2013). Users can create graphical user interface applications simply by using components supplied by B4A itself without any coding.

1.6. Theoretical framework of this research

This researcher believes it is the **scarcity of available curriculum content** suitable for smartphones that hampers them being fully exploited and as useful as PCs in language learning. If proper teaching/learning materials are designed, this problem could be rectified. Applying the intentional vocabulary learning strategy, word list method and the L2-L1 pair learning technique to obtain more repetitions that generate better remembrance as discussed by the presenters of these theories, and adopting smartphones with the technological superiorities in “pushing” and “access”, the researcher, an EFL English teacher chose the simple programming language of B4A to design a smartphone app for curriculum study in order to **solve the three deficiencies in SMS studies** so as to **expand the practical value of mobile learning and find a new way for EFL students to learn English vocabulary**.

1.7. Purpose of the study

This study was conducted by **the empirical research method** to investigate the effectiveness of smartphones in helping EFL college students learn English vocabulary in a natural environment. The purposes are to:

1. Explore the effectiveness of using smartphones as a tool for teaching/learning English vocabulary in a natural environment. It was based on the assumption that the participants with Word Learning-CET6 installed in their smartphones would have more encounters with these words due to its accessibility, **利用准实验的方法，验证该工具的有效性**
2. Introduce a pedagogical example of employing a smartphone app for teaching/learning vocabulary. **介绍一个利用手机app进行单词教学和学习的教学实例**

2. The app of word Learning-CET6

2.1. Origin of vocabulary pool **词汇库的形成**

There are a total of 6674 English words in the glossary section of the handbook of *College English Curriculum Requirements*, administered by the Chinese Ministry of Education. Within these 6674 words, 4538 words are listed under basic requirements. Basic requirement means that a college graduate must have acquired these 4538 words by graduation. The remaining 2136 words, usually called CET6 words, are stipulated in the intermediate and higher requirements sections. Most CET6 vocabulary books do not embody all these 2136 words and are compiled by discarding phrases and cognate words to obtain a remaining vocabulary pool of 1200–1300 words. The vocabulary library of Word Learning-CET6, amassed by the same means, contains 1274 words. **app词汇库的形成，词汇来源于考试大纲，包含基础部分和高级部分，指出一般的词汇书没有对高级词汇详细描述，突显出app的优势**

2.2. Word learning-CET6 app software design **软件设计**

Using her knowledge of computer science and experience as an English (L2) learner/teacher, this researcher drew the concepts and structures of Word Learning-CET6 and designed it. The framework was to mimic a paper word list or vocabulary book, attaching two important functions of **Unknown Words and Sample Test**, which are difficult to be accomplished by a learner with a paper word list. Word Learning-CET6 was framed to execute three simple functions: **该app实现了词汇书不能实现的功能 “你不知道的词汇”和“单词测试”**

- a) Displaying words alphabetically;
- b) Selecting (or de-selecting) words from word database and building a new word pool to increase the efficiency of learning;
- c) Performing sample test to evaluate learning effectiveness;

In beginning, these 1274 words were programmed into an applicable computer database with three features; namely: spelling, pronunciation and Chinese definitions. Next, without any reference or help, the researcher used B4A programming language and managed to develop Word Learning-CET6, an Android app with touchscreen commands (insert smartphone screen shot **Image 1, 2, 3 and 4** here, to download the app, please visit the researcher's blog, <http://perry20008.blog.sohu.com>). It had been beta-tested among colleagues before it was installed into smartphones of the participants.

The reasons for selection of B4A to develop Word Learning-CET6 were:

1. B4A is very simple, easy to learn and use, and very popular in designing apps for Android.
2. Android is the most widely used smartphone operating system. As in July 2012, Android's market share rose to 90% in China (Wikipedia, 2013).
3. Apps designed with other programming languages for other smartphone operating systems (e.g. Apple iOS) may not be executable on smartphones with Android platform.



Image 1. Screen shot image of Word Learning-CET6.

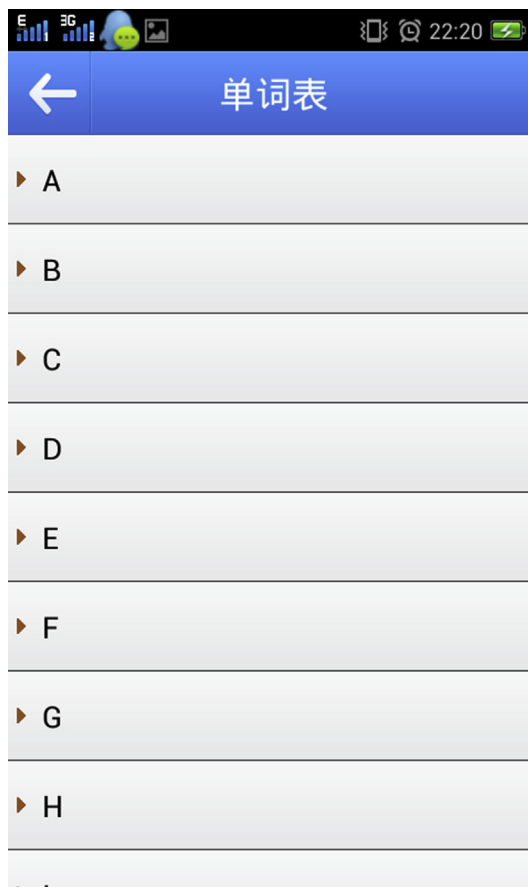


Image 2. Screen shot image of Word Learning-CET6.



Image 3. Screen shot image of Word Learning-CET6.

2.3. Functions of word learning-CET6 app

The Word Learning-CET6 software has the following six commands:

1. Search command: To search for a word from its 1274 words database.
2. Glossary command: To scroll through the alphabetically listed 1274 words database.
3. Unknown Words command: A touch screen function that isolates words that are unknown to a user from those that are known. There are three separate folders aptly named Unknown Words One, Two, and Three. Users can load and clear these files at any time. A user can select, as an example, 500 words from the glossary and put them in Unknown Words One for repetitive study. From those words the user may select, again as an example, 300 of the more difficult words to form Unknown Words Two folder, and subsequently a reduced number of words from this group of study words that are proving particularly difficult to fill the Unknown Words Three. This function allows the user to increase the frequency of learning the more difficult words by eliminating the redundancy of seeing the words already known, thus improving efficiency. Unknown Words folders are automatically built and saved (or deleted) once words are touchscreen selected or de-selected.
4. Sample Test command: To create a sample test. Users can randomly select a number of words, create a sample test and examine how much they have learned.
5. Touchscreen Selection: Users can finger-touch any part of the definition of a word to select it. It will be de-selected if it is touched again. The display color changes to inform users whether a word is selected or de-selected.
6. Exit command: To exit the app.

3. Research design and procedure

3.1. Participant selection

To prepare for CET6 and graduate school entrance examinations, most 4th year medical school students of a 5-year college system in Jiujiang University stayed on campus to study English during the summer vacation of 2014. Embracing the participant selection method utilized by Hayati et al. (2013), this researcher selected 100 4th year medical school volunteer students who possessed Android smartphones to participate in a vocabulary pretest. There were 71 students whose scores fell between one standard deviation above and below the mean. 16 students whose scores fell below $M - 1SD$ and 13 above $M + 1SD$ were regarded as heterogeneous and excluded from consideration. To



Image 4. Screen shot image of Word Learning-CET6.

ensure homogeneity, the researcher chose 70 students from the 71 as participants and equally divided them into a test group and a control group by random selection. Table 1 and Table 2 present the pretest data.

3.2. Treatments

After the participants were chosen, the research proceeded to compare the two groups as in other MALL studies (Lu, 2008; Tai, 2012). On the morning of July 3, 2014, the researcher installed Word Learning-CET6 to all 35 participants' smartphones in the test group and taught them how to use it. The process of installation and teaching lasted less than an hour because it was designed with simple interfaces and the participants were familiar with smartphones. Word Learning-CET6 was protected with a password key. The researcher controlled the password so that the app could not be copied from an unlocked original. On the afternoon of July 3, 2014, the researcher met the 35 participants in the control group and informed them that they would also receive “pushing” messages to encourage them to study CET6 vocabulary. Mastering CET6 vocabulary is considered a big challenge for most Chinese college students. This can be inferred from the low scores of the pretest and posttest in this research. Most students who want to take the national CET6 examination own at least one CET6 vocabulary book. In the researcher's university, a student receives seven English textbooks each semester when English is a compulsory course in the first two years. All 70 participants possessed CET6 vocabulary books or word lists and piles of materials of English learning. Each of the 70 participants received a printed wordlist copy of these 1274 words.

The researcher sent 10 “pushing” short text messages to smartphones of all 70 participants at 5-day intervals. The contents of the ten messages were similar, in “study English hard” reminders. There was no other intervention during the experiment; participants were left to learn on their own. (Word Learning-CET6 is unlocked now. Visit the researcher's blog <http://perry20008.blog.sohu.com> to download its .apk or .doc version).

3.3. Vocabulary knowledge tests (Pretest and posttest)

Selections of words were performed twice to extract 100 words each time by applying Sample Test function in Word Learning-CET6. These words were used to perform the pretest and posttest in an effort to appraise the ability of vocabulary recognition in the research. Examinees were asked to write down the common Chinese meaning during the tests; one point was awarded if a correct Chinese meaning or interpretation was noted.

The pretest was conducted on July 2, 2014 to select two participating groups.

The posttest was conducted on August 26, 2014 to evaluate the effectiveness of the app.

Table 1
Descriptive statistics of pretest.

n	100
Mean	34.62
SD	6.173

Table 2
Frequencies and percentage of the homogeneity pretest scores.

Value	Frequency	Percentage
M– 1SD	16	16%
Between M ± 1SD	71	71%
M + 1SD	13	13%
Total	100	100%

4. Results

4.1. Comparison of the test group and control group before the experiment (pretest)

Because all participants were pre-selected from students whose scores were within $M \pm 1SD$ in the pretest, the mean (mean = 35.13) of the randomly assigned test group and that (mean = 35.68) of randomly assigned control group displayed no significant difference ($p = 0.872$).

4.2. Comparison of the test group and control group after treatment (posttest)

After the experiment, participants in the test group had a mean score of 50.52, the mean score of the control group was 43.56 and the mean difference was 6.96 (Table 3). Since Sig. = 0.740, greater than 0.05, equal variance was accepted; because the t value of the analysis was 2.310, $p = 0.001$, a significant difference was concluded (Table 4).

Each participant in the test group acquired 88.67 more words on average ($QD = MD/f = (M_t - M_c) \times (N/n) = (50.52 - 43.56) \times (1274/100) = 88.67$ words (note: QD = quantity difference, MD = mean difference, f = fraction, M_t = Mean of the test group, M_c = Mean of the control group, N = population (the vocabulary pool contains 1274 words), n = sample size (posttest composes 100 words)).

Since the test pool had 100 words, the mean scores in Table 3 can be interpreted in percentage terms. That is, the participants in the test group recognized 50.52% of these 1274 words, while participants in the control group remembered 43.56%. The percentage difference was 6.96%.

4.3. Other surveys

Of the 35 participants in the test group, 8 participants spent less than one hour; 20 spent one to two hours; 7 spent more than two hours per day (55 total experimental days) on learning with Word Learning-CET6 (Table 5). Another finding was that all 35 participants acknowledged that they occasionally spent idle time, such as waiting and commuting, on learning.

5. Discussion

The results (Tables 3 and 4) show that participants in the test group remembered 88.67 more words than participants in the control group at the end of the research. The difference was significant. Considering that there was no significant difference between groups in the pretest and all participants were treated equally except for that the participants in the test group had Word Learning-CET6 app in their smartphones, the advantage of using smartphones with Word Learning-CET6 for EFL learners to learn English vocabulary is attested. This study provides additional support to Viberg and Gronlund's (2013) conclusion "that mobile technology can enhance learners' second language acquisition"; it also endorses the argument proposed by Mikalef, Giannakos, Chorianopoulos, and Jaccheri (2013) that informal learning benefits from mobile interactivity if this experimental design was categorized as informal learning since it was not in a classroom teaching/learning setting.

The higher score that the participants in the test group achieved may be attributed to three reasons. First, Word Learning-CET6 provided them with direct and explicit information about words in a simple wordlist design. This enabled them to improve their vocabulary acquisition by reducing the burden of memorization. In other words, they could focus on the three key features of the words, i.e., spelling, pronunciation and Chinese definitions. They were not disturbed by superfluous content such as synonyms, antonyms and usage examples, which are often included in vocabulary books. Word Learning-CET6 is in essence a compiled list of 1274 words that electronically mimics a

Table 3
Descriptive group statistics (posttest).

Score	N	Mean	Std. Deviation
Posttest test group	35	50.52	10.413
Control group	35	43.56	11.404

Table 4
Independent t-Test (posttest).

Levene's test for equality of variances		t-test for equality of means		
F	Sig.	t	df	Sig.(2-tailed)
2.268	0.740	2.310	68	0.001

paper word list, which is recommended by many English (L2) educators (([Editorial, 2005](#); [Read, 2000](#), p40), but is more accessible and convenient than a paper word list. It is also more appealing to modern day language learners who are accustomed to electronic devices ([Al-Hinnawi, 2012](#)).

The second reason that the participants in the test group were more successful was the superiority of Word Learning-CET6 functions. A study displayed that functional simplicity in a CD-ROM design had better performance than relatively complicated web-based vocabulary learning ([Gyun, 2011](#)). Functions like Unknown Words and Sample Test make learning simple and easy. Unknown Words helps users concentrate on the words they find most difficult to learn. It saves time and improves learning efficiency. Sample Test assists learners to evaluate their study progress.

The third reason, probably the most important reason, was the length of the time the study took. It was 55 days. With such a long period of time to learn via smartphones, the participants in the test group were motivated and facilitated in their learning with frequent engagement in vocabulary study, as discussed by [Ushioda \(2013\)](#). They probably spent a longer accumulated time than the participants in the control group on learning these 1274 words because of the convenient access they had to the material with Word Learning-CET6. They might subconsciously spend more time on learning by “taking advantage of ‘dead time’, for example, when commuting” ([Ballance, 2012](#)). The survey finding (Section 4.3) that all 35 participants in the test group sometimes spent their idle time on learning corroborates this argument. On the other hand, the participants in the control group had to have their textbooks, word cards, self recorded mp3 files, or word lists on hand to take advantage of this “dead time”. As a result, they would often find themselves in situations where they had time to study but could not because they did not have access to the material. Because it was difficult to quantify the “pushing” effect and the sample size was too small to render any statistical meaning in this part, the researcher did not analyze the effect of the 10 “pushing” messages. However, in her personal communication with participants, she was told that some participants in the test group sometimes started to learn via Word Learning-CET6 immediately after they received a “pushing” message at the time of idling, while the participants in the control group disregarded the messages in the same situation. Longer accumulated study time results in more repetitions, and more repetitions lead to better recollection ([Xue et al., 2010](#)). Traditionally, more repetitions require more effort. With Word Learning-CET6, however, some of this effort is alleviated through convenience, access, and ease of use.

Compared to the studies of [Thornton and Houser \(2005\)](#), [Lu \(2008\)](#), [Cavus and Ibrahim \(2009\)](#), and [Hayati et al. \(2013\)](#), mentioned earlier, on sending SMS texts to teach/learn English words or idioms, this researcher believes her design solved the three deficiencies and the limitation of practical usage existing in their researches. Firstly, the technological constraints limited their material to small content, i.e. 14 words in one week ([Lu, 2008](#)). The broad practical application of learning like this is quite dubious. Word Learning-CET6, on the other hand, contains 1274 words in a 350k.apk file with neat formatting and simplicity. Secondly, since Word Learning-CET6 was installed into smartphones directly, it could be utilized “anytime, anywhere”; there was no access or delivery problem. On the contrary, learners in their studies could do nothing but wait passively for SMS messages at set times, on set days, in which punctual delivery and receipt were not well known. E.g., in [Thornton and Houser's \(2005\)](#) study, only 10% of participants read their SMS on time. Lastly, Word Learning-CET6 has the options to selectively choose words that learners want to concentrate on with Unknown Words and to evaluate performance with Sample Test. That the participants spent many hours ([Table 5](#)) on learning with their smartphones certifies its value. Word Learning-CET6 fulfills the standards of “apps based” set by [Godwin-Jones \(2011\)](#) and “anytime, anywhere” by [Kukul'ska-Hulme and Shield \(2008\)](#) in MALL activities.

Unlike the aforementioned SMS researches in which the displaying of content was artificially split into short lines to be recognizable, the layout of Word Learning-CET6 has words listed alphabetically in a wordlist formation that is comparable to a vocabulary book or a paper word list. As turning book pages, users can easily move to previous or next screen of displaying with touchscreen function in Word Learning-CET6. Word Learning-CET6 is natural. The experimental design that all participants studied on their own terms and the 35 participants in the test group received no additional treatment except for downloaded Word Learning-CET6 did not modify and intervene in the participants' normal learning pattern. Therefore, the experimental design was also natural. Consequently, the researcher concludes that smartphones with Word Learning-CET6 are effective supplementary tools in addition to textbooks for learners to learn English vocabulary in a natural environment.

Although electronic Chinese-English dictionaries/translators are incorporated in applications of some smartphone models, or users can download or direct access online dictionaries and/or buy commercial apps if their smartphones do not come with a dictionary app, this researcher's design still has significance. A dictionary is a tool that is designed for users to search for words that they encounter and want to know in daily life. It is hard, if not impossible for users to pick up certain words to actually learn and put into daily use because the database is so large that revisiting these words is difficult, sporadic, and laborious. Word Learning-CET6 was designed to get words into peoples' daily vocabulary. It was designed for word acquisition, not word recognition; it had six simple commands designed to make word acquisition seamless, effortless, and efficient; it was based on the specific vocabulary that the participating students were required to study for their university careers. Compared to the three smartphone vocabulary dictionaries (YOU DAO, JIN SHAN CI BA and ZHANG ZHONG YING YU)

Table 5
Accumulated learning hours participants spent on with Word Learning-CET6.

Hours	<55 h	55–110 h	>110 h
No. of Participants	8	20	7

designed by business companies that the researcher found in China, Word Learning-CET6 was special. It was designed for curriculum education with the particular functions of Unknown Words and Sample Test to help students learn. One reason of why the researcher designed Word Learning-CET6 instead of using an existing one was that she thought that the vocabulary databases of the three dictionary apps she knew were too large to be selected as teaching/learning materials. The second reason was for functional deficiencies. Two of the three apps were without Unknown Words and all three had no Sample Test command. In the one app with Unknown Words function, there was only one unknown word database folder existing. The researcher deemed that one database for unknown words is insufficient because some words are harder to learn than others and constructed a three tier folder system to help learning in Word Learning-CET6. The third reason was “they can do it, I can do it” mentality since the researcher never believed that coding a small software application was an insurmountable challenge.

6. Pedagogical implication

The apparent applicability is to expand into vocabulary learning of other languages. The study was carried out by writing an app and employing smartphones to help the Chinese college students learn English (L2) vocabulary. Clearly, the variables of app, smartphones, Chinese college students and English can be replaced.

Apart from being an example for further MALL activities, the pedagogical implication of this study may give educators, textbook writers or publishing houses certain ideas, in which in the future, they may include files or applications downloadable to smartphones along with their materials. This researcher believes that teaching/learning via smartphones will become increasingly important in technical fields where practitioners must understand a range of specific terms to successfully operate in the workplace of their chosen field, for example, to work safely and professionally. A smartphone is always handy and readily available. In case of uncertainty, professionals in situations are more likely to pull out their smartphones to search for a solution rather than risk a dangerous uninformed attempt at solving problems. For teachers, this program can serve as a foundation for their own ideas. This program has proven to be successful, and so, will assist teachers to design MALL classes, especially L2 vocabulary classes.

This researcher considers that the design of Word Learning-CET6 was a simple task. Her knowledge of computer sciences was limited, but with a limited amount of assistance from online programmer forums it was quite manageable. The program was written by the researcher with a downloaded B4A manual in a month. The only time consuming part was the repetitive work of collecting, organizing and compiling the 1274 words. This compilation work is easy to hire out. In conclusion, for the pedagogical portion of this study, this researcher believes that most teachers can make their own mobile teaching/learning materials in a similar or better design. The intention of this portion of the article is to introduce a direction in which educators should be setting their minds, and set up a pedagogical example which can be followed.

7. Conclusion

The first purpose of this study was to find a new way to help EFL students retain English vocabulary. The theory was to make learning vocabulary more convenient and user friendly. To do this, Word Learning-CET6 was created. Word Learning-CET6, designed with B4A programming language and based on the curriculum content for the students involved in this study, was a simple word learning program through smartphones. The study was inspired on findings of previously published research on the subject. The goal was to show that access to proper material, convenience of use, and the integration of advances in modern technology with old school methods could significantly improve vocabulary acquisition. Using this researcher's theory and newly developed program the participants in the test group recognized 88.67 more words, or a 6.96% improvement than the control group. This result concluded the researcher's first purpose and attested that smartphones are effective tools for learning English vocabulary in a natural environment. This study examined three reasons for the significant result. The first two are the convenience and accessibility as discussed. The third is the technological functions incorporated into the program that make learning, testing and reviewing easy.

The second purpose of this study was to pave the way for educators of second language acquisition to better results. Learning from past researchers, repetition, accessibility and convenience are all important aspects of learning vocabulary. The smartphone and B4A programming language provide an easy solution for all of those obstacles. This researcher hopes that in reading this paper other educators would embrace this new technology while doing their service to make learning English as a foreign language easier.

8. Limitations of the study

The Word Learning-CET6 app needs to be upgraded. The researcher understands the absence of a function to communicate with users; another missing function is update, for correcting errors or supplying new content. Both functions are requisites to run live class. This study focuses on facilitating students' recognizing and recalling of vocabulary only. In the future, perhaps, studies may consider facilitating students' other 17 cognitive processes (Anderson & Krathwohl, 2001, p67–68), such as to understand the meaning of vocabulary in learned context and out of it as well as to apply that vocabulary in daily life situations. This research presents a neonatal idea to invite further scrutiny.

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