Taiwan Journal of TESOL
Vol. 19.2, 1-28, 2022 10.30397/TJTESOL.202210_19(2).0001

MOBILE ASSISTED ACADEMIC VOCABULARY LEARNING

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ABSTRACT

While existing literature supports the use of smartphones to teach English vocabulary, limited studies have addressed how learned words can be transferred to college students' writing. This action research study designed pretest, treatment on mobile phones, posttest, and out-of-class pair-work, followed by a delayed posttest after three weeks to promote academic vocabulary use in writing. In the four-week treatment, academic words and collocations were designed using Quizlet units, combined with in-class writing practice. In the pair-work stage, the participants were allowed freedom to choose words they desired to learn and to exchange each other's word logs with recycling of taught vocabulary designed in the treatment. Assessment of the pretest, posttest, and the delayed posttest involved (a) a general academic vocabulary test (receptive knowledge), (b) a vocabulary test of target words (gap-filling), and (c) an in-class writing task. Results show that our mobile-assisted language learning (MALL) project helped participants remember more words after their MALL experiences and apply them in their writing; meanwhile, such improvement could be maintained. Pair work was more favored than individual work as the participants indicated a stronger preference and endorsed collaborative learning. We argue that mobile devices should be combined with new learning strategies for both in-class and out-of-class learning.

Key Words: Quizlet, academic vocabulary, mobile-assisted language learning, college writing

INTRODUCTION

Smartphones have become very common among the younger generation as part of their leisure life for communication and other purposes. Mobile devices adopted anywhere and anytime have

increasingly been applied in educational and language learning contexts (Kukulska, Lee, & Norris, 2017; Lin & Lin, 2019; Liu, 2016; Luo, 2020), called mobile-assisted language learning (MALL, Stockwell, 2016). To write English academically is challenging for first-year college students even when they are English majors. In the context of Taiwan, academic literacy is a needed component for college newcomers because in high school education, not enough authentic academic discourse is offered. Academic words (e.g., those on the academic word list, AWL, Coxhead, 2000) are suggested as the first step to help college students to master academic reading and writing (Lin & Liou, 2009). While single words used in an academic text are crucial to master, multi-word units (such as collocations) in academic discourse can assist college students in processing English chunks more efficiently for communication. Thus, academic formulaic sequences have gradually become more common and important in learning language. However, few studies discuss their application to teaching English writing via cell phones.

How to harness MALL for the purpose of increasing college students' academic vocabulary (and collocations) to be applied for writing requires new learning strategies as argued by Kukulska-Hulme, Lee, and Norris (2017). Mobile devices for language learning can be adopted for both in-class and out-of-class tasks. Autonomous learning (meaning the students can learn by themselves) and learning mobility (learning takes place anyplace at any time) are two key features of MALL. Some limited studies (e.g., Chan & Liou, 2005; Lin & Liou, 2009; Liou & Chen, 2018; Liou & Chou, 2018; Liou & Lin, 2017) have addressed the teaching of academic words or formulaic sequences to improve college writing by adopting classroom teaching or resources on personal computers. How MALL can be applied to enhance the use of academic vocabulary for writing requires more research to provide empirical evidence for teachers. The aim of the current action research project is to examine how MALL can be designed to help students acquire academic words and collocations for their English writing enhanced by in-class writing activities and pair-work both in and outside of the class.

LITERATURE REVIEW

As the authority in the research topic of MALL, Kukulska-Hulme (2009) discussed the effect of mobile learning and whether it may change how languages are taught and learned. She maintained that smartphone use contributes to the learner's mobility which can

develop an evolving environment for learning. Rethinking the relationship between the devices of learners and learners' mobility shows that mobile technology could help learners when they need it and in ways that suit their different mobile learning styles. Further, mobile devices should be combined with new learning strategies for not only in-class but also out-of-class learning. Hence, the learners are able to improve their learning motivation and performance via mobile-assisted language learning (Kukulska-Hulme, Lee, & Norris, 2017). Kukulska-Hulme, et al. developed a pedagogical framework to help teachers combine their language teaching strategies with mobile technology. It has four themes: teacher wisdom, device features, learner mobility and language dynamics. Teacher wisdom involves teachers' experiences and teaching strategies. Device features include ubiquitous learning via mobile technology. Learner mobility refers to when and where learners would start to learn and learners' goals. Language dynamics mean the evolving language use (e.g., social media). They also came up with four connected approaches: learning outcomes, inquiry, rehearsal and reflection. The four themes and four connected approaches may foster some probable positive mobile learning results for learners: learning to notice how language is used, rehearsing, experimenting, developing mobile literacies, learning to learn and developing autonomy and learner-centeredness.

Several recent studies have confirmed the effects of MALL. Bower and Rutson-Griffiths (2016) used a spaced repetition software combining a TOEIC word list (640 words chosen from TOEIC and Japanese high school textbooks) to investigate effects. Sixty participants took the TOEIC test twice in the beginning and at the end of the semester as the pre-test and the post-test. The use of spaced repetition software with a TOEIC word list was shown to improve students' vocabulary learning motivation and help learners do better on the TOEIC. Li and Cummins (2019) examined the effects of using text messages to enhance 108 learners' academic vocabulary acquisition for reading. The project lasted for nine weeks. Both treatment and control groups were required to read the same reading materials and join the class discussions. The control group used online dictionaries and dictionary apps to search for definitions and sample sentences of target words by themselves. By contrast, the treatment group received emails with the information about three selected words from the required reading materials each day through text messages on smartphones. In the nine weeks, the treatment group received 189 target words. The treatment group performed significantly better than the control group in the posttest of target

academic words. Text messages were helpful for learning gains of target words.

To examine how short message and multimedia message services on mobiles were used to help ESL/EFL vocabulary learning, Lin and Lin (2019) investigated the effect and connection of 33 studies researching MALL for vocabulary learning via a meta-analysis. The results indicated both modes were more beneficial than the mobile application mode for learning L2 vocabulary. Nevertheless, each study had a different background and experimental method, so caution should be taken when we explain individual study results. To illustrate, several individual MALL vocabulary studies have been reviewed (Alfarania & Su, 2016; Ankeny, 2019; Andarab, 2019; Ko, 2019; Luo, 2020). Alfarania and Su (2016) investigated whether a mobile learning app, 'NCLEX RN Mastery 2015', can enhance nursing students' medical terminology knowledge. After a five-week RN vocabulary course, students' vocabulary scores improved. Andarab (2019) investigated whether collocating the lexical items on Quizlet could promote the acquisition of vocabulary. Quizlet is a mobile and a web-based vocabulary learning system with several different learning modes. Seventy participants were divided into a control group and an experimental group. Each group received a pretest with 60 gap-filling vocabulary items. Then, the control group students were assigned a list of synonymous English vocabulary items on Quizlet. The students worked on Quizlet with 30 to 40 vocabulary items selected from the course books for each week. On the other hand, the experimental group students were assigned some vocabulary and collocations in sentences. Using Quizlet to learn vocabulary was found to be more beneficial in the experimental group.

Luo (2020) combined a Massive Open Online Course with a Spanish course. Thirty participants were from two classes. The Spanish course was taught two hours per week. Both experimental and control classes used Quizlet and other digital platforms. On Quizlet, teachers or students can establish a vocabulary learning course via flashcards. During two semesters, if the students forgot the vocabulary, they could use Quizlet to learn and enhance their vocabulary. Luo found that the total number of Quizlet exercises completed by the experimental class was more than twice as many as that of the control class. Combined with the use of materials in other platforms, the students showed a more positive learning attitude than those who did not use it.

Based on task-based language teaching (TBLT) as applied to MALL, Ankeny (2019) describes her experiences of integrating cellphone-based WhatsApp applications of teaching academic

vocabulary in an intensive English program. Five key features of technology-mediated TBLT (González-Lloret & Ortega, 2014, pp. 5-6) include (a) primary focus on meaning—a preplanned language learning goal, (b) goal orientation—language-and-action experience, (c) learner-centeredness—learners' needs and wants must be addressed by the task, (d) holism—a task draws on real-world processes of language use, integrating form-function-meaning, and (e) reflective learning—cycles of reflection and self-reflection. Forming a WhatsApp chat group with 13 students in a writing class to learn 30 target words (goal orientation) for eight days, she guided students to learn words through definitions, synonyms, real-life examples, and sentence composition (holism). She also encouraged them to associate words with web images, emojis, and daily life situations (reflective learning). The results showed 12 of the 13 students had improved scores between the pretest and posttest, and seven of the 13 applied the learned vocabulary words to writing narrative paragraphs. Furthermore, most students felt more confident to use the new vocabulary and enjoyed it. WhatsApp is a suitable platform where teachers can guide writing tasks explicitly and foster student motivation and interest. In this short article on classroom explorations, Ankeny did not address how they assessed vocabulary used in students' narrative paragraphs.

Ko (2019) examined 208 students' perspectives on using smartphones and social media with feedback while learning English vocabulary. They asked students to upload assignments and give them immediate feedback both via smartphones. In their reading course, students learned each phrasal verb in context and then created their own sentences using each target phrasal verb. The teacher's feedback followed. Via a survey's responses, students pointed out four benefits of feedback: (a) induce comfort and active learning; (b) increase interest and satisfaction; (c) enhance cooperation and sharing; and (d) improve word use.

From the above individual studies on MALL for vocabulary learning, we found that via various applications on cellphones, medical vocabulary (Alfarania & Su, 2016), collocations (Andarab, 2019), Spanish verbs (Luo, 2020), and academic vocabulary (Ankeny, 2019) could be taught via MALL. Different strategies such as feedback (Ko, 2019) can be used in combination to enhance students' vocabulary learning. These studies, except for Ankeny (2019 but no assessment data of student writing), have yet to examine how learned vocabulary can be transferred to students' writing.

Explicit instruction on academic vocabulary for college writing is not new and has been shown effective when using computers (Chan

& Liou, 2005; Lin & Liou, 2009; Liou & Chen, 2018; Liou & Chou, 2018). While mobile technology would take learning out of the classroom compared with computers, and several studies showed their positive effects (e.g., Andarab, 2019; Ankeny, 2019; Ko, 2019), how such MALL applications could be extended for college writing remains to be explored. Writing exemplifies holism, integrating form and meaning. In other words, we are curious whether item learning of vocabulary on mobiles can be applied to essay writing using target vocabulary.

Needed Research

MALL offers ubiquitous learning to our language learners being digital natives. With its specific technological features, MALL requires new teaching strategies which may combine in-class instruction with more learner-centered out-of-class activities in order to encourage our digital natives to learn English beyond the classroom (LBC, Reinders & Benson, 2017). In Taiwan, academic vocabulary is one crucial aspect for college English teachers to devote their efforts to because freshmen have not had enough opportunities to have been exposed to academic discourse before they are admitted into college. Prior research shows that explicit classroom or online instruction and practice was effective in improving college students' use of academic words (Lin & Liou, 2009) or multi-word units (academic formulaic sequences in studies e. g., Liou & Chen, 2018) for writing. They were implemented in either traditional classrooms or using resources on personal computers and as part of course activities in a classroom context. Limited prior MALL research addressed teaching of academic vocabulary for writing. What is missing in all prior relevant studies is that they did not address what would happen when learners were on their own aiming to learn academic vocabulary for writing outside of the class via smartphones. Thus, the current study addressed the following three questions:

(1) Does a combination of out-of-class smartphone-based vocabulary exercises and in-class writing practice improve students' use of academic vocabulary in writing, vocabulary tests, and essay quality?
(2) Does pair work of out-of-class vocabulary review and learning of each other's new academic vocabulary lead to more use of such vocabulary in their writing after the vocabulary exercise sessions stop?
(3) How do college students feel about the blended design of

Quizlet units, in-class pair writing, and out-of-class pair work on their vocabulary learning for writing?

METHODOLOGY OF THE STUDY

Twenty-six students who were first-year English majors served as participants of the project and signed a consent form before they joined the research. They took a two-credit required freshman writing course in a college which is located in the central part of Taiwan. A blended design was implemented in the course where smartphone-based units were used outside of class together with in-class writing practice.

Treatment of MALL vocabulary exercises

A target word list served as research material for our instruction and assessment. The target word list with 60 items was selected as content and designed using Quizlet in the current study. The target words consisted of 40 single academic words (*exclude, contrast, crucial,* see Appendix) and 20 (mainly grammatical) collocations out of half of the 40 (e.g., *exclude from, contrast with, crucial role*). The selection standard of the target word list was based on the AWL list (Coxhead, 2000), Huntley (2006) and prior studies (Ackermann & Chen, 2013; Liou & Chen, 2018; Liou & Chou, 2018) as the AWL is helpful for improving students' comprehension of academic written texts, and developing vocabulary tests and dictionaries (Coxhead, 2011, 2016).

We chose Quizlet, a cellphone app, as a delivery application for exercises of academic vocabulary and collocation items. Quizlet is a free mobile and a web-based vocabulary learning system with eight different study modes: (a) Flashcards, (b) Learn, (c) Write, (d) Spell, (e) Test, (f) Match, (g) Gravity, and (h) Live. Our treatment required students to operate units using the mobile version with only five study modes excluding Spell, Gravity, and Live. Students could use the other study modes on their computers.

The five MALL study modes are illustrated below:

(1) Flashcards: it is a digital flashcard for pair-associated words or phrases in two languages (English and Chinese in our project). The students not only can read the English vocabulary item (*access* in Figure 1) and Chinese meaning (通道、途徑) and an illustrative example sentence (*The only access to the village is*

by boat. 到那個村子去的唯一方法是乘船。). Additionally, they can also listen to the built-in pronunciation of the target word or the phrase. Moreover, some vocabulary items have built-in pictures, helping students memorize the form more easily. All these features encourage noticing when students aim to acquire target academic words (Kukulska-Hulme, et al., 2017).

(1) English vocabulary item

(2) Chinese meaning and an illustrative example sentence

Figure 1. Flashcards study mode

(2) Learn: there are three question types in the *Learn* mode—flashcards, multiple choice questions, and writing questions (see Figure 2). The system shows each vocabulary item randomly and tracks users' vocabulary learning progress. When students give the wrong answer, the system shows the correct answer for students. They can memorize target words through repeated practice with these three question types.

(1) multiple choice questions

(2) writing questions.

Figure 2. Learn study mode

(3) Write: it is to spell the word form based on a cued vocabulary item (see Figure 3). The student is prompted by the Chinese definition on the screen or hears the English word pronounced from the system, and then spells the word form.

Figure 3. Write study mode

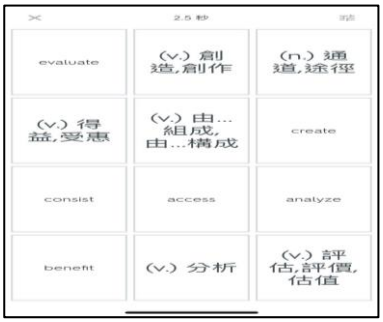

Figure 4. Match study mode

(4) Match: it is a timed game that students have to match four of the five terms with their correct corresponding definitions as quickly as possible. If students pick the wrong match, extra time will be added to complete the exercise. In Figure 4, the English word *evaluate* is matched with one of six Chinese definitions provided.

(5) Test: it is a warm-up test where students are assessed by the system with randomized items. There are four question types—writing, matching, multiple choice, and true/false. Students can use this mode to test how many vocabulary words they have memorized.

Research Instruments

To assess the participants' vocabulary performance, three tasks were given at the pretest, posttest, and delayed posttest stages: a self-made 20-item vocabulary test (a sample illustrated below), AWL-receptive, and an in-class writing task. First, the 20-item vocabulary test in a gap-filling format was adopted as one instrument to assess students' vocabulary performance on the 40 target vocabulary items.

Forty target academic words which were taught on Quizlet units were provided in a list such as: *access, achieve, assess, benefit, contrast, crucial* (six words illustrated with two items given below).

That is, half of the target words (20 items) were assessed by asking students to choose appropriate words in a 40-word list to fill in.

1. The only _access to_ the village is by boat.
2. I feel that I have _benefited_ greatly from her wisdom.

The second task was a vocabulary test of 30 words selected from the Academic Word List: Test A (Nation, see the complete version and answer keys https://www.victoria.ac.nz/lals/about/staff/averil-coxhead, AWL test). To show their receptive knowledge of academic words, students matched three word definitions out of a set of six words. Altogether there were ten sets. The third task was a sixty-minute in-class writing task to be completed on a word processor. Three prompts were designed for the pretest, posttest, and delayed posttest: (a) "Reasons for Buying a New Cellphone" (b) "Reasons for Buying a New Notebook Computer", and (c) "Reasons for Collaborative Learning in College". The genre of the three writing prompts was all of analysis type by giving two or three reasons with illustrations. The ratio of academic words in all student essays was obtained via Vocabprofile analysis (https://www.lextutor.ca/vp/eng/).

We referred to the questionnaire used in Perez-Paredes et al. (2019, their Appendix A) and modified its items in order to design two of our questionnaires (1 and 2) to be used in the posttest and delayed posttest. The two questionnaires consisted of items with a five-point Likert scale of agreement (5 = Strongly Agree, 4 =Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree) and one item on feelings about the designed treatments and out-of-class pair-work. The posttest questionnaire had 15 items and the delayed posttest questionnaire had seven items. Both were translated into a Chinese version to avoid confusion on the students' understanding when they responded.

Data Collection

The designed activities covered two semesters of the writing course by integrating them into traditional classroom tasks. The first semester was mainly for preparation of the participants' MALL literacy and activities. Three essay assignments were required by the writing curriculum in this institution each semester. In weeks 12 and 13 of the first semester, smartphone literacy and Quizlet functions were introduced to the students in order for them to learn with content on academic words and collocations. In the second semester, the treatment design included four-week units as the out-of-class MALL-based vocabulary exercises was given via four Quizlet units followed

by three weeks of pair work. A pretest, a posttest, and a delayed posttest were designed to assess how the participants learned academic words and collocations through these activities.

In week 1 of the second semester, students were given the pretest which consisted of the three assessment tasks. In weeks 2-5, students were learning 10 academic words and five collocations on Quizlet (using their own cellphones) each week outside of class before they came to class to do pair-writing using six of the target ten items to compose an 80-word paragraph. The in-class practice enabled rehearsing of target vocabulary and experimenting with them in the paragraph (Kukulska-Hulme, et al., 2017), and took about 40 minutes to complete. Each week, the instructor commented on the paragraph (concerning content, organization, and usage of target words and language use), and returned them to all students in the following week by giving a score (out of 100) as classroom assessment (not included as this research data). In week 6, students were given the posttest and questionnaire 1. In weeks 7-9, students were required to find a peer to do the pair-work with by (a) selecting four academic words of their own new or unfamiliar items to learn and (b) reviewing three academic words they had already learned during weeks 2 to 5 on Quizlet (both outside of class). For the new words to add, the headwords of the AWL were provided for all participants to view. For the two tasks on Quizlet, students have to give an example sentence for each chosen new or old word. Information added in by students (a word log) was kept in Quizlet so they could view it later using their smartphones at any time or anywhere. In week 10, students were given the delayed posttest and questionnaire 2. Table 1 provides the time table of data collection.

Table 1

Timetable of Data Collection

Week	Content
Week 1 (100-minute in-class time)	Pretest (in class)
Week 2 (out-of-class MALL before class meeting)	Quizlet unit 1 (academic words/collocations) + in-class pair writing
Week 3 (out-of-class MALL)	Quizlet unit 2 (academic words/collocations) + in-class pair writing
Week 4 (out-of-class MALL)	Quizlet unit 3 (academic words/collocations) + in-class pair writing
Week 5 (out-of-class MALL)	Quizlet unit 4 (academic words/collocations) + in-class pair writing
Week 6 (100-minute long)	Posttest+ questionnaire 1 (in-class)
Week 7	Out-of-class Quizlet pair work 1
Week 8	Out-of-class Quizlet pair work 2
Week 9	Out-of-class Quizlet pair work 3
Week 10	Delayed posttest+ questionnaire 2 (in-class)

FINDINGS AND RESULTS

The statistical paired T-test was used to compare students' performance elicited in the pretest and posttest, as well as in the posttest and delayed posttest concerning our vocabulary test and the AWL-receptive test. As indicated in Table 2, we found that students' posttest performance when compared with that elicited in the pretest was significantly different, which indicated they had improved due perhaps to the smartphone treatment on Quizlet units and in-class practice. Students' AWL-receptive scores improved from 68.50 to 73.97 (out of 100.00, t=-3.612, p<0.01) as in Table 3; and the vocabulary test improved from 47.38 to 55.12 (p<0.05, t=-3.825, p<0.01) as in Table 4. When their delayed posttest performance on both tests was compared with those of their corresponding posttests using the same paired t-test, the progress from the pretest assessed in the beginning of the semester was maintained (both p's >0.05).

Table 2

Results of Descriptive Statistics of AWL-receptive Tests at Three Time Points

N=26	Mean	Standard deviation	Maximum	Minimum
Pretest	68.50	15.83	87	30
Posttest	73.97	15.33	93	33
Delayed Posttest	75.77	14.19	100	37

Table 3

Results of Paired T-tests on AWL-receptive Tests at Three Time Points

N=26	*T*	*P*
AWL30 Pretest - AWL30 Posttest	-3.612	.001
AWL30 Posttest - AWL30 Delayed Posttest	-0.917	.368

Table 4

Results of the Vocabulary Tests at Three Time Points

N=26	Mean	The Vocabulary Tests	*T*	*P*
Pretest	47.38	Pretest - Posttest	-3.825	.001
Posttest	55.12*			
Delayed Posttest	54.81	Posttest - Delayed Posttest	-0.127	.900

Rating of all the students' writing at the three time points was conducted by a professor and an MA graduate student both with a background in English teaching with an inter-rater reliability of 0.87 using the TOEFL independent writing rubric (https://www.ets.org/s/toefl/pdf/toefl_writing_rubrics.pdf, with a full

score of 100 instead of 0-5). T-test results of the students' writing quality as elicited at the three time points indicate the trends are like those of the two tests: significant improvement from the pretest (t=-5.363, p<0.01) and maintained as shown on the delayed posttest (see Table 5).

Table 5

Results of the Writing Task at Three Time Points

N=26	Mean	The Writing Task	*T*	*P*
Pretest	70.75	Pretest - Posttest	-5.363	.000
Posttest	75.75*			
Delayed Posttest	75.00	Posttest - Delayed Posttest	-0.549	.588

We further examined the students' use of academic word profiles in their texts by comparing their word ratios, word types, and the 40 target words at three time points as shown in the underlined/bold columns of Table 6. The use of academic words from the three dimensions, when we compared their pretest and posttest performance, all show significant differences, better in the posttest (all p's<0.05).

Table 6

Profiles of Vocabulary Use in Student Essays Across Three Time Points

N=26	Pretest		Posttest		Delayed posttest	
Words of essay	**Total**	**Mean**	**Total**	**Mean**	**Total**	**Mean**
	5452	209.69	6504	250.15	6308	242.62
K1 (%)	-	084.35	-	082.40	-	086.03
K2 (%)	-	006.15	-	003.88	-	003.79
AWL (%)	-	002.96	-	006.50	-	005.60
Off list (%)	-	006.53	-	007.21	-	004.58
AWL Type (raw no.)	0142	005.46	0217	008.35	0290	011.15
AWL (40) (type, raw no.)	0010	000.38	0029	001.12	0052	002.0

To illustrate how the students used the 40 target words with their collocations designed on Quizlet, Table 7 lists taught vocabulary items used in the pretest, posttest and delayed posttest writing. As clearly shown, students learned more academic words and collocations and could apply them in the posttest and delayed posttest writing (increases from 10 to 29 to 52 words) after the MALL experiences and pair work both in and out of the class.

Table 7

Students' Actual Use of the 40 Target Words and Collocations at Three Time Points

Pretest essays	Posttest essays		Delayed Posttest essays	
communicate	create	contrast (to)	Benefits	create
design	focus (on)	occupy	communicate	communicate
benefit	contrast (with)	benefit	(with)	(with)
access (to)	enforce	create	communicate	range
goal	consist	benefit	(with)	enables
design	design	evaluating	benefits	goal
benefit	evaluate	focus (on)	benefits	create
create	excluded	monitor	benefits	communicate
occupy	monitor	interact	communicate	potential
communicate	communicate	enable	(with)	select
(with)	(with)	selecting	benefits	contrast (to)
	enable	maintain	designing	create
	access	design	benefits	perceive
	enable	transfer	benefits	goals
	accessed	contrast	benefits (from)	communicate
		(with)	communicate	(with)
			communicating	enable (to)
			attribute (to)	enables (to)
			focus (on)	interacting (with)
			benefit	access
			benefits	communicate
			create	(with)
			communicate	contrast (to)
			(with)	enable
			create	communicate
			benefit	interact (with)
			compute	communicate
			benefit (from)	(with)
			goal	goal
			contrast	
10 words with 2 collocations	29 words with 6 collocations		52 words with 18 collocations	

To understand the students' perceptions about this MALL project, the overall rating of the 14 items in the posttest questionnaire came to an average of 3.82 out of a total of 5.00 as indicated in Table 8. This

indicates most of the participants agreed with statements related to the instructional design of this MALL project or felt moderately satisfied with the design. Specifically, content of academic words designed in *Quizlet* Quizlet units was deemed useful in assisting students in applying words into essay writing (items 1, 4, and 5, ratings higher than 3.91) with mobility (item 5). Compared with the out-of-class individual practice on Quizlet units which focused on usage of the 40 target words, the participants preferred the collaborative learning approach in class with peers in order to apply target word knowledge to writing paragraphs (items 10, 12, 13, 14, rating higher than 3.95). Still the pair practice in class did not help them memorize words for writing more easily (item 9). Moreover, the MALL design did not encourage them to learn about English writing autonomously (item 7) and they would not keep using them in the future (item 2), from items with the lowest ranking. While Quizlet units may help the participants memorize academic words more easily, one example sentence in the flashcards may not be enough for some participants to acquire word usage or be able to apply them in their writing (items 6, 8). Nor did they see direct relevance of integrating the units into a writing course syllabus (item 3).

Table 8

Results of the Posttest Questionnaire on Quizlet Units

items (N=26)	Mean	SD	Rank order
1.這個 APP 對於寫作上用到的學術單字和搭配詞學習是有用的。 The app is useful for learning academic words and collocations for writing.	4.15	0.675	3
2.在使用這個 APP 之後，我未來將會繼續使用這個 APP。 After using the app, I am going to continue to use the app.	3.35	0.977	13
3.使用此 APP 應納入寫作課程的一部分。 The app should be used as part of a writing course.	3.42	0.809	11
4.這個 APP 幫助我提升學術單字和搭配詞的知識。 The app helped me improve my knowledge of academic words and collocations.	3.96	0.720	5
5.這個 APP (Quizlet) 讓我可隨時隨地使用並容易記住學術單字和搭配詞，幫助寫作。 Using Quizlet/the app made it easier to memorize useful academic words and collocations for writing anywhere any time I like.	3.92	0.935	7
6.使用這個 APP 後，我對學術單字/搭配詞在作文文句上下文中的使用更加敏銳。 After using the app, I am more sensitive to how academic words/collocations are used in context.	3.42	0.857	11
7.使用這個 APP 使我能夠更自主學習英語寫作。 Using this app can turn me into a more autonomous English learner-writer.	3.31	0.884	14
8.使用這個 APP 後，我對英文詞彙在寫作中的使用更加敏銳。 After using the app, I am more sensitive to the role of vocabulary in writing.	3.69	0.884	10
9.分組課堂寫作，可幫助我記住在 Quizlet 中所學之學術單字/搭配詞，並應用到寫作上。 To have pair writing on Quizlet review of English academic words/collocations was useful for me to memorize them and apply them to writing.	3.88	0.653	8
10.我喜歡在課堂上與我的同學一起學習寫作，因為這比獨自一人寫作更有效。 I like to learn with my partners out of class as it is more effective than learning alone.	3.96	0.999	5
11.使用這個 APP Quizlet 分組活動，讓我能更自主學習英語寫作。 Using this app (Quizlet part I and part II-pair work) can turn me into a more autonomous English learner-writer.	3.81	0.981	9

Table 8 (continued).

12.小組課堂寫作我們主要（完全）都在構思內容及如何用上六個單字(每週寫作應用單字量)。 While doing in-class pair writing, we are mainly (completely) thinking about the content and how to use six academic words.	4.04	1.038	4
13.小組課堂寫作，我們有回頭查手機某些關鍵學術單字的例句用法,或用字典再查詢某些字以確認用法正確。 In in-class pair writing, we go back and look up examples of some key academic words on our mobile phones or look up some words in a dictionary in order to make sure they are used correctly.	4.50	0.762	1
14.課堂小組合作寫作，對運用手機學到新單字應用到寫作較個人單獨思考運用單字寫作有幫助。 Pair writing is more helpful for learning new words on mobile phones and applying them to writing than thinking and working on the writing task alone.	4.19	0.939	2
Average	3.83		

Note. 1= strongly disagree, 5=strongly agree

In item 15, among several design features, the content of academic words and collocations was rated the highest compared with others. Still, 15 out of all participants supported the mobility and accessibility of using cell phones to learn the target vocabulary for writing. While they liked to learn academic words via smartphones, they still prefer to having more in-class activities (50%) compared with those outside of the class or “homework”. For the downside of the project’s design features, one student pointed out raising the difficulty level of the words chosen.

Table 8 (continued).

15.我對 Quizlet 活動的整體設計(第一部分和第二部分)感到滿意，因為：(可複選) The entire design of Quizlet activities (part I and part II) is satisfactory to me because (of)	N=26
(1)其內容 (學術單字/搭配詞) its content (academic words/collocations).	21 (81%)
(2)其活動設計：先單獨學習(+課堂中分組寫作) ，再分組工作。its activity design: first learning alone (+in class pair writing) and then pair work	16 (61%)
(3)透過手機操作 (課外隨時隨地)。 its delivery on cell phones. (anywhere)	15 (57%)
(4)課堂中操作的部分愈多愈好。 More in-class part would be better.	13 (50%)
(5)下次可持續改進的部分 Other parts can be improved in the future Student A: The vocabulary could be more difficult.	

Concerning the three-week design after the posttest, the students agreed that, with their classmates together, the reviews of target words were helpful for memorization of words and collocations (item 1), reviews of word knowledge (item 2), and learning of useful academic word items via adding new targets (item 7) as shown in Table 9. While the in-class pair work was preferred to the individual out-of-class exercises as shown in the first questionnaire responses, they did not like out-of-class pair work and did not think it more effective than individual work (item 5). Learner autonomy takes a much longer time and perhaps a different design or strategy for this group to develop because on both questionnaires they did not think they became more autonomous (item 6 in Table 9 and item 7 in Table 8).

Table 9

Results of the Delayed Posttest Questionnaire

Results of the delayed posttest questionnaire (N=26)		
Items	Mean	Rank Order
1.此三週中在 Quizlet 中分組學習學術單字(*access*)/搭配詞(如 *access to*)對我記住它們和應用到寫作裡是有幫助的。 During the three weeks, pair work helped me remember how to apply academic words/phrases in my writing.	3.96	1
2.在 Quizlet 中分組複習學過單字對我很有幫助 During the three weeks, pair-work for reviewing old words was helpful to me.	3.88	2
3.在分組學習中，新增我自選的新學術單字和其含義，可以滿足我的學習目的。 Adding new words in the 3-week pair work can satisfy my own learning needs.	3.81	4
4.在分組學習中，同學所增添的新學術單字/搭配詞，擴展我的詞彙量和幫助我學習。 To learn the new words added by classmate(s) expanded my vocabulary, which is helpful to learning.	3.58	6
5.我喜歡在課後與我的同學一起學習，因為這比獨自一人學習更有效。 I like to learn with classmate(s) after class because this is more effective than learning alone.	3.23	7
6.使用這個 APP (Quizlet 同儕分組一和二)在課後學習，讓我成為一個更自主學習的英語寫作者。 Using the after-class Quizlet app units helped me to become an independent learner for writing	3.73	5
7.使用這個 APP (Quizlet 單元及新增單字) 讓我更容易記住有幫助的學術單字和搭配詞 Using Quizlet units helped me remember useful academic words/phrases more easily.	3.88	2
Average	3.73	

DISCUSSION

To address the first research question, we examined the effect of the MALL project from two vocabulary tests and a writing task at three time points. Significant improvement was found on all the assessment tasks from the pretest to the posttest. When the delayed

posttest performance was compared with that of the posttest, the MALL effects were maintained. That is, a combination of out-of-class smartphone-based vocabulary exercises and in-class writing practice improved students' use of academic vocabulary in writing, vocabulary tests, and essay quality. Like Lin and Liou (2009) and Liou and Chen (2018), raising students' awareness of academic vocabulary seems to be evident in this project for students to demonstrate learning gains not only in tests but also in their writing because more general academic words and target items were applied in their post-treatment writing together with better writing quality. In our instructional design of Quizlet units, we provided example sentences for academic words or collocations. This was different from other earlier MALL studies (e.g., Alfarania & Su, 2016; Andarab, 2019; Bower & Rutson-Griffiths, 2016) but unique because to apply academic vocabulary to writing requires acquisition of productive knowledge which is much deeper than recognizing its Chinese meaning alone. The in-class writing practice is also essential to consolidate the productive knowledge in order to use words appropriately. While all three writing prompts used in the pretest, posttest, and delayed posttest required analysis, they were different. We did not ask students about difficulty levels of the three prompts from their perspective; however, topic differences may have an effect on writing quality and constrain or facilitate their use of the target academic words in their texts. This was a factor our design of an action research project could not control. Anecdotal evidence from our lab observations when the participants were composing the three essays indicate they felt they had much to share on the first topic of "buying a new cellphone" but were bored to have to discuss "collaborative learning" when they were given this prompt to work on.

To address the second research question, we compared the posttest performance with that of the delayed posttest and found the participants could maintain the same level. In other words, the design of pair work of out-of-class vocabulary reviews and learning of each other's new academic vocabulary both on the participants' mobile activities (using Quizlet functions) have led to more use of such vocabulary in their writing after the vocabulary exercises stopped.

To address the third research question, we analyzed the two questionnaire responses and found partial confirmation. The participants agreed that the content of academic vocabulary with illustrated sentences was useful for vocabulary acquisition. They particularly liked to be able to write with classmates in class in order to use the vocabulary they had learned via cellphones. Pair work

using Quizlet was generally regarded as helpful for them to consolidate the productive vocabulary knowledge for writing. In other words, these college students were positive about the effects of the blended MALL design with in-class practice and out-of-class pair work on their vocabulary learning for writing. However, negative comments from the participants were also noted: they preferred more in-class pair work to out-of-class homework (be it individual or collaborative); nor did they feel more autonomous in learning about English writing, given the integral part of the academic word units.

In this study, effects of MALL mediation, learner autonomy and pair work were supported in our study like the findings in another virtual vocabulary learning project (Tseng, Liu, & Chu, 2020). In our study, learners' individual work and pair-work both in and out of the class were designed in a smartphone-mediated environment. As argued by Tseng et al., all of the individual, pair-work, and the teacher-designed smartphone units (on Quizlet) showed positive effects on the students' learning outcome. Particularly, pair-work conditions still maintained the same learning effect in the delayed posttest. In the pair-work, students learned with their partners and consolidated knowledge of taught words with each other. In contrast with the out-of-class individual MALL practice, pair-work of in-class practice writing could provide direct assistance for or from peers. The out-of-class pair-work enhanced students' long-term learning for memorizing the taught vocabulary as shown in the delayed posttest. The current study indicated that the result of learner autonomy was more significant with pair work than studying alone. Our students also highlighted the accessibility of using smartphones for English vocabulary learning. The design of individual learning plus pair-work consolidated their knowledge of academic vocabulary. While all the measures confirm the usefulness of our blended design augmented by MALL, the participants' perceptions did not indicate an obvious increase of learner autonomy, along with other reservations in this project. While it seems that most students obediently finished weekly assignments on time to yield a positive outcome, their autonomous learning attitudes may take a much longer treatment time for them to develop or other strategies such as more in-class collaborative work which future research may uncover.

CONCLUSION

This study evaluates a course design where mobile phones with Quizlet units and supporting vocabulary activities were integrated.

After the mobile experiences, we show several positive effects of higher vocabulary test scores, better writing quality, more academic vocabulary to emerge in students' essays, and students' moderate satisfaction plus maintained learning effects.

Although smartphones are effective for short-text display and single-item vocabulary learning, contexts for academic words are essential to mastery of productive vocabulary knowledge. We would recommend example sentences to go with word meaning to be included in the MALL design, like what was done in the current study, if other English teachers also aim for having students use more academic words in writing.

More multi-word instruction should be given to EFL students in a similar context as our study. We did not find an obvious increase of collocation use (from 2, 6 to 18 target collocations over the project duration) on our students. More exposure to the target collocations via reading or media may raise the students' awareness.

As an action research project, the study has some limitations. It did not have a control group and factors involved in the treatment did not allow a rigorous analysis of individual or pair work. We argue that combining in-class with out-of-class activities, and including pair work after individual MALL experience contributed to the success of this pedagogical project. We support that mobile devices should be combined with new learning strategies for both in-class and out-of-class learning (Kukulska-Hulme et al., 2017). To learn academic vocabulary beyond the classroom not only saves the teacher's in-class time for other valuable activities and interaction with students, but also cultivates the students' individual work with smartphones on their own after class.

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ACKNOWLEDGMENTS

The authors would like to thank the anonymous reviewers of the Taiwan Journal of TESOL for their constructive comments to help improve earlier versions of this paper. The research project which led to this paper was partially funded by Ministry of Education, Taiwan, under the number of PED1090439.

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PUBLISHING RECORD

Manuscript received: January 28, 2021; Revision received: May 20, 2021; Manuscript accepted: June 15, 2021.

APPENDIX

Appendix A. Target words/collocations list

	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**
1	analyze	Enable enable to	range	retain
2	access access to	Monitor	deduce deduce from	register
3	assume	Specific	exclude exclude from	interact interact with
4	benefit benefit from	Dispose dispose of	apparent	focus focus on
5	consist consist of	Enforce enforce on	attitude	commit commit oneself
6	contract contract with	compute	communicate communicate with	attribute attribute to
7	create	maintain	contrast contrast with	occupy
8	design	obtain	goal	emerge
9	evaluate	perceive	investigate	imply
10	select select from	potential	resolve resolve to	transfer transfer to