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Investigating the Impacts of Mobile Assisted Reading on EFL Learners' Vocabulary Knowledge Development*

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Abstract. In recent years, the proliferation of mobile technologies is transforming educational practices around the world. In this regard, students are attending classes with their mobile or tablet devices, on which they do most of their reading and writing activities. This has resulted in new understanding of literacy as being multimodal, fluid, sociocultural, and dynamic social practices. Meanwhile, mobile-assisted language learning developed exponentially, and its implementation has been reported to be generally effective in language education compared to traditional materials. Within this line of research, the current study examined the impacts of mobile assisted reading on English language learners' vocabulary development. The participants of the research were 52 adult language learners divided into one experimental and one control groups. The participants in the experimental group employed mobile devices for reading a number of selected and simplified news reports, however, the control group used traditional print-based materials for reading the same content over the course of 10 weeks. The participants' vocabulary gains were compared in pre- and post-tests and the findings indicated that the two groups improved their vocabulary knowledge, but the experimental group learned more vocabulary items and outperformed the control group on post-test. The findings highlighted the significant contribution of mobile phones in improving foreign language reading with associated impacts on vocabulary development. The study has implications for language teachers and materials development in teaching English to speakers of other languages.

Keywords: MALL, Reading, Vocabulary, EFL, Educational Technology.

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1. INTRODUCTION

Digital technologies are fundamentally transforming different aspects of human life and educational practices around the world. In this regard, with the transition of educational practices in formal and informal contexts towards online platforms (Meskill & Quah, 2012), Internet and digital tools started to challenge traditional views on literacy and redefined them as an amalgam of fluid, sociocultural, multimodal, and dynamic social practices (H.-I. Chen, 2013). Additionally, given that the majority of literacy practices in education and life, in general, have moved onto the digital screens (Pennington, 2003), some recent voices argued for the "reevaluation of literacy, writing genres, and associated instructional practices in the L2 classroom" (Elola & Oskoz, 2017, p. 5). In line with these developments, Computer Assisted Language Learning (CALL) is gaining increased attention (Chapelle, 2009; Garrett, 2009; Kessler, 2018; Lafford, 2009; Levy, 2009), and the application of different technologies is reported to be facilitative in language education (Farr & Murray, 2016; Golonka et al., 2014). Furthermore, within the changing and evolving landscape of CALL, the growing functionality and affordability of mobile phones for language learners and teachers have made Mobile Assisted Language Learning (MALL) an attractive option for teaching language (Demouy & Kukulska-Hulme, 2010; Godwin-Jones, 2017; Grigoryan, 2020; Lai, 2016; Nazari & Xodabande, 2022; Wrigglesworth & Harvor, 2018), and it has been argued that the use of smartphone devices are associated with the start of new era in educational technology implementation (Godwin-Jones, 2017).

The accumulated body of knowledge attained from various MALL implementation studies show that portable digital devices such as personal digital assistants (PDAs), tablets, smartphones, and MP3 players contributed significantly to learning outcomes and improved language learning (AbuSa'aleek, 2014; Burston, 2013, 2014; Z. Chen et al., 2020; Chwo et al., 2018; Godwin-Jones, 2011; Hwang & Fu, 2019; Stockwell, 2013; Sung et al., 2015; Wong & Looi, 2011; Xodabande & Atai, 2022). In this regard, some studies explored the impacts of MALL on second language reading comprehension (Gutiérrez-Colón et al., 2020). The findings from these studies generally show that those students who used mobile devices for reading scored higher than those who used traditional materials in reading tests. Nonetheless, the use of various mobile technologies in most studies has been associated with short-term interventions (Chwo et al., 2018; Hwang & Fu, 2019), and their potentialand affordances for second language acquisition remained largely unexplored. Given that reading in a foreign language is among the main sources for vocabulary development (Nation, 2013; Webb & Nation, 2017), and the fact that knowledge of vocabulary correlates positively with all other language skills including speaking, writing, and listening (Morris & Cobb, 2004; Qian, 2002; Schmitt et al., 2011, 2017), there is a need for more studies investigating the effects of mobile-assisted reading on second language vocabulary development. This study followed this line of inquiryand compared the vocabulary learning gains from mobile or paper- based reading.

Literature Review

Focusing on strategy use in mobile-assisted reading, Auer (2014) investigated the use of tablet devices in English reading comprehension among seven high school students in Denmark. The participants' data were collected using iPad usage logs over three weeks, and semi-structured interviews. The findings pointed to the usefulness of mobile devices in reading comprehension as students employed a variety of cognitive and metacognitive strategies. In another study, Hamdan and Amorri (2014) reported a study in United Arab Emirates where language teachers worked collaboratively with ICT specialists in developing a mobile application to help English language learners in developing reading comprehension. The results of this study revealed that using mobiles improved students reading competence by activating their prior knowledge, and equipped them with top-down and bottom-up reading skills and strategies.

Gheytasi et al. (2015) explored the effectiveness of smartphone devices in promoting reading comprehension among 40 Iranian high school students, who were divided into control and experimental. The students received different treatments for reading in English, as the experimental group employed a mobile application for a month and the control group was taught by traditional materials. The researchers collected a combination of qualitative and quantitative data to illuminate on differences between the two groups. The results showed that using mobile phones was associated with improved reading competence for the experimental group. Taj et al. (2017) investigated the impacts of MALL on EFL students' reading comprehension at the tertiary level by conducting a quasi-experimental study involving pre- and post-test. Participants were 122 university students, which received second language reading comprehension materials on mobile devices or personal computers for six weeks. The results indicated that those who received reading materials on their mobile phones outperformed those using PCs.

Plana et al. (2016) studied 95 Spanish university students' attitudes towards using mobile device and WhatsApp application to improve English language reading skill. Over a period of three months and a three times a week basis, the participants received reading activities including multiple-choice, gap-filling, T/F, and open-ended questions through WhatsApp. The teachers provided immediate feedback on students' performances in the activities. The researchers employed pre- and post-treatment questionnaires to uncover the participants' perceptions and reactions regarding using mobile phones for reading comprehension. Findings showed that the participants received the intervention positively and regarded mobile devices as facilitative in L2 English reading development. Khubyari and Narafshan (2018) studied the impacts of MALL on reading comprehension development among 40 EFL learners in Iran. After administration of the pre-test, the participants were divided equally and randomly into experimental and control groups. After giving each group assigned treatments (traditional and mobile-based reading), the study then compared the performance of the groups in the reading comprehension test (post-test). The result indicated that EFL learners preferred reading comprehension materials delivered via mobile phones, and

regarded portability and accessibility made available by mobile phones to be influential in developing reading comprehension.

Hsu et al. (2013) developed a language learning approach bacentered on a personalized recommendation on mobile phones to guide EFL students in reading articles based on their knowledge levels and personal preferences. The application contained a module for annotating texts and sharing notes on vocabulary translation for reading comprehension. The effectiveness of the mobile-based reading intervention was evaluated by using two experimental and one control group. One of the experimental groups learned English with a designed recommendation feature and annotation function based on individual preferences. However, the participants in the next experimental group employed a system with the associated annotation function shared among students. Those students in the control group used the system with no recommendation feature. The findings indicated that the two experimental groups performed better than the participants in the control group. Nevertheless, the findings revealed no significant difference in learning outcomes attained by experimental groups. Ishikawa et al. (2014) reported using an application for English reading practice designed for Android tablet devices to aid EFL students in Japan. The researchers developed an application for learning vocabulary in reading passages that contained a database compiled technical collocations. The study aimed to help students studying international affairs with their reading skill development. The findings of the study provided empirical evidence for the positive influences of mobile- based reading on students' reading speed development without any negative impacts on comprehension. The results also revealed that the students experienced joy while reading English text with their tablet devices, and perceived their implementation in the course positively which was previously based on hard copy format materials.

Lin (2014) investigated the potential of mobile devices in improving students' linguistic abilities and their motivation and attitudes in an online program designed to facilitate extensive reading. The study used two intact English classes in a senior high school instructed by one English teacher. During the study that lasted for a period of ten weeks, one of the classes used tablet devices to read their assignments, while the other received the same materials for reading on their desktop computers. Every session, students were involved in reading texts inside the classroom and they were asked to continue reading outside the language classroom. Findings indicated the tablet users outperformed the participants in the desktop computer group in online reading activities and follow-up achievement measures. The participants also reported positive perceptions towards the online extensive reading compared to their PC user counterparts. Liu et al. (2014) reported on the development of a system based on mobile devices for promoting context-aware learning programs aimed at developing fitness-related reading comprehension. This study showed that using mobile phones and QR codes were effective in developing English reading comprehension of fitness-related texts.

Lin (2017) explored the use of electronic version of textbooks on mobile and tablet devices among adolescent learners. The research aimed to compare reading textbooks on mobile devices with traditional materials. The results indicated the students' achievements were similar, regardless of the materials employed. Moreover, those students who used mobile devices for studying English held positive attitudes towards them, and regarded these platforms to be useful for reading. Shraim (2014) explored the use of Kindle devices in informal and lifelong learning among 114 EFL learners in Palestine. The study also aimed to examine the contributions of electronic readers by focusing on students' attitudes, reading comprehension, and vocabulary knowledge development at a national level. Employing a mixed method approach, the study used surveys to collect the data. The findings showed that the affordances provided by Kindle devices were influential in shaping a language learning environment that is authentic, interactive, and flexible. The study also found that students' attitudes towards learning English with mobile devices were positive, and they experienced significant improvements in vocabulary and pronunciation.

In addition to this growing body of knowledge on mobile-assisted foreign language reading instruction, a considerable number of studies also investigated the impacts of using various portable mobile devices on foreign language vocabulary development (Lin & Lin, 2019). Accordingly, the studies explored the contribution of a range of technologies and tools including SMS/MMS, digital flashcards, gaming environments, context-aware tools, and other applications for vocabulary learning (Lin & Lin, 2019; Mahdi, 2018). In this regard, the findings of the studies indicated that mobile-assisted vocabulary learning provides learners with a more effective platform for boosting their vocabulary knowledge as the portability of the devices makes it possible for learners to bypass the physical limitations of traditional classrooms and conduct instructional activities at any place and any time (Hao et al., 2021; Lin & Lin, 2019). However, against this positive view toward mobile assisted vocabulary learning, a recent review of the existing studies concluded that the overall effectiveness of mobile platforms for vocabulary learning and instruction remained inconclusive demanding further research (Lin & Lin, 2019).

The abovementioned studies investigated the motivational potentials of mobile devices for reading development, students' perceptions and attitudes towards mobile-based reading comprehension, the role of context-aware mobile technologies in facilitating reading, and the affordances of these portable technologies for reading at any timeand anyplace. The studies also focused on a variety of mobile devices including PDAs, tablet devices, smartphones, and Kindle e-readers. The overall conclusion from the past studies is that the use of mobile phones is generally facilitative with respect to the reading comprehension. Nevertheless, most studies in this area have focused on tablet devices and the use of mobile devices (with their smaller screens compared to tablets) remained less explored. Moreover, the majority of studies were carried out in short-term periods with little use of standard measurements to compare the outcomes (J.-J. Lin & Lin, 2019; Xodabande & Atai, 2022). These shortcomings have made it somehow

difficult to clearly understand the longterm affordances of mobiles on language learning, as a considerable proportion of the studies were conducted in very short time spans ranging from two sessions to a few weeks (Lin & Lin, 2019). Given the prominence of vocabulary in second language development, and since reading is the main source for its development in the learning process (Nation, 2013), the current study sets out to investigate vocabulary gains in mobile-assisted reading. In doing so, the study used of a relatively long period of 10 weeks to investigate the impacts of mobile-assisted reading comprehension and employed a validated vocabulary test to measure the learning outcomes. The findings contribute to the expanding body of knowledge in MALL, and shed light on affordances provided by mobile-assisted reading on vocabulary development. The study aimed to answer these research questions:

1- Is there any significant difference in vocabulary gains attained by EFL learners in the paper- and mobile-based reading?

2- Does mobile-assisted reading in English contribute to general vocabulary knowledge development among EFL learners?

2. METHOD

The present study employed a pre-test and post-test design to investigate the impacts of mobile-assisted foreign language reading on vocabulary development. Accordingly, prior to the treatment, the participants' vocabulary level was assessed. In order to track the developmental changes after the treatment, the participants were tested following the treatments. This section provides additional information with respect to the participants, materials and instruments, procedures, and data analysis.

Participants

The participants of this study were 52 adult English as foreign language learners (20 males, 32 females) selected based on convenience sampling procedures from two intact classes. The mean age of the participants was 23, and they were taught by the same English teacher for over 10 weeks. The participants were at pre-intermediate level, learning English in a private institute, and had two classes every week. One of the classes was assigned randomly to the experimental group, and the other class acted as a control group. In this regard, those in the control group (N = 25) used paper-based materials, and those in the experimental group (N = 27) used digital material delivered to them via mobile devices. Before conducting the study, informed consent were obtained from the participants, and the study adhered to ethical codes of educational research by protecting the anonymity of the subjects, confidentiality of the obtained data, and ensuring them regarding the possible negative impacts of long-term use of mobile devices with small screen size in reading. Given that the participation in the study was voluntary, the participants were given the option of not participating at any stage of data collection. It should be noted that due to the participants' motivation and interest to develop their vocabulary knowledge, all students actively participated in the study.

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Materials and Instruments

Before conducting the study, the Oxford Placement Test (OPT) was used to ensure the homogeneity of the participants. OPT tests general proficiency and is widely used in the field of English language teaching, and the results obtained by the participants indicate their accurate levels ranging from basic (A1) to very sophisticated (C2) users of English. The results of the OPT revealed that the majority of the participants (i.e. 46 individuals or 88.5%) were at pre-intermediate level, scoring between 29 and 40. Only six participants were identified as being in the intermediate level of proficiency. The materials used for paper- or mobile-based reading were 60 news reports from News in Levels website (https://www.newsinlevels.com/). The target vocabulary items were 180 words (three vocabulary items in each text) that belonged to the second and the third BNC/COCA lists (Nation, 2012) that represent the most frequent words in English.

In order to assess vocabulary gains from the assigned reading materials, the participants were tested using different measures. As for the first instrument, similar to procedures taken by Wu (2015a, 2015b), a vocabulary test with two versions was developed to measure the receptive knowledge of the target items before and after the treatment. To this end, 90 vocabulary items from target words were randomly selected, and two similar multiple-choice item tests each with 45 questions were created. These tests were administered to a group of participants (N=31) with similar levels of proficiency, and data analysis revealed an acceptable reliability index (Cronbach's Alpha= 0.849). Moreover, in order to assess the impacts of the intervention on the participants' general vocabulary development in English, the updated Vocabulary Levels Test (Webb et al., 2017) was used, which is a standard and reliable (Cronbach's Alpha= 0.96) measure of vocabulary knowledge currently available in two versions. This instruments tests the receptive knowledge of English vocabulary in 1000, 2000, 3000, 4000, and 5000 levels. In this study, the first three sections of the test (3000 levels) were used. Version A of the test was used as the pre-test, and the version B used for the post-test.

Data Collection Procedure

Before the commencement of the study, the participants' general vocabulary knowledge of English, and also their knowledge of the first 45 randomly selected items from the 180 target words were tested in the first session. Following that, the participants received a 30-minute training on reading and vocabulary learning strategies. During the following weeks, the participants in the experimental and control groups received the same content for their outside-the-classroom reading, nonetheless, the delivery mediums were different. In this regard, the participants in the control group were given paper-based reading materials, and those in the experimental group used their mobile devices to access and read the same content.

For 10 weeks, the participants read 6 short news reports in English (each report contained around 150 words), totaling 60 reports for the entire period of the study. The participants in the control group were given three texts in print format at the end of each weekly session, and those in the experimental group received the same material after the classes using a locally popular social media network (i.e. WhatsApp). The participants were asked to read the reports at least once before the next session (no limitation for the number of subsequent readings). At the end of the research period, the participants' vocabulary knowledge was tested using different versions of the tests employed in the pre-test.

Data Analysis

The obtained scores on vocabulary tests in pre- and post-test were analyzed for descriptive and inferential statistics. Descriptive statistics techniques employed included obtaining mean values and standard deviations for the scores obtained on vocabulary tests. As for inferential statistics, independent samples t-test (Pallant, 2016) was performed to analyze the scores obtained by the experimental and the control groups on pre- and post-test.

3. FINDINGS

The results of the pre-test (measuring the existing knowledge of the target vocabulary items), and the first vocabulary levels test (version A) are summarized in Table 1. Regarding the pre-test, the mean value for the scores obtained by the participants in the experimental group was 15.80 (SD = 3.57). The mean value for the scores obtained by those in the control group was 16.67 (SD = 3.12). As for the first vocabulary levels test, the mean values for the participants' scores were 32.56 (SD = 3.07) and 32.22 (SD = 2.98) for the experimental and control groups respectively.

Table 1

Group Statistics

	Group	N	Mean	SD	SEM
Pre-test	Experimental	27	15.80	3.571	.714
	Control	25	16.67	3.126	.602
Vocabulary Levels Test	Experimental	27	32.56	3.070	.614
	Control	25	32.22	2.979	.573

In order to see if there are any significant differences in the participants' general vocabulary knowledge, or in the pre-existing knowledge of the target vocabulary items, independent samples t-tests were conducted (Table 2). The results revealed that the observed differences in the mean values for the scores on pre-test (t (50) = -0.933, sig = 0.355) and vocabulary levels test (t (50) = 0.403, sig = 0.69) were not statistically significant. These findings indicated that both groups were similar with respect to their general vocabulary knowledge in English (the first 3000 most frequent words), and their pre-existing knowledge of the target vocabulary items.

Table 2

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-test	.673	.416	-.933	50	.355	-.867	.929	-2.732	.999
Vocabulary Levels Test	.064	.802	.403	50	.689	.338	.839	-1.347	2.023

After giving different treatments to the participants in the experimental and control groups for ten weeks, their knowledge of the target words selected for the current study, and also their general vocabulary knowledge was tested. The descriptive statistics for the results are provided in Table 3. As for the post-test which measured the knowledge of target vocabulary items, the mean value for the scores obtained by the experimental group was 26.41 (SD = 4.35), and for the control group was 20.80 (SD = 3.55). For the vocabulary levels test, the mean value for the participants' scores in the experimental group was 39.11 (SD = 3.21), and for the control group was 35.11 (SD = 2.46).

Table 3

Group Statistics

	Group	N	Mean	SD	SEM
Post-test	Experimental	27	26.41	4.359	.838
	Control	25	20.80	3.552	.712
Vocabulary Levels Test B	Experimental	27	39.11	3.211	.619
	Control	25	35.116	2.465	.492

To see if the observed are statistically significant, independent samples t-tests were conducted. The results indicated that the observed differences for the scores obtained on post-test (t (50) = -5.06, sig = 0.000, two-tailed), and vocabulary levels test (t (50) = -4.94, sig = 0.000, two-tailed) were significant. These findings indicated that although the control and experimental groups enhanced their vocabulary knowledge on the two measures, those in the experimental group that used mobile devices for their readings outperformed those in the control group, and attained better results at the end of the treatment.

Table 4

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Post-test	Equal variances assumed	3.419	.070	-5.062	50	.000	-5.607	1.108	-7.832	-3.382
	Equal variances not assumed			-5.101	49.274	.000	-5.607	1.099	-7.816	-3.399

Vocabulary Levels Test	Equal variances assumed	5.217	.027	-4.947	50	.000	-3.951	.799	-5.555 -2.347
	Equal variances not assumed			-4.998	48.348	.000	-3.951	.791	-5.540 -2.362

4. RESULTS, DISCUSSIONS AND SUGGESTIONS

The first research question addressed in the current study was related to the relative effectiveness of mobile devices and paper-based materials in helping EFL students to learn vocabulary through reading. The results of the pre-and post-test revealed that although there was no significant difference in the experimental and control groups' performances prior to the treatment, those participants in the experimental group outperformed their counterparts after using mobile-based reading materials. The results indicated that the use of mobile devices in English reading produced better outcomes in terms of vocabulary learning. These findings are in line with the broad literature currently available in this area (Gutiérrez-Colón et al., 2020) that regards mobile-assisted reading in English to be effective and beneficial, and the limited number of studies in this line of research that investigated the contribution of mobile-assisted reading on vocabulary development (Hsu et al., 2013; Ishikawa et al., 2014; Shraim, 2014). In the current study, over the treatment period, the participants in the experimental group learned around 22% of the 180 target words, while the participants in the control group learned 10% of the same items.

The second research question examined the impacts of mobile-assisted reading on foreign language acquisition in terms of vocabulary development. In this regard, the findings indicated that reading simplified English texts on mobile devices and paper-based materials both resulted in vocabulary knowledge development beyond the target words. Nevertheless, the current study showed that those students who used mobile devices gained more vocabulary knowledge over the course of the ten weeks, and obtained significantly higher scores compared to the control group in the post-test. More specifically, the results of vocabularylevels test (Webb et al., 2017) administered in the post-test indicated that mobile users scored 4 points higher on average compared to the control group. Given that the test measures the receptive vocabulary knowledge of the 5000 most frequent words in English based on BNC/COCA lists (Nation, 2012), this development amounts to around 2.6% of this large number of words. These findings indicate that although the original focus of the study was on 180 target words, by being exposed to reading materials on paper or mobile devices, the participants acquired significant gains in essential vocabulary in English. As the previous studies did not investigate this aspect of mobile-assisted reading in English, such findings can shed more light on the potentials of MALL on second language acquisition.

There might be some reasons for the experimental group's better performance in the post-tests. First, given that mobile devices are easily portable, the participants in the experimental group had much easier access to the learning materials. In this regard, this feature enabled them to spend more time reading the texts and learning the target vocabulary items. Second, the introduction of digital technologies to language learning and teaching is by nature motivating (Stockwell, 2013), and motivation is one of the most important individual differences that contribute to learning (Dörnyei, 2009). As part of providing a facilitative condition for second language development, the use of mobile devices makes considerable impact on the outcomes of language learning and makes the process more enjoyable and fun for the learners. This factor has resulted in increased engagement and better learning outcomes for mobile users. Finally, mobile users in the current study had access to other resources for scaffolding their reading and vocabulary development, such as electronic dictionaries and internet connections. These factors in general contributed to their significantly better learning outcomes.

The findings have some implications for EFL teachers and materials developers in general English courses. As the findings indicated, the use of mobile devices for reading and vocabulary development is more effective compared to the traditional materials. In this regard, the use of mobile devices to supplement language teaching materials can benefit learners in numerous ways and contribute to their overall language development. Additionally, given that most language learners nowadays have their own smartphone or tablet devices, the implementation of mobile-assisted language learning helps teachers to create more motivating and engaging materials. Moreover, it has been argued that for most students around the world, language learning classes are only one site for learning additional languages (Cole & Vanderplank, 2016), and what happens outside the classroom is equally important for language development (Richards, 2015). Given the portability of mobile devices and their affordances in providing access to a range of textual and multimedia materials, teachers can employ such platforms to extend language learning beyond the classroom, and help the students in having increased contact with the target language. Such extension of learning activities to spaces beyond the traditional classroom also fosters learner autonomy which is a much-desired condition in language education (Benson, 2011; Rosell-Aguilar, 2018).

In conclusion, the current study investigated the impacts of mobile-assisted reading on English as a foreign language (EFL) learners' vocabulary development. To this end, adult language learners were divided into a control and an experimental group and received paper- (traditional) and mobile-based reading materials respectively. The participants' receptive vocabulary knowledge was tested before the treatment and after 10 weeks of treatment. The results of pre- and post-tests revealed that experimental and control groups enhanced their vocabulary knowledge, however, the experimental group outperformed the control group in vocabulary tests. The findings highlighted the affordances of mobile phones in teaching second language reading with associated impacts on vocabulary development. Despite these positive outcomes, the study had

some limitations. First, the current study relied on convenience sampling by using intact classes and the availability of the participants. This factor should be taken into consideration in generalizing the findings of the study. Second, it was not possible for the researcher to control for some of the intervening variables such as additional contacts with the English language beyond the classroom and materials provided for participants. In this respect, some of the learning gains in terms of vocabulary knowledge observed in this study might have other sources. Future research can address these shortcomings and also focus on the impacts of mobile-assisted reading on productive vocabulary development.

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There is no conflict of interest

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