A new vocabulary revision technique using WhatsApp: Peer-chain

Özgül Balcı¹ · Galip Kartal²

Received: 20 January 2021 / Accepted: 27 April 2021 / Published online: 6 May 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract

The purpose of this mixed-method study was to examine the effect of a new vocabulary revision technique “peer-chain” developed by the researchers on vocabulary learning and retention among English as a foreign language (EFL) university students. A total of 46 participants (21 in the control group and 25 in the experimental group) completed the study, and the effectiveness of the treatment was checked via conducting a pre-test post-test/retention test control group design for the quantitative part. The study was eight weeks in duration, and the students were assessed with a 42-question, multiple-choice vocabulary achievement test (VAT). An analysis of ANOVA for the quantitative data showed a significant difference in students’ vocabulary achievement between the students who used peer-chain and the students who used traditional word cards. Also, the study explored learner perceptions through interviews with the experimental group students. The qualitative content analysis of the interview data showed that most learners had positive perceptions of the technique. Both quantitative and qualitative outcomes suggest that integrating WhatsApp with the peer-chain technique in teaching vocabulary is a promising technique and can be more successful than the traditional paper-based word cards for vocabulary learning and retention.

Keywords Vocabulary teaching · Vocabulary revision · Peer-chain · WhatsApp · English as a Foreign Language (EFL)

✉ Özgül Balcı
ozgulbalci@gmail.com

Galip Kartal
kartalgalip@gmail.com

¹ School of Foreign Languages, Necmettin Erbakan University, Konya, Turkey

² Ahmet Keleşoğlu Faculty of Education, Department of English Language Teaching, Necmettin Erbakan University, Konya, Turkey

1 Introduction

It is widely acknowledged that vocabulary knowledge is a key factor in second language (L2) proficiency (see among others, Schmitt, 2010; Webb & Nation, 2017). Wilkins (1972) indicates the significance of vocabulary by asserting that “while without grammar very little can be conveyed, without vocabulary nothing can be conveyed” (p. 111). Plausibly, enriching vocabulary learning is a priority for any foreign language learning institution (Tanaka, 2017). With the importance attached to vocabulary knowledge in L2, there has been a massive increase in research on vocabulary learning, so the practitioners and researchers have been pursuing strategies and techniques to boost learning and retention of vocabulary knowledge effectively.

One comprehensive vocabulary learning strategy is the use of visual aids. The related research clearly shows that vocabulary learning with both labels and pictures is more profitable and productive than vocabulary learning with only labels (Lin & Yu, 2017). One of the common ways of using pictures is utilising word cards, which is a powerful and widely applicable strategy in vocabulary learning. Word cards, as an effective and efficient way of deliberate vocabulary learning, are pieces of easily carried cards with a target word on one side and a piece of information that helps the retrieval of its meaning in the possible forms of its first language translation, second language definition, a picture, a sample sentence, or collocations on the other side (Nation, 2001). With the current trends in digital learning technologies, the positive effects of using digital word cards in L2 vocabulary learning have been demonstrated in studies (Ashcroft et al., 2018; Yüksel et al., 2020), while paper-based word cards have also been reported to be beneficial as much as digital word cards (Nikoopour & Kazemi, 2014; Sage et al., 2019). Similarly, the use of paper-based cards is also regarded among the most popular key strategies for autonomous vocabulary learning to develop learners’ vocabulary knowledge as they are easy to use and portable (Webb & Nation, 2017). Also, when two digital tools of vocabulary, namely mobile and online digital word cards, were compared, it was found that mobile digital cards were more effective than online cards which were explained by the portability and high accessibility of cell phones (Nikoopour & Kazemi, 2014). In the same vein, Webb and Nation (2017) also assert that digital word cards are as effective as paper-based ones or they can be used more efficiently in favour of their adaptive recycling and record-keeping characteristics.

It is acknowledged that using word cards as a deliberate vocabulary learning strategy is one of the useful ways of increasing repetition and providing opportunities for retrieval (Webb & Nation, 2017). Repetition, defined as the number of times a learner encounters a word, and the high-quality encounters are the important factors that affect the conditions facilitating vocabulary learning (Webb & Nation, 2017). Repetition has an important place in language learning which add to the quantity and quality of learning because a word requires lots of continuous encounters to fully gain the knowledge of the word (Nation, 2001) and to store in the long-term memory (Zou et al., 2019). When the number of repetitions increases and is spaced, the possibility of learning a word is enhanced (Nation,

2001; Webb & Nation, 2017). Language games, for instance, have been indicated as one of the effective techniques for vocabulary presentation and revision as they help the retention and retrieval of the vocabulary (Uberman, 1998). Graded readers for language learners, re-reading the same text called repeated reading, dealing with the same vocabulary in the activities of different language skills called linked skills, and deliberate learning activities such as dictionary use, semantic mapping, and flashcards or also called word cards are ways of increasing repetition (Webb & Nation, 2017).

The affordances of word cards and repetition ally well with ubiquitous and seamless learning because language learners are surrounded by opportunities to see the cards and see the words. Ubiquitous learning is about making learning possible anytime, anywhere for various educational purposes (Jung, 2014). Seamless learning, on the other hand, occurs when in-class and beyond the class experiences are connected (Wong, 2013). Ubiquitous learning gains significance in L2 learning contexts as it encourages designing interactive and collaborative tasks that are backed by information and communication technologies (ICT). This kind of collaboration is essential because collaborative ubiquitous learning tasks can enhance students' motivation (García-Sánchez & Luján-García, 2016). Dörnyei and Ushioda (2013) assert that motivation is based on the “discursive interactions between people situated in particular sociocultural contexts” (p. 8). By strengthening the social bonds, collaboration and cooperation facilitate social relatedness among the members of a group (Deci & Ryan, 2000). Consequently, working towards a common goal increases motivation and engagement in cooperative learning (Wang et al., 2020). Collaboration and cooperation can be viewed as two significant tenets of the constructivism theory that urge for innovation in the instruction models and designing suitable learning environments for students to foster their enthusiasm for learning. For Vygotsky (1978), a constructivist learning environment should stimulate interaction between peers and their teachers. The developments in mobile technology accommodate plenty of opportunities to achieve constructivism in language learning.

Technological developments have dramatically changed the way languages are taught and learnt (Hung et al., 2018). Therefore, there has been a growing shift in integrating technology into language learning to achieve ubiquitous and seamless learning (García-Sánchez & Luján-García, 2016). The use of mobile technologies has snowballed worldwide (Sundberg & Cardoso, 2019) with the increasing rate of device ownership and widespread use of the internet. As a new form of computer-assisted language learning (CALL), mobile-assisted language learning (MALL) has been widely used as a powerful way of integrating technology in higher education (Cheon et al., 2012) by supporting ubiquitous learning (Thomas et al., 2013) and enhancing student interaction (Arifani et al., 2020). As a result, mobile smart devices, which are digitalised user environments for learning, have turned into practical tools for delivering learning content to students by covering and penetrating students' language learning process. Since mobile technology in L2 learning is more attainable now than ever, the phenomenon has become a nascent field of research. One recent popular way of exploiting MALL is mobile instant messaging (MIM) tools.

There are some available MIM tools such as WhatsApp, WeChat, LINE, Kakao Talk, and Viber. Different regions of the world pick different MIMs to become the de-facto standard. In Japan and Taiwan, for instance, it is LINE, and in China, it is WeChat. The most frequently used one in Europe, including Turkey, is WhatsApp, which can be easily used with smartphones and personal computers. Research on WhatsApp shows that it helps teachers save time via its immediacy and ubiquity (Lauricella & Kay, 2013) and keep students up to date with classroom activities (Awada, 2016), which is labelled as seamless learning. Empirical research findings indicate that WhatsApp can be used to enhance vocabulary learning via using dialogue journaling (Alsalem, 2013), giving vocabulary homework (Bensalem, 2018), sending synonyms and antonyms (Jafari & Chalak, 2016), studying learning and retention of collocations (Ashiyan & Salehi, 2016), utilising concept-mapping (Liu, 2016), sending pictures and the meaning (Şahan et al., 2016), and sending multimedia annotations (Çetinkaya & Sütçü, 2019). These studies show the affordance of WhatsApp to implement various techniques to teach and learn L2 vocabulary.

2 Study motivation and research goals

Approaches to vocabulary learning are generally categorised under implicit and explicit learning paradigms (Ma & Kelly, 2006). While implicit one is about learning the vocabulary items in natural contexts through repeated exposure, the supporters of explicit learning believe that it is necessary to learn and teach vocabulary learning strategies explicitly for efficient learning (Oxford & Scarcella, 1994). Vocabulary knowledge can also be evaluated via the receptive and productive distinction (Schmitt, 2010). There is a bulk of evidence that due to the vital role of vocabulary knowledge in main language skills, getting an idea about learners' receptive vocabulary size plays a crucial role (Beglar, 2010).

Recently, language teaching programmes have exploited technology to conform learning to L2 learners' vocabulary needs. Meta-analyses and review studies on MALL show that vocabulary gains were among the most frequently researched language areas that benefit from technology (Elaish et al., 2019; Hwang & Fu, 2019; Kartal, 2019; Son, 2018). As a result, new techniques have been proposed to enhance the vocabulary learning of L2 learners. This current study leads a new initiative through using WhatsApp to implement the peer-chain technique, which is a vocabulary revision technique developed and investigated in this study. The technique is inspired by constructivist learning theory by enhancing collaboration and cooperation between peers and their teachers and encourages ubiquitous and seamless learning environments by taking advantage of ICT. This novel technique utilises the tenets of the cognitive theory of multimedia learning (Mayer, 2009), which postulates that word knowledge is acquired through visual and verbal channels, and this way of learning stimulates both channels and strengthens learners' memory retention. Also, the peer-chain technique applies the Contribution-Oriented Learning Approach (COLA) proposed by Collis and Moonen (2001) and the Contribution-oriented Self-directed Mobile Learning Ecology Model (CSDMLE) proposed by Wang et al. (2020). The COLA model, which is a pedagogical theory, supports the

active role of learners in an online learning environment (Collis & Moonen, 2006) and views the role of the teachers as facilitator and coordinator of activities. In this study, the teacher was the first ring of the chain that initiated the process and students were required to be active to finish the chain. The CSDMLE, which is found to be effective in guiding student-directed collaborative learning (Wang et al., 2020) aims at developing learner-directed and motivational learning exercises in groups. This model requires an activity to follow the stages of entering motivation, self-managing, contribution, and self-monitoring.

WhatsApp was selected as the medium of the chain system since it allows sharing information like text and voice messages, videos, and documents. So, it helps deliver active vocabulary teaching–learning experiences to learners at anytime and anywhere. It also promotes ubiquitous and seamless learning as well as the actualisation of the receptive and explicit vocabulary teaching with collaboration and cooperation of the learners (Kartal, 2019). Moreover, previous studies showed that WhatsApp is one of the most convenient technological tools that can be used for vocabulary learning (Çetinkaya & Sütçü, 2018; Kartal, 2019). WhatsApp, which offers users a very convenient mode of communication, is found to be more effective than Facebook in teaching vocabulary (Çetinkaya & Sütçü, 2018). Kartal (2019) reviewed 37 studies that used WhatsApp for language learning and found that WhatsApp is mainly used to teach vocabulary among other language areas. Taken together, the goal of this present study was to investigate the effect of a new vocabulary revision technique (so-called “peer-chain technique”) developed by the authors on Turkish EFL learners’ receptive vocabulary learning and retention. Another goal of the study was exploring learner perceptions as an aim to understand the participants’ degree of acceptance of this new technique. Based on these objectives, the following three research questions (RQ) were formulated:

- (RQ 1) Does the peer-chain technique promote receptive vocabulary learning over paper-based revision technique?
- (RQ 2) Does the peer-chain technique promote receptive vocabulary retention over the paper-based revision technique?
- (RQ 3) How do learners perceive their vocabulary learning experiences using the peer-chain technique?

3 Method

3.1 Research design and sample

A sequential explanatory mixed-method design which consisted of two phases (Creswell, 2014; Fraenkel et al., 2012) was used in the study to examine the effect of a new vocabulary revision technique peer-chain on vocabulary learning and retention among EFL university students. In the quantitative phase, the method adopted was quasi-experimental with the matching-only pre-test post-test control group design. In this design, intact groups are randomly assigned to the different treatments, and the subjects in the groups are matched on some variables (Fraenkel et al. 2012). The

students' classes were first formed by the school administration at the very beginning of the academic year. As truly random sampling was impossible in this study because of the institutional constraints, two intact classes among a group of EFL preparatory class students were used and the participants were selected using non-probability convenience sampling. The two intact classes were randomly assigned as the experimental and the control groups. The subjects in the experimental and control groups were matched on their vocabulary achievement pre-test scores. In the qualitative phase, one-on-one semi-structured interviews were carried out to gain an in-depth understanding of experimental group participants' experiences and perceptions regarding the peer-chain technique using WhatsApp.

3.2 Setting and participants

The population for the study started with 61 participants (32 in the control group and 29 in the experimental group) from two intact classes, of which 15 dropped out after the pre-test due to transfers to other universities and permanently leaving the school for personal and educational reasons. So, a total of 46 participants (21 in the control group and 25 in the experimental group) completed the quantitative phase of the study. They were university English preparatory class students enrolled in different programs at a leading state university in Central Anatolia who failed the proficiency exam at the beginning of the academic year and were required to complete the intensive English preparatory program offered by School of Foreign Languages successfully before starting their undergraduate study at the university. English preparatory courses are based on a 30 class-hour a week schedule; 18 class-hour of which is reserved to Main Course, six class-hour is reserved to Listening and Speaking, and six class-hour is reserved to Reading and Writing lessons approximately, along with some exceptional weeks. Students' ages ranged from 17 to 20 years. In the control group, there were seven females and 14 males, while in the experimental group there were 12 females and 13 males. All the participants in both groups were informed about the study, and that participation was voluntary. One-on-one interviews were conducted with each of the 25 participants in the experimental group who also volunteered to take part in the qualitative phase of the study.

The participants in the experimental and control groups were matched based on their pre-test scores on the Vocabulary Achievement Test (VAT). The VAT pre-test results were analysed by independent samples t-test. The results did not yield any statistically significant differences ($t=0.75$, $p=0.46$) between the two groups, which means that the participants in both the experimental and control groups had similar ability in vocabulary knowledge for the pre-test (Table 2).

3.3 Peer-chain technique

Peer-chain is a vocabulary revision technique based on WhatsApp. Each participant represents a ring in the chain and has a peer to whom he or she sends the WhatsApp message after reading it carefully. The teacher of the class is both the first and the last ring in the WhatsApp chain. After the target word was presented

in the lesson, the first ring in the chain (the teacher) sends the WhatsApp message to her peer. Each participant as a ring in the chain continues to send the message to his/her peer (another ring in the chain) until the last ring (the teacher) receives the message back which demonstrates that everybody in the chain has received the message. The aim of the peer-chain technique is not presenting or teaching the target words, but to enable students to revise them after the regular instruction in the class. So, it could be said that peer-chain revision technique does not substitute for, or replace, the regular classroom instruction, but is used to support it as a vocabulary revision technique. Our main aim was to design a vocabulary revision technique based on Nation's (2001) idea that repetition is of vital importance in vocabulary learning in that it helps learners know different aspects of word knowledge and so enhances both the quality and the quantity of vocabulary knowledge. In the same vein, Webb and Nation (2017) point out that repetition has an important place in learning vocabulary and contributes to learning. Also, WhatsApp instant messaging smartphone application was used as the medium to send and receive the digital word cards among the rings in the chain because it is known that WhatsApp encourages group communication as it connects the community (Waldman & Blonder, 2020) and leads to collaborative learning (Udenze & Oshionebo, 2020). So, we tried to make the students take responsibility for their own learning and so encourage vocabulary learning autonomy and take responsibility for their peers in the chain as well to create a group cohesion among the participants.

Each WhatsApp message was composed of a digital word card, also called a digital flashcard in the literature (Webb & Nation, 2017), prepared by the researchers considering Nation's (2001) suggestions for preparing word cards. The reason for using word cards in this study is that deliberately studying words on word cards is indicated in the literature (Nation & Meara, 2002) as one of the four major powerful and widely applicable strategies that help find the meaning of unknown vocabulary items and making these items stay in memory. Also, it is known that using word cards as a deliberate vocabulary learning strategy is one of the useful ways of increasing repetition and providing opportunities of retrieval (Webb & Nation, 2017) and can help learners increase their vocabulary size through deliberate learning (Nation, 2001, 2003). In our study, the word cards sent via WhatsApp consisted of the target word in a sentence context with the target word underlined, italicised, and with bold type. We opted for using sentence context and presenting collocates of the words on the word cards because Nation (2001) suggests writing the word in a sentence context could be helpful in terms of learning. The other information provided on the card for the students included such aspects of word knowledge as a synonym, antonym, and collocation where possible with a picture representing the meaning of the target word and a sample sentence. In doing so, we tried to compensate the limitedness of word cards, as stated by Webb and Nation (2017) to learn different aspects of word knowledge along with the form-meaning connection of the words. We did not use a first language translation (Turkish translation in our context) on the cards despite being common. Nation (2001) emphasises that a second language definition, a picture, a sample sentence, or collocations can also be good possibilities while designing

word cards. We included pictures as Nation (2001) remarks that learners store the meaning of the words both linguistically and visually. Two sample WhatsApp messages used in the study are shown in Fig. 1 below.

3.4 Research instruments

One of the instruments used in the study was the 42-item multiple-choice VAT. It was developed by the researchers and used as a pre-test to match the groups before the treatment. It was also used as a post and retention test to measure the participants' receptive vocabulary achievement after the treatment and to investigate the effectiveness of "peer-chain technique" on participants' vocabulary learning and retention using the target words that appeared in the units to be covered over the study (last 4 units in Main Course book A2 and all 12 units in Main Course book B1). Nation (2001) remarks that a good vocabulary test has plenty of items (minimum around 30 items) and uses the item type which can measure the vocabulary knowledge that is supposed to be tested. The test developed in this study aimed to measure 'form and meaning' aspect of vocabulary knowledge receptively according to the Nation's (2001) framework. The VAT was a kind of mid-course long-term achievement test (Nation, 2001) as it comprises most of the target words that appeared in the units to be covered over the first term of the academic year. Nation (2001) specifies that multiple-choice test item types are easy to mark and respected because they have been used in the international standardised language tests.

Fig. 1 Sample WhatsApp messages used in the study

The following procedure was adopted for developing the VAT.

- A vocabulary yes/no checklist was prepared by the researchers to identify the unknown words using the target vocabulary lists of the main course books used in the main course lesson at school. The checklist consisted of 200 target words covered in the last 4 units in Main Course book A2 and the target words in all 12 units in Main Course book B1. Sample vocabulary items in the list and the format of the checklist was given in Table 1. Students were asked to tick off the appropriate box in the checklist. If they tick “I KNOW the word” option, they were required to write the Turkish translation of the word in order not to let them tick off the words they did not know.
- Among the 200 target words, 45 words that none of the participants knew/ answered correctly were chosen to be included in the VAT and in the treatment phase as well.
- Two items were prepared to test each unknown (target) word and included in the 90-item multiple-choice pilot form of the VAT. The draft used in the pilot test was revised based on a field expert and two English instructors’ feedbacks.
- The pilot test was conducted with 149 English preparatory class students (different from the participants in the actual study) to compute test and item statistics.
- After correct answers were coded as 1, and incorrect and missing responses were coded as 0, item difficulty and item discrimination indices were analysed. Item discrimination index is a measure of how well a test item discriminates between the high and low performers while item difficulty index is a measure of the difficulty level of a single test item. Discrimination index above 0.4 are considered particularly good discriminators and difficulty index around 0.5 is also desirable as suggested by Crocker and Albina (2006), Ebel and Frisbie (1991), Karaca (2008). Therefore, item discrimination index above 0.4 and item difficulty index around 0.5 were used as the item selection criteria in this study. Six items which have discrimination index under 0.4 were eliminated from the test. One of the two items prepared to test each target word with higher discrimination index, and difficulty index around 0.5 was chosen for the final form. So, the final version of the test consisted of a total of 42 items which have the discrimination index above 0.4 and item difficulty index around 0.5.
- The test yielded 0.93 reliability coefficient for internal consistency using Kuder-Richardson Formula 20 (KR-20). The average difficulty of the test was 0.42 (with a range of 0.25 to 0.60) and the average discrimination was 0.55 (with a range of 0.41 to 0.70).

Table 1 Sample vocabulary items in the yes/no vocabulary checklist

No	Item	I DON'T KNOW the word	I KNOW the word	Write the Turkish translation of the word if you tick “I KNOW the word” option
36	receipt			
54	glacier			

The study also utilised semi-structured interviews to determine experimental group participants' perceptions regarding the peer-chain technique. The interviews were conducted only with experimental group participants because as Hwang et al. (2016) indicates it is crucial to investigate participants' views and degree of acceptance about a learning tool. Therefore, no interviews were conducted with the control group since the purpose of the interviews was to get the experimental group participants' perceptions and opinions of the peer-chain technique. The participants in the control group continued to revise the new words using the traditional paper-based word cards as they did before the study. The questions were prepared by the researchers considering the purpose of the study. After the experts' feedback, two of the questions were removed, and two unclear questions were revised. The final form of the interview questionnaire contained a total of eight open-ended questions pertaining to the participant's general opinions of the peer-chain technique, its possible advantages in vocabulary learning and retention, the digital word cards used in the study, use of WhatsApp as the medium to send and receive the digital word cards, the chain system used in the technique, and participants' own frequency of repetition and the effect of the technique on their repetition of the target words.

3.5 Procedure

The purpose of this study was to investigate the effect of the peer-chain revision technique on Turkish EFL learners' receptive vocabulary learning and retention. Among the 200 target words listed, 45 unknown words that none of the participants knew/answered correctly in the vocabulary yes/no checklist were chosen for the study and the VAT was developed to test the target words. Three pairs of items (6 items totally) testing three of the target words were excluded from the test because of validity and reliability problems, so our study comprised of a total of 42 target words.

The students in the experimental and control groups continued their regular program in their classes. It should be noted that all the preparatory classes at school followed the same syllabus and procedures, adopted the same course books, and were exposed to the same lessons from their course books. Our treatment did not replace the regular classroom instruction but was used to support it as a vocabulary revision technique outside the classroom. Immediately after the target words were presented in the class, the teacher as the first ring in the chain sent the digital words cards using WhatsApp at random times between 9 am and 9 pm. Nation (2001) remarks that students should review the newly learned vocabulary immediately after they have encountered them, which helps prevent them from forgetting the words. Each ring (student) in the chain sent it to his/her peer who was determined before the study until the teacher as the last ring in the chain received it back. The study continued eight weeks until 42 digital word cards were sent and received back by the teacher (42 chains in total). Five digital word cards were sent each week (between 1st-7th weeks of the experiment) except for the last week (8th week of the experiment), in which seven cards were sent. It took two or three days approximately to complete the circle. The control group continued to follow the same syllabus as the treatment

group, was exposed to the same lessons using the same course books and the corresponding target words as the experimental group, but it did not get the digital word cards via WhatsApp. The control group received paper versions of the word cards immediately after the target words were presented in the class as in the experimental group. They received five word cards between the 1st and 7th weeks, and seven word cards in the 8th week (totally 42 word cards) just like the experimental group. The researchers got feedback from the control group about their revision process during the regular classroom periods.

The VAT was administered as a pre-test a week before the treatment to match the groups, post-test a week after the end of the study, and a retention test eight weeks after the end of the study. The pre, post and retention tests were conducted during a regular class session and took approximately 30 min each to complete. All one-on-one semi-structured interviews were conducted on the phone by one of the researchers because of the coronavirus outbreak and lasted for 7 to 18 min. They were audio-recorded and transcribed verbatim.

3.6 Data analysis and statistical techniques

The arithmetic means, standard deviations, and 95% confidence intervals of the variables were given. The normality of the data was verified with the Shapiro–Wilk test. A two-way (split-plot) ANOVA with repeated measures (2×3) was used to test the effect of the experiment on participants' vocabulary knowledge and retention. The two factors were group (experiment and control) and repeated measures (pre-test, post-test, retention test). When the time effect was significant via split-plot ANOVA, one-way repeated measures analysis of variance with Bonferroni post hoc test was applied to identify whether the repeated vocabulary tests were responsible for the difference. For each ANOVA, partial eta squared (η^2) was calculated as a measure of effect size. When the group effect and/or interaction of group $\times$ time effect was significant in the split-plot ANOVA, unpaired t-tests were used to compare mean values between groups, and the effect size was calculated using the standard formula for Cohen's d (Sullivan & Feinn, 2012). Statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) 22.0. Significance was set at $p < 0.05$.

Experimental group participants' perceptions regarding the peer-chain technique were analysed through a qualitative inductive approach. This required adopting the four-phase content analysis procedure (coding the data, identifying the themes that emerge, the arrangement of the codes and themes, and definition and interpretation of the findings) as suggested by Yıldırım and Şimşek (2006). Two separate rounds of coding were undertaken by the researchers, and the intra-coding reliability was calculated by Miles and Huberman's (1994) formula ($\text{Reliability} = \text{Number of agreement} / (\text{Agreement} + \text{Disagreement}) \times 100$) and found to be 93% agreement. The names of the participants were coded as S1-S25 for confidentiality. In the relationship establishment, the relationships were investigated, and then the codes, themes, and categories were established. Also, member checking was conducted for respondent validation by allowing participants to review findings from the interview data.

4 Results

4.1 Achievement test results

Split-plot ANOVA results that show the effect of the peer-chain technique on participants' vocabulary learning and retention were presented in Table 2. The changes in participants' vocabulary pre-test, post-test and retention test results were significant (Time factor; $F_{1,5-66,8} = 139.3$, $\eta^2 = 0.76$, $p < 0.001$). Also, the group factor was significant on vocabulary knowledge (Group factor; $F_{1,44} = 7.1$, $\eta^2 = 0.14$, $p = 0.01$). Moreover, time and group interaction were significant on the participants' vocabulary knowledge (Time $\times$ Group interaction; $F_{1,5-66,8} = 3.8$, $\eta^2 = 0.08$, $p = 0.04$) which means that changes in participants' vocabulary knowledge were different between the groups.

According to one-way repeated measures analysis of variance with Bonferroni post hoc test results, the changes in vocabulary knowledge were significant in both control ($F_{1,3-25,8} = 63.3$, $\eta^2 = 0.76$, $p < 0.001$) and experimental ($F_{1,6-39,2} = 82.9$, $\eta^2 = 0.78$, $p < 0.001$) groups. The post-test and the retention test mean scores were significantly higher than the pre-test mean scores in both control ($p < 0.001$) and experimental ($p < 0.001$) groups. However, the post-test and the retention test mean scores were similar in the experimental group ($p = 1.00$) while the retention test mean scores were significantly lower compared to the post-test mean scores in the control group ($p = 0.01$).

Independent samples t-test was utilised to compare the pre-test, post-test and retention test results between the control and experimental groups. There was no significant difference in pre-test mean scores between the control and experimental groups ($t_{44} = 0.75$, $d = 0.22$, $p = 0.46$). However, vocabulary knowledge mean scores were significantly higher in the experimental group in both post ($t_{44} = 3.03$, $d = 0.90$, large effect, $p < 0.001$) and retention test ($t_{44} = 3.50$, $d = 1.03$, large effect, $p < 0.001$) compared to the control group.

4.2 Interview results

Follow-up interviews were carried out to gain an in-depth understanding of experimental group participants' experiences and perceptions regarding the peer-chain technique using WhatsApp. Table 3 includes the categories, themes, and sub-themes from the interview data.

Table 2 The effect of the peer-chain technique on participants' vocabulary knowledge and retention

	Control		Experiment		ANOVA		
	<i>M</i> ± <i>SD</i>	(%95 <i>CI</i>)	<i>M</i> ± <i>SD</i>	(%95 <i>CI</i>)	Time	Group	Time×Group
Pre-test	17.3±6.5	(14.4–20.3) ^a	18.8±6.8	(16.0–21.6) ^a			
Post-test	^β 27.6±4.1	(25.8–29.5) ^b	31.6±4.8	(29.7–33.6) ^{bc}	139.3**	7.1*	3.8*
Retention test	^β 20.0±4.4	(24.0–28.0) ^c	31.7±6.3	(29.1–34.3) ^{cb}			

* $p < .05$; ** $p < .01$; 95 % *CI* = 95% Confidence Interval, Time = Pre-test, post-test and retention test, Group = Experiment and control groups, Time×Group = The interaction of time and group factors.

^βSignificant differences between the groups, ^{a,b,c} Significant difference among means with different letter in the same column $p < .05$.

Table 3 The list of categories, themes, and sub-themes

Category	Theme	Sub-theme	<i>f</i>	Total
Perceptions about peer-chain	Promises of peer-chain	Opportunity for repetition	22	105
		Learning vocabulary	22	
		Recalling vocabulary	17	
		Visual aids	17	
		Increased interest and motivation	16	
		Increased responsibility	11	
	Challenges of peer-chain	Delays in messages	8	10
		A high number of people in the chain	2	
Perceptions about using WhatsApp for the peer-chain	Promises of WhatsApp	Ease of access and use	25	46
		Frequency of exposure and revision	21	
	Challenges of WhatsApp	Distractors	2	2

**f* (frequency) value indicates the frequency of expressions repeating. Some participants' responses fit more than one category

The analysis of the interview data regarding the perceptions about peer-chain revealed that all the participants found the peer-chain technique beneficial. Therefore, they mainly had positive views and reported promises of the technique. They believed that it provided opportunities to repeat the target words. S12, for instance, commented as follows: “The chain shape of the process enabled us to repeat the words both when we received and when sending the message, which was useful.” Also, the students found the technique useful for vocabulary learning and retention. S7, by considering the word lists, views this technique as helpful and said “We usually learn the words from our textbooks and teachers in our classroom. Also, we try to learn words in lists. However, this technique helps us focus on one word and learn easier than the word lists.” Another gain was about word cards. According to the participants, the word card accompanied by pictures and enabled learning with visual aids. The comment of S6 is like a summary of his friends' views: “You can easily open the message, and you can benefit from pictures that help you learn the words easier than the traditional way.” The technique is also reported to increase interest and motivation, which is voiced by S2 as “This way of studying words increased my interest and curiosity. We are more motivated to study words.” The following idea from S13 shows the role of the technique to increase responsibility: “Sometimes, you do not want to study the words. However, as you have the responsibility of sending the word to your friend, you automatically study the word before sending it. It is good to learn vocabularies with your friends by sharing responsibility.”

Although the participants mostly had positive views, there were a few challenges. The participants mentioned the delays in delivering messages and the high numbers of people in the chain. As for the delays in messages, S22 lamented: “I think this activity is extremely useful, but some of our friends did not send the messages on time. Although WhatsApp is an application we use very often, some of our friends did not send the messages to their chain friend on time.” The views on the group size

are voiced as the following by S4: “I think this is a useful application, but I prefer this to be done with a group of fewer people. Because it is a little difficult this way.”

The views about the role of WhatsApp during the process showed that the participants benefitted from WhatsApp as it provided fast and appealing learning. Students believe that WhatsApp helped them access the words easily anywhere and anytime. S9 said: “We use WhatsApp all the time. It is not time-consuming. We can use it easily. We already use WhatsApp frequently in our daily life.” They also believe that WhatsApp allowed frequent exposure. S6 uttered: “As the words go to our gallery, we revised the word not only before and after receiving and sending but also by checking our gallery.”

The use of WhatsApp is reported to attract and motivate learners to participate in the peer-chain technique. The only negative view on the use of WhatsApp is the fact that WhatsApp is a frequently used messaging app, and sometimes students get lost in their inbox. S21 commented: “Everything was fine with WhatsApp. However, sometimes you can miss the related message in your inbox with lots of messages.”

5 Discussion

The current study was designed to investigate the effect of a newly developed vocabulary revision technique called “peer-chain” on Turkish EFL learners’ receptive vocabulary learning and retention. We found that peer-chain technique significantly promoted receptive vocabulary learning (RQ 1) and retention (RQ 2) over paper-based word card revision technique. These findings suggest that the newly designed peer-chain vocabulary revision technique could be used as an effective technique in foreign language classes to enhance vocabulary learning and retention. The use of digital word cards with the medium of WhatsApp is thought to be one of the reasons for the positive effect of the technique in that it both provides the opportunity of deliberate vocabulary learning which is reported as a powerful strategy in terms of vocabulary learning and retention (Nation, 2001, 2003, 2006; Nation & Meara, 2002; Webb & Nation, 2017) and unlimited opportunities of repetition which is indicated in the literature (Bloom & Shuell, 1981; Dempster, 1987; Laufer et al. 2005; Namaziandost et al. 2019; Nation, 2001; Nation & Meara, 2002; Webb & Nation, 2017) as an important factor in vocabulary learning. It is known that the use of WhatsApp was common among the participants of this study for social communication, and they already had a class WhatsApp group. So, the use of WhatsApp in the peer-chain technique could help construct a ubiquitous learning environment and so gives the participants in the experimental group the advantage to revise the target words regardless of the time and place against paper-based word cards that the participants in the control group necessarily need to keep in their bags to revise. This finding is also in line with the studies reporting positive results about the integration of WhatsApp into vocabulary learning in particular (Ashiyan & Salehi, 2016; Basal et al., 2016; Bensalem, 2018; Çetinkaya & Sütçü, 2018, 2019; Chuah, 2014; Hashemifardnia et al., 2018) and language learning in general (Ali & Bin-Hady, 2019; Mistar & Embi, 2016). However, in contrast with our result, Dehghan et al. (2017) found that WhatsApp group did not have a better performance than that of the traditional group in which list of words

was used for repetition, which was attributed to the negative effect of the irrelevant distractions students exposed to due to the nature of WhatsApp. Moreover, the chain system in our vocabulary revision technique can be another reason for the significant positive effect of the technique on the students' vocabulary learning and retention. We think that it fostered vocabulary learning autonomy and encouraged students to take responsibility both for their own learning and for their peers as well.

As we have noted, this study revealed that peer-chain technique enhanced the participants' retention in the experimental group. However, paper-based word card revision technique did not sustain the participants' retention of the target words in the control group as much as peer-chain did in the experimental group. In other words, it was clear from the results that paper-based word card revision technique did not yield the same positive effect on the retention of the target words that the peer-chain technique in which we used digital word cards via WhatsApp did. This finding is line with the results from another study by Ashiyan and Salehi (2016) reporting positive results about the use of WhatsApp application on the retention of vocabulary. Also, this result is in line with previous studies which conclude that teacher-designed electronic flashcards may help students remember the target words (Çetinkaya & Sütçü, 2019; Dodigovic, 2013; Lin & Yu, 2017; Peker et al. 2018). This result can be explained by the assumption that peer-chain technique using WhatsApp may provide the participants with the opportunity of spacing the repetition which is indicated in the literature (Nation, 2001; Nation & Meara, 2002; Webb & Nation, 2017) as an important factor in terms of retention of the words. Nation (2001) suggests that the facilitative effect of the spacing of repetition improves during learners' leisure time when they can choose the most suitable time and the best way for learning to occur. We believe that peer-chain technique can be effective in helping students review the vocabulary cards during their leisure time because of its ease of keeping the digital cards via WhatsApp, and consequently could enhance retention of the target words. However, it is interesting that the participants in the control group achieved significantly lower scores in the retention test compared to the post-test when using paper-based word cards. This contradicts the prevailing opinion in the literature (Nation, 2001; Nation & Meara, 2002; Webb & Nation, 2017) that direct learning of words using word cards enhances retention of the target words. The reason for this result could be the necessity of carrying word cards around which can result in less repetition of the target words to some extent compared to the digital word cards which are more accessible. This result contradicts with the result of a previous study by Nikoopour and Kazemi (2014), which reported similar vocabulary gain with both mobile and traditional paper-based flashcards and explained it with the ubiquity and portability of both tools. However, in our study, digital flashcards via WhatsApp outperformed traditional paper-based word cards, which can show that digital word cards via WhatsApp are more portable as the students did not need to carry the cards but just their mobile phone as usual.

This study also demonstrated that both peer-chain revision technique in which we used digital word cards via WhatsApp and paper-based revision technique in which we used paper-based word cards enhanced vocabulary learning significantly. The significant improvement in the performance of the control group, though statistically lower than that of the experimental group, was an expected result and demonstrates that standard paper-based word cards are also effective and could be used in EFL

classes as an effective strategy. This result contributes to the literature on the positive effect of deliberate or direct vocabulary learning (Nation, 2001, 2003, 2006; Nation & Meara, 2002) by providing evidence that deliberate vocabulary learning contributes to vocabulary learning, either with digital word cards or paper-based standard word cards.

The third research question explored learners' perceptions regarding their vocabulary learning experiences using the WhatsApp-assisted peer-chain technique. The qualitative findings strongly support the quantitative findings suggesting that the peer-chain technique is beneficial in terms of vocabulary learning and retention by allowing an opportunity for repetition and frequent exposure to the target words as well as increasing interest, motivation, and responsibility. Through the analysis of the interview data, this current study found that most of the participants found the peer review technique promising as it allowed an opportunity for repetition. This finding makes the technique beneficial because learning possibility is enhanced when the number of repetitions increases (Nation, 2001; Webb & Nation, 2017). The participants also mentioned the promises of the visual aids, which make vocabulary learning more profitable (Lin & Yu, 2017). Our participants believed that the technique increased interest and motivation. This finding aligns well with the advantages of collaborative ubiquitous learning tasks that can enhance students' motivation (García-Sánchez & Luján-García, 2016). By strengthening the social bonds, collaboration in the chain facilitated social relatedness among the members of a group, which corresponds to findings of Deci and Ryan (2000). Therefore, we suggest that working towards a common goal increased motivation and engagement in cooperative learning. Moreover, the chain system is reported to increase responsibility, which is important for vocabulary learning (Nation, 2011; Webb & Nation, 2017). One of Nation's (2011) guiding principles for teaching vocabulary is that teachers should help learners take responsibility for their own vocabulary learning, or in other words, encourage vocabulary learning autonomy as one of the important roles of the teacher in the language class. The peer-chain technique also utilised the tenets of the COLA (Collis & Moonen, 2001) and the CSDMLE (Wang et al. 2020). The COLA model requires teachers to facilitate and coordinate the learning activities. In this study, the teacher was the first ring of the chain and she initiated the process and students were required to be active to finish the chain. Therefore, it is reasonable to conclude that the peer-chain technique is appropriate for the COLA model. Additionally, the peer-chain technique has addressed the CSDMLE, which aims at developing motivational and learner-controlled vocabulary learning in groups. Although the participants mostly had positive perceptions about the peer-chain technique, there were a few negative comments that were about delays in delivering messages and high numbers of people in the chain. Considering the experimental group students' views, we suggest using the peer-chain technique with relatively a low number of students in the chain, as this can overcome the problem of the delays in delivering the messages.

Perceptions about using WhatsApp as the medium of the chain system showed that it was convenient with its features such as ease of access and use, frequency of exposure, and revision. These results are in line with other studies reporting positive perception about the use of WhatsApp for vocabulary learning (Ali & Bin-Hady, 2019;

Bensalem, 2018; Chuah, 2014), and for language learning in general (Annamalai, 2018; Gasaymeh, 2017; Udenze & Oshionebo, 2020). Our participants believe that WhatsApp is easy to use and apply this novel technique, which corresponds to the findings of Nikoopour and Kazemi (2014). They found that mobile digital cards were more effective than online cards since they were portable and highly accessible. Our finding on the ease of use is important because convenience has been indicated as essential to examine the learner acceptance of a tool (Venkatesh & Davis, 2000). The only challenge of WhatsApp was distractors. This is also in line with the results of the study by Dehghan et al. (2017), in which the WhatsApp group did not get better vocabulary performance which was explained with a variety of irrelevant distractions such as playing online games, listening to music, watching movies, and chatting with friends that students exposed to due to the nature of WhatsApp. We think that social media and the internet offer a wealth of opportunities for students which can also distract them from the potential benefits of learning. Concerning the study results, it can be said that the positive effects of using WhatsApp in vocabulary learning are considerably higher and the negative effects and irrelevant distractors can be diminished via some precautions taken by language teachers during the teaching–learning process such as creating a class WhatsApp group only for learning purposes.

6 Conclusions

This study has provided empirical evidence that peer-chain word card revision technique could outperform the paper-based word card revision technique in terms of both vocabulary learning and retention. Also, the qualitative findings supporting the quantitative data revealed that most of the participants had positive perceptions of the peer-chain technique via WhatsApp. This indicates that integrating WhatsApp with the chain system in our newly developed peer-chain vocabulary revision technique can be a promising way in terms of learning and retention of vocabulary and can be more effective than the traditional paper-based word cards for vocabulary learning. Both quantitative and qualitative results imply that peer-chain revision technique might potentially help students learn and remember the target vocabulary in an easy and engaging way via using WhatsApp, one of the most popular MIM tools among today's generation z students. Based on the evidence arising from this study's findings, teachers wishing to foster students' vocabulary learning may find it beneficial to consider incorporating the peer-chain technique via WhatsApp anywhere and anytime for vocabulary revision. For teachers who seek to integrate this technique into their teaching, the efficiency of the intervention emerges as a priority because L2 vocabulary knowledge is a crucial issue, and it was found that university L2 vocabulary learning can be facilitated and supported via using this newly introduced technique. Also, with the use of WhatsApp and similar MIMs, which learners already use without any training, technology use can be encouraged in language classes.

The study is not without some limitations that also leave room for further research. First, as a nature of quasi-experimental studies, participants constitute intact class groups, and therefore there was no control over the demographics. A

future study could consider finding a way to conduct a true experimental study. Another limitation is that our treatment was just a vocabulary revision technique and used to support the regular classroom instruction which was performed through the same procedures. So, we could not control students' extra learning activities except the lessons at school and the revision activities in both groups. One other limitation is that the participants studied certain words that appeared in their course-book. Future studies may consider replication of the study with new words or with the high-frequency words which are essential in vocabulary learning and deserve considerable time and effort as strongly recommended by researchers (Laufer et al. 2005; Nation, 2001; Webb & Nation, 2017). Also, the digital word cards were prepared by the researchers in this study. In a future study, teachers may wish to provide room for learners to prepare their own word cards. Moreover, considering the views of some participants in the experimental group, the effect of the peer-chain technique with fewer participants is worth testing. Lastly, considering the uniqueness of each context and the novelty of the technique, further research is needed to conduct other experimental studies both with secondary and tertiary level students.

References

- Ali, J. K. M., & Bin-Hady, W. R. A. (2019). A study of EFL students' attitudes, motivation and anxiety towards WhatsApp as a language learning tool. *Arab World English Journal, Special Issue on CALL* (5), 289–298. <https://doi.org/10.24093/awej/call5.19>
- Alsaleem, B. I. A. (2013). The effect of "WhatsApp" electronic dialogue journaling on improving writing vocabulary word choice and voice of EFL undergraduate Saudi students. *Arab World English Journal*, 4(3), 213–225
- Annamalai, N. (2018). How do we know what is happening in WhatsApp: A case study investigating pre-service teachers' online activity. *Malaysian Journal of Learning and Instruction*, 15 (2), 207–225. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1201730.pdf>
- Arifani, Y., Asari, S., Anwar, K., & Budianto, L. (2020). Individual or collaborative "WhatsApp" learning? A flipped classroom model of EFL writing instruction. *Teaching English with Technology*, 20 (1), 122–139. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1242659.pdf>
- Ashcroft, R. J., Cvitkovic, R., & Praver, M. (2018). Digital flashcard L2 vocabulary learning out-performs traditional flashcards at lower proficiency levels: A mixed-methods study of 139 Japanese university students. *The EUROCALL Review*, 26(1), 14–28. <https://doi.org/10.4995/eurocall.2018.7881>
- Ashiyani, Z., & Salehi, H. (2016). Impact of WhatsApp on learning and retention of collocation knowledge among Iranian EFL learners. *Advances in Language and Literary Studies*, 7(5), 112–127. <https://doi.org/10.7575/aialc.all.v.7n.5p.112>
- Awada, G. (2016). Effect of WhatsApp on critique writing proficiency and perceptions toward learning. *Cogent Education*, 3(1), 1264173. <https://doi.org/10.1080/2331186X.2016.1264173>
- Basal, A., Yilmaz, S., Tanriverdi, A., & Sari, L. (2016). Effectiveness of mobile applications in vocabulary teaching. *Contemporary Educational Technology*, 7 (1), 47–59. <https://doi.org/10.30935/cedtech/6162>
- Beglar, D. (2010). A Rasch-based validation of the Vocabulary Size Test. *Language Testing*, 27(1), 101–118. <https://doi.org/10.1177/0265532209340194>
- Bensalem, E. (2018). The impact of WhatsApp on EFL students' vocabulary learning. *Arab World English Journal*, 9 (1), 23–38. <https://doi.org/10.24093/awej/vol9no1.2>
- Bloom, K. C., & Shuell, T. J. (1981). Effects of massed and distributed practice on the learning and retention of second-language vocabulary. *Journal of Educational Research*, 74(4), 245–248. <https://doi.org/10.1080/00220671.1981.10885317>
- Cheon, J., Lee, S., Crooks, S. M., & Song, J. (2012). An investigation of mobile learning readiness in higher education based on the theory of planned behavior. *Computers & Education*, 59(3), 1054–1064. <https://doi.org/10.1016/j.compedu.2012.04.015>

- Chuah, K. M. (2014). *Word's up with WhatsApp: The use of instant messaging in consciousness-raising of academic vocabulary* [Conference session]. 23rd MELTA and 12th Asia TEFL International Conference, Borneo Convention Centre, Kuching, Malaysia.
- Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. Kogan Page.
- Collis, B., & Moonen, J. (2006). The contributing student: Learners as co-developers of learning resources for reuse in web environments. In D. Hung, & M. S. Khine, (Eds.), *Engaged Learning with Emerging Technologies* (pp. 49–67). Springer. https://doi.org/10.1007/1-4020-3669-8_3
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches*. (4th ed.). Sage.
- Crocker, L., & Algina, J. (2006). *Introduction to classical and modern test theory*. Cengage Learning.
- Çetinkaya, L., & Sütçü, S. S. (2018). The effects of Facebook and WhatsApp on success in English vocabulary instruction. *Journal of Computer Assisted Learning*, 34, 504–514. <https://doi.org/10.1111/jcal.12255>
- Çetinkaya, L., & Sütçü, S. S. (2019). Students' Success in English Vocabulary Acquisition through Multimedia Annotations Sent via WhatsApp. *Turkish Online Journal of Distance Education*, 20 (4), 85–98. <https://doi.org/10.17718/tojde.640517>
- Deci, E., & Ryan, R. (2000). The “what” and “why” of goal pursuits: Human needs and self-determination of behavior. *Psychological Inquiry*, 11, 227–268. https://doi.org/10.1207/S15327965PLI1104_01
- Dehghan, F., Fazeli, S. A., & Rezvani, R. (2017). Social networks and their effectiveness in learning foreign language vocabulary: A comparative study using WhatsApp. *CALL-EJ*, 18 (2), 1–13. Retrieved from <http://caliej.org/journal/18-2/Dehghan-Rezvani-Fazeli2017.pdf>
- Dempster, F. N. (1987). Effects of variable encoding and spaced presentation on vocabulary learning. *Journal of Educational Psychology*, 79, 162–170. <https://doi.org/10.1037/0022-0663.79.2.162>
- Dodigovic, M. (2013). Vocabulary learning: An electronic word card study. *TESOL Arabia Perspectives*, 20(1), 13–21
- Dörnyei, Z., & Ushioda, E. (2013). *Teaching and researching: Motivation*. Routledge. <https://doi.org/10.4324/9781315833750>
- Ebel, R. L., & Frisbie, D. A. (1991). *Essentials of educational measurement* (5th ed.). Prentice-Hall.
- Elaish, M. M., Shuib, L., Ghani, N. A., & Yadegaridehkordi, E. (2019). Mobile English Language Learning (MELL): A Literature review. *Educational Review*, 71(2), 257–276. <https://doi.org/10.1080/00131911.2017.1382445>
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education*. (8th ed.). McGraw-Hill.
- García-Sánchez, S., & Luján-García, C. (2016). Ubiquitous knowledge and experiences to foster EFL learning affordances. *Computer Assisted Language Learning*, 29(7), 1169–1180. <https://doi.org/10.1080/09588221.2016.1176047>
- Gasaymeh, A. M. M. (2017). University students' use of WhatsApp and their perceptions regarding its possible integration into their education. *Global Journal of Computer Science and Technology*, 17 (1), 1–9. Retrieved from <https://computerresearch.org/index.php/computer/article/view/1641>
- Hashemifardnia, A., Namaziandost, E., & Esfahani, F. R. (2018). The effect of using WhatsApp on Iranian EFL learners' vocabulary learning. *Journal of Applied Linguistics and Language Research*, 5 (3), 256–267. Retrieved from <http://www.jallr.com/index.php/JALLR/article/view/859>
- Hung, H. T., Yang, J. C., Hwang, G. J., Chu, H. C., & Wang, C. C. (2018). A scoping review of research on digital game-based language learning. *Computers & Education*, 126, 89–104. <https://doi.org/10.1016/j.compedu.2018.07.001>
- Hwang, W. Y., Shadiev, R., Hsu, J. L., Huang, Y. M., Hsu, G. L., & Lin, Y. C. (2016). Effects of storytelling to facilitate EFL speaking using web-based multimedia system. *Computer Assisted Language Learning*, 29(2), 215–241. <https://doi.org/10.1080/09588221.2014.927367>
- Hwang, G. J., & Fu, Q. K. (2019). Trends in the research design and application of mobile language learning: A Review of 2007–2016 publications in selected SSCI journals. *Interactive Learning Environments*, 27(4), 567–581. <https://doi.org/10.1080/10494820.2018.1486861>
- Jafari, S., & Chalak, A. (2016). The role of WhatsApp in teaching vocabulary to Iranian EFL learners at junior high school. *English Language Teaching*, 8(9), 85–92. <https://doi.org/10.5539/elt.v9n8p85>
- Jung, H. J. (2014). Ubiquitous learning: Determinants impacting learners' satisfaction and performance with smartphones. *Language Learning & Technology*, 18 (3), 97–119. <https://doi.org/10.12544/386>

- Karaca, E. (2008). Test ve madde analizi. In S. Erkan & M. Gömleksiz (Eds.), *Eğitimde ölçme ve değerlendirme*. (pp. 239–306). Nobel Yayın Dağıtım.
- Kartal, G. (2019). What's up with WhatsApp? A critical analysis of mobile instant messaging research in language learning. *International Journal of Contemporary Educational Research*, 6(2), 352–365. <https://doi.org/10.33200/ijcer.599138>
- Laufer, B., Meara, P., & Nation, I. S. P. (2005). Ten best ideas for teaching vocabulary. *Language Teacher*, 29(7), 3–6
- Lauricella, S., & Kay, R. (2013). Exploring the use of text and instant messaging in higher education classrooms. *Research in Learning Technology*, 21, 1–17. <https://doi.org/10.3402/rlt.v21i0.19061>
- Lin, C. C., & Yu, Y. C. (2017). Effects of presentation modes on mobile-assisted vocabulary learning and cognitive load. *Interactive Learning Environments*, 25(4), 528–542. <https://doi.org/10.1080/10494820.2016.1155160>
- Liu, P. L. (2016). Mobile English vocabulary learning based on concept mapping strategy. *Language Learning & Technology*, 20 (1), 128–140. <https://doi.org/10.12544/485>
- Ma, Q., & Kelly, P. (2006). Computer assisted vocabulary learning: Design and evaluation. *Computer Assisted Language Learning*, 19(1), 15–45. <https://doi.org/10.1080/09588220600803998>
- Mayer, R. E. (2009). *Multimedia learning*. (2nd ed.). Cambridge University Press.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.
- Mistar, I. B., & Embi, M. A. (2016). Students' perception on the use of WhatsApp as a learning tool in ESL classroom. *Journal of Education and Social Sciences*, 4(June), 96–104. Retrieved from <http://jesoc.com/wp-content/uploads/2016/08/Edu-76.pdf>
- Namazizadost, E., Nasri, M., Esfahani, F. R., Keshmirshekan, M. H., & Agudo, J. D. D. M. (2019). The impacts of spaced and massed distribution instruction on EFL learners' vocabulary learning. *Cogent Education*, 6(1), 1661131. <https://doi.org/10.1080/2331186X.2019.1661131>
- Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139524759>
- Nation, I. S. P. (2003). Vocabulary. In D. Nunan. (Ed.), *Practical English language teaching* (pp. 129–152). New York: McGraw Hill. <https://doi.org/10.1016/B0-08-044854-2/00678-7>
- Nation, I. S. P. (2006). Language education - vocabulary. In K. Brown (Ed.), *Encyclopaedia of language and linguistics*. (2nd ed., Vol. 6, pp. 494–499). Elsevier.
- Nation, I. S. P. (2011). My ideal vocabulary course. In M. H. Chau, & I. A. Khairi (Eds), *Vocabulary Learning in the Language Classroom*. Petaling Jaya: MELTA-Sasbadi.
- Nation, I. S. P., & Meara, P. (2002). Vocabulary. In N. Schmitt (Ed.), *An introduction to applied linguistics*. (pp. 35–54). Edward Arnold.
- Nikooipour, J., & Kazemi, A. (2014). Vocabulary learning through digitized & non-digitized flashcards delivery. *Procedia - Social and Behavioral Sciences*, 98, 1366–1373. <https://doi.org/10.1016/j.sbspro.2014.03.554>
- Oxford, R. L., & Scarcella, R. C. (1994). Second language vocabulary learning among adults: State of the art in vocabulary instruction. *System*, 22(2), 231–243. [https://doi.org/10.1016/0346-251X\(94\)90059-0](https://doi.org/10.1016/0346-251X(94)90059-0)
- Peker, H., Regalla, M., & Cox, T. D. (2018). Teaching and learning vocabulary in context: Examining engagement in three prekindergarten French classrooms. *Foreign Language Annals*, 51(2), 472–483. <https://doi.org/10.1111/flan.12338>
- Sage, K., Krebs, B., & Grove, R. (2019). Flip, slide, or swipe? Learning outcomes from paper, computer, and tablet flashcards. *Technology, Knowledge and Learning*, 24, 461–482. <https://doi.org/10.1007/s10758-017-9345-9>
- Şahan, Ö., Çoban, M., & Razi, S. (2016). Students learn English idioms through WhatsApp: Extensive use of smartphones. *Erzincan University Journal of Education Faculty*, 18 (2), 1230–1251. <https://doi.org/10.17556/jef.72045>
- Schmitt, N. (2010). *Researching vocabulary: A vocabulary research manual*. Palgrave MacMillan.
- Son, J. B. (2018). Technology in English as a foreign language (EFL) teaching. In J. Lontas (Ed.), *The TESOL encyclopedia of English language teaching* (pp. 1–7). Malden, MA: Wiley. <https://doi.org/10.1002/9781118784235.eelt0448>
- Sullivan, G. M., & Feinn, R. (2012). Using effect size-or why the p value is not enough. *Journal of Graduate Medical Education*, 4(3), 279–282. <https://doi.org/10.4300/JGME-D-12-00156.1>
- Sundberg, R., & Cardoso, W. (2019). Learning French through music: The Development of the Bande à Part app. *Computer Assisted Language Learning*, 32(1–2), 49–70. <https://doi.org/10.1080/09588221.2018.1472616>

- Tanaka, M. (2017). Examining EFL vocabulary learning motivation in a demotivating learning environment. *System*, 65, 130–138. <https://doi.org/10.1016/j.system.2017.01.010>
- Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, 9 (3), 71–85. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1071379.pdf>
- Uberman, A. (1998). The use of games for vocabulary presentation and revision. *English Teaching Forum*, 36(1), 20–27
- Udenze, S., & Oshionebo, B. (2020). Investigating ‘WhatsApp’ for collaborative learning among undergraduates. *Etkileşim*, 5, 24–50. Retrieved from <https://dergipark.org.tr/tr/download/article-file/1039203>
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Waldman R., & Blonder R. (2020). A sense of community in a professional learning community of chemistry teachers: A study of an online platform for group communication. In Y. Ben-David Kolikant, D. Martinovic, & M. Milner-Bolotin (Eds.), *Stem teachers and teaching in the digital era* (pp. 111–139). Springer, Cham. https://doi.org/10.1007/978-3-030-29396-3_7
- Wang, Z., Hwang, G. J., Yin, Z., & Ma, Y. (2020). A Contribution-Oriented Self-Directed Mobile Learning Approach to Improving EFL Students’ Vocabulary Retention and Second Language Motivation. *Educational Technology & Society*, 23 (1), 16–29. Retrieved from <https://www.jstor.org/stable/26915404>
- Webb, S., & Nation, P. (2017). *How vocabulary is learned*. Oxford University Press.
- Wilkins, D. A. (1972). *Linguistics and language teaching*. Edward Arnold.
- Wong, L. H. (2013). Analysis of students’ after-school mobile-assisted artifact creation processes in a seamless language learning environment. *Journal of Educational Technology & Society*, 16(2), 198–211
- Yıldırım, A., & Şimşek, H. (2006). *Sosyal bilimlerde nitel araştırma yöntemleri*. (6th ed.). SeçkinYayıncılık.
- Yüksel, H. G., Mercanoğlu, H. G., & Yılmaz, M. B. (2020). Digital flashcards vs. wordlists for learning technical vocabulary. *Computer Assisted Language Learning*, <https://doi.org/10.1080/09588221.2020.1854312>
- Zou, D., Huang, Y., & Xie, H. (2019). Digital game-based vocabulary learning: where are we and where are we going?, *Computer Assisted Language Learning*. Advanced online publication. <https://doi.org/10.1080/09588221.2019.1640745>

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.