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Spacing effects in vocabulary learning: Young EFL learners in focus

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Abstract: This study used a novel method to explore different schedules of spacing in young EFL learners. In doing so, we taught young EFL learners English–Farsi word pairs using different spacing schedules (massed vs. spaced). In the massed condition, learners studied five-word pairs in session one and five-other word pairs one week later. In the spaced condition, the learners studied 10-word pairs in session one and restudied them one week later. To amplify the benefits of spacing, we incorporated tests (with corrective feedback) into different schedules of spacing. In other words, EFL learners were instructed to test each other on their knowledge of the vocabulary and to give each other feedback. One week and five weeks later learners' recall was assessed. The results showed that spaced practice produced better long-term retention than massed practice. To summarize, this study used spacing and retrieval practice techniques (with corrective feedback) to offer a pedagogically powerful approach for learning vocabulary.

Subjects: Cognitive Psychology; Memory; Bilingualism/ESL; English Language; Language Teaching and Learning

Keywords: EFL; spacing effect; spaced retrieval practice; massed practice; vocabulary

1. Introduction

Vocabulary has taken center stage of foreign language (FL) teaching in recent three decades (e.g. Carter & McCarthy, 1988; Nation, 2001). Many studies have shown that vocabulary knowledge is an essential prerequisite for reading comprehension (e.g. Biemiller & Boote, 2006). Schmitt (2008)

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PUBLIC INTEREST STATEMENT

The spacing effect refers to spreading study sessions in time, instead of cramming them together. It is a learning advantage that facilitates transfer of information into long-term memory. In this study, we aim to examine whether the spacing techniques can be employed for EFL vocabulary learning in a naturalistic learning setting. The results showed that spacing techniques can be successfully employed in EFL classes.

reported that, in order to understand a text, learners are required to understand 95–98% of the words of the text. This means that FL learners need to learn a great number of word families in a limited-course time. However, acquiring a large number of words does not happen incidentally. Therefore, teachers need to use some deliberate second language (L2) vocabulary instructions as a supplement to incidental learning. In general, knowing a word means knowing its form (pronunciation and spelling), meaning, and use (Cameron, 2001).

Allen (1983) stated that FL teachers need additional help with vocabulary instruction because even where teachers have devoted a lot of time to vocabulary teaching, many of the words needed have never been learned after weeks, months, or even years of English. Cameron (2001) noted two issues with regard to the teaching of L2 words in an English as a foreign language (EFL) situation. The first issue is that meeting and understanding a new word is just the onset of a learner's vocabulary acquisition process. The second issue is the challenge of how to create the memory of a word so that it will be available for future usage. She further added that learners need to use some memorizing activities at the point of learning new vocabulary words for the first time, and they need to regularly review those words in intervals (Cameron, 2001). Although most available literature is in agreement that for FL/L2 learning one should implement word repetition at the time of study and in intervals, it is not as clear how these repetitions should be implemented in foreign vocabulary teaching as a memory aid.

Exploring the beneficial effects of spacing in learning has been an active area of research in psychological sciences under the name of the spacing effect. The spacing effect refers to a memory advantage whereby memory is enhanced when learning episodes are spread over longer periods of time rather than being massed in one single session (e.g. Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). In general, it is necessary to distinguish between two types of repetitions, namely restudy and retrieval practice (Goossens, Camp, Verkoeijen, & Tabbers, 2014). The research in cognitive psychology has shown that using retrieval practice leads to better memory than restudy in the learning phase (for a review see e.g. Roediger & Karpicke, 2006). This phenomenon is commonly referred to as the retrieval practice effect or testing effect. The testing effect refers to a memory phenomenon whereby testing has a more reinforcing impact on memory than restudying. The testing effect is a very well-documented phenomenon (e.g. Bjork, 1975; Goossens et al., 2014), but its tremendous effects are unknown to many scholars outside the domain of cognitive psychology. For instance, Ur (2012) stated that reviewing words results in more effective learning than testing words. She also stated that the tests merely assess students' knowledge, but do not promote further learning (Ur, 2012).

The question here is whether spacing techniques will benefit vocabulary learning in EFL classes. We found this research question important because it does make a relevant practical contribution to the literature, instead of a more fundamental theoretical contribution. Given the vast body of literature on distributed practice effects, people may wonder why it is important to use spacing effect studies in EFL vocabulary learning in real educational settings with children. First, developing useful vocabulary is fundamental for learning an FL especially at the primary levels (Cameron, 2001). Second, teaching needs to include word review in intervals and different vocabulary learning activities (Cameron, 2001; Ur, 2012). Third, a number of studies highlighted the significant role of spacing in vocabulary learning (e.g. Dempster, 1987). Fourth, the number of studies which examined retention intervals (RIs) longer than seven days is so limited, and it is not perfectly possible to determine the optimal study gap on the basis of short-term studies (for a review, see Cepeda, Vul, Rohrer, Wixted, & Pashler, 2008). Moreover, doing long-term spacing effect studies in real educational settings provides the opportunity to determine the magnitude of the spacing effect. The magnitude of the spacing effect is determined by the lag and the RI. The lag or the intersession interval (ISI) is the break between two learning events, and the RI is the break between the last learning session and the final test session (see, Cepeda et al., 2006; Rohrer & Pashler, 2007). There is a relationship between ISI and RI, and some studies have attempted to explain this relationship. A major finding of these studies is that there is an optimal ISI for any given RI. In their study, Cepeda et al. (2006) concluded that RI (recall) increases as the length of ISI increases. Rohrer and Pashler (2007) also showed that the optimal ISI depends on

the length of RI. They also stated that the optimal ISI ranges somewhere between 10 and 30% of the RI. It is noteworthy that the optimal ISI used in several previous studies was 20% of the given RI. For instance, the optimal ISI for 5-weeks RI would be 1-week. Fifth, decades of laboratory-based psychological research demonstrated the robustness of spacing in vocabulary learning with adults (Cepeda et al., 2006). Additional studies are needed to demonstrate the robustness of spacing effect in word learning with school-aged children (Sobel, Cepeda, & Kapler, 2011). Furthermore, because the cognitive factors involved in vocabulary learning (e.g. conceptual knowledge) differ in younger and older children (e.g. syntagmatic-paradigmatic shift) and between children and adults (for a review, see Singleton, 1999), the spacing effects may operate differently within different age groups.

In general, the primary concern of most of the previous spacing effect studies was to determine the underlying mechanisms of human memory regarding learning and forgetting. The primary aim of this study is to bridge the findings of previous psychological research to validate EFL classrooms in an attempt to make practical suggestions of how to implement spaced practice in foreign vocabulary teaching.

To date, a significant number of studies in the memory research have demonstrated that spaced practice outweighs massed practice with regard to learning. These studies have demonstrated the positive effects of spacing in learning of words (e.g. Bloom & Shuell, 1981; Gerbier, Toppino, & Koenig, 2014; Goossens, Camp, Verkoeijen, Tabbers, & Zwaan, 2012; Kornell, 2009; Küpper-Tetzel, Erdfelder, & Dickhäuser, 2014; Nakata, 2015; Nakata & Webb, 2015; Schuetze, 2015; Swehla et al., 2016; Zeelenberg, de Jonge, Tabbers, & Pecher, 2015; Zigterman, Simone, & Bell, 2015), in learning of text passages (e.g. Wang, 2015), and in learning of L2 constructions (e.g. Matusevych, Alishahi, & Backus, 2016).

For instance, in the study by Bloom and Shuell (1981), 56 high school students' learning of French studied 20 French–English word pairs under two different learning conditions (massed or spaced). In the massed group, students spent 30 consecutive minutes studying word pairs, whereas in the spaced group students spent 10 min a day for three consecutive days studying the word pairs. Furthermore, a retention test assessed students' recall either immediately or 4 days after the final study session. The results of the delayed recall test showed that learning the word pairs in the spaced fashion led to better recall (35%) than learning the words in the massed fashion.

In another study, Sobel et al. (2011) had 39 middle-school children study 8 new English words during two sessions with a 1-week break between study sessions. The children learned the words under two different learning conditions (massed vs. spaced). In the massed condition, the two study sessions took place in immediate succession in session one. In the spaced condition, however, the two learning sessions were separated by a 1-week break in between study sessions. Thirty-five days after the second learning session, a cued recall test assessed children's performance. The results revealed that the recall for spaced items was vastly better than the recall for massed items.

In the study by Goossens et al. (2012), 48 elementary school children studied 15 unfamiliar words in the massed fashion and 15 other unfamiliar words in the spaced fashion. In the massed condition, the target words were divided into three sets of five words each and children practiced each set three times in one of three study sessions. In the spaced condition, the children studied the words across three consecutive sessions during which the children studied the words once in each of the three study sessions. A retention test assessed children's recall 7 days and 35 days after the last study session. The results showed that children recalled the spaced words better than the massed words.

Moreover, Bahrick, Bahrick, Bahrick, and Bahrick (1993) demonstrated the power of the spacing effect over several years. In their study, participants studied and restudied 300 English-foreign language word pairs. The training sessions consisted of either 13 or 26 learning or relearning sessions which were administered at intervals of 2, 4, or 8 weeks. After the training was completed, the participants recalled words at intervals of 1, 2, 3, or 5 years. The results showed that 13 relearning sessions separated by 8 weeks interstudy gaps yielded recall comparable to 26 study sessions separated by 2 weeks.

Reviewing the related literature on spacing effect studies (e.g. Sobel et al., 2011), a simple design of a spacing effect research has several characteristics: First, a spacing effect study is made up of two main phases of study and test. Second, the study phase consists of at least two similar sessions. Third, the study sessions are separated by a break in between. If this break does not exist, the result will be a massing effect. Fourth, another break which separates the study phase and the test phase from each other. This break is usually longer than the study break. Fifth, the test phase (test session) during which a recall test assesses the learned information.

1.1. The present study

In our study, we investigated whether there was a spacing effect in vocabulary learning in an authentic EFL setting where learners performed typical learning activities. This study is important in the respect that it has been conducted in real-world classrooms with minimal experimental control and very high ecological validity. It used methods that to the best of our knowledge have not been used before in the context of the spacing effect research where students were instructed to test each other on their knowledge of the vocabulary; and were specifically instructed to pay attention to the form and meaning of the word. Adapting learning procedures from Sobel et al. (2011; i.e. study-test-study-test sequence) who found that spacing improves delayed recall in fifth graders, we examined the spacing effect in young EFL learners using two tests and two study sessions.

2. Method

2.1. Participants

The participants were 28 young EFL learners from an English language institute. They were recruited from two classrooms, and all of them were native speakers of Farsi, with a regional dialect. They were 2nd, 3rd, 4th, and 5th graders in elementary school and had not received any formal English instruction in elementary school because Iranian students receive formal English instruction in the 7th grade when they are in junior high school. The participants participated in all conditions of the experiment. The mean age of the sample was 9.17 years, ranging from 7 years to 11 years. By the time of the study, the participants had all completed the first two of the six-level English Time series. They had also completed both levels of elementary Magic Time series which is followed by the English Time course. Magic Time and English Time are communicative courses for young FL learners who are learning English for the first time. Therefore, the participants had limited English vocabulary knowledge which indeed enhances the reliability of the results. At the time of the study, all the participants were studying English Time book 3. Moreover, we gave each learner a consent form packet containing a letter explaining the nature and procedure of the study and a form to be signed by the guardian or parent. Parents signed a consent form and children verbally assented to participate.

2.2. Design and materials

The study was conducted across six weeks using 28 young EFL learners learning English–Farsi word pairs. Within each class, the learners participated in two different learning conditions (massed or spaced). In Week 1, they learned half of the words in a massed condition and the other half of the words in a spaced condition; they were also tested 1 week and 5 weeks later. In this study, both learning condition and delay were manipulated within subjects (Figure 1).

Materials of the study were 20 English–Farsi word pairs (see Appendix 1). We selected 20 new English words from the English Time book Level 4 (e.g. shut, earth, mail, and artist). All English words were

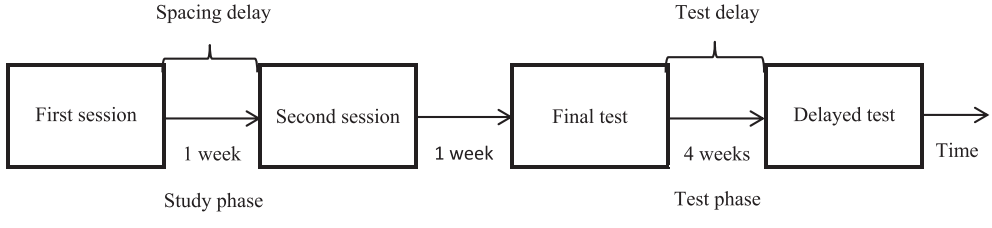

Figure 1. Design of the study.

between three and seven letters long, and their Farsi translations varied in length from three to ten letters. The mean word length of English words was 5.1 (SD = 1.35), and the mean word length of Farsi words was 6.00 (SD = 2.20). Nine words were nouns, seven words were verbs, and four words were adjectives. Ten words contained one syllable and ten words contained two syllables. Moreover, before running the main study, these words were pretested, and the learners were asked to write down the meaning of the words. The pretest showed that the learners didn't know any of the words. The pretest was approximately 5 min in length. Further, we randomly assigned the word pairs to two lists of 10 word pairs each (List A and List B). Furthermore, in order to avoid unintended effects, we counterbalanced assignment of the lists such that each list appeared equally as massed and spaced across two conditions. Therefore, the participants in one class received List A in a spaced fashion and List B in a massed fashion. On the other hand, the participants in the other class received List B in the spaced fashion and List A in the massed fashion. It should be noted that there were the same numbers of learners for each counterbalancing list. Furthermore, we counterbalanced the order of the conditions to account for potential ordering effects. In one class, the order of presentation followed an 'SM' (S for spaced; M for massed) sequence in session one and an 'MS' sequence in session two. In the other class, the participants studied the words in the reversed presentation order. In the test phase, the order of the lists was also counterbalanced.

2.3. Procedure

The study took place as part of the learners' regular class sessions. The type, sequence, and duration of activities were the same for learners in both participating classes. At the beginning of the study, the children were instructed about the nature of the study. They were informed that they would learn some word pairs as part of their regular course work. Table 1 shows a summary of the procedure.

Table 1. Procedure of the study

Class	Presentation phase		Test phase	
	Study session 1	**Study session 2**	**Test session 1**	**Test session 2**
1	List A (Items 1–10)	List B (Items 6–10)	List A (Items 1–10)	List B (Items 1–10)
	Page 1 (Drilling in pairs)	Page 1 (Drilling in pairs)	List B (Items 1–10)	List A (Items 1–10)
	CF	CF		
	Page 2 (Choral repetition)	Page 2 (Choral repetition)		
	Page 3 (Drilling in pairs)	Page 3 (Drilling in pairs)		
	CF (Spaced)	CF (Massed)		
	List B (Items 1–5)	List A (Items 1–10)		
	Page 1 (Drilling in pairs)	Page 1 (Drilling in pairs)		
	CF	CF		
	Page 2 (Choral repetition)	Page 2 (Choral repetition)		
	Page 3 (Drilling in pairs)	Page 3 (Drilling in pairs)		
	CF (Massed)	CF (Spaced)		
2	List B (Items 1–10)	List A (Items 6–10)	List B (Items 1–10)	List A (Items 1–10)
	Page 1 (Drilling in pairs)	Page 1 (Drilling in pairs)	List A (Items 1–10)	List B (Items 1–10)
	CF	CF		
	Page 2 (Choral repetition)	Page 2 (Choral repetition)		
	Page 3 (Drilling in pairs)	Page 3 (Drilling in pairs)		
	CF (Spaced)	CF (Massed)		
	List A (Items 1–5)	List B (Items 1–10)		
	Page 1 (Drilling in pairs)	Page 1 (Drilling in pairs)		
	CF	CF		
	Page 2 (Choral repetition)	Page 2 (Choral repetition)		
	Page 3 (Drilling in pairs)	Page 3 (Drilling in pairs)		
	CF (Massed)	CF (Spaced)		

2.4. Learning sessions

The learning sessions were tutorial sessions on English–Farsi word pairs. In total, each learning session consisted of four consecutive trials that consisted of study and test activities in which the word pairs were practiced. In the massed condition, learners studied 5 word pairs in session one and 5 other word pairs in session two, whereas in the spaced condition, the learners studied 10 word pairs in session one and restudied them in session two. Furthermore, each learning episode (in both learning conditions) consisted of four steps that took approximately 20 min to complete.

In step one, the booklets were distributed, and the word pairs and their sample sentences were shown to learners using a portable projector. At first, an English word was shown on the left side of the projection screen. Learners were told to pay attention to its shape, its spelling, and its letter clusters. Next, the teacher read out the English word and told the learners to pay attention to its pronunciation. Then, the Farsi equivalent appeared on the right side of the screen and the teacher read out the Farsi translation. After that, a sample sentence was presented on the left side to clarify the target word. The teacher read out the sample sentence and translated it into Farsi. Finally, the teacher repeated the English–Farsi word pairs, and learners were instructed to rehearse the pairs along with their teacher.

In step two, learners were told to turn to page 1 of the booklet. Page 1 listed the target English–Farsi word pairs. The learners were given 5 min to drill the words in pairs. That is, one child had to ask the English words in random order while his partner had to give the meaning of each word in Farsi. The children then switched roles. At the end of the activity, learners gave each other corrective feedback (CF) on the wrong given answers. However, it should be noted that learners had to do this activity in turn. That is, only one child was allowed to open his booklet during this activity. This activity was an ecologically valid vocabulary learning strategy that young learners use at the primary levels in actual FL classrooms. The purpose of this activity was twofold: First, it enabled the children to test each other's understanding and to give each other CF. Second, it enabled the learners to help themselves understand and remember word pairs.

In step three, the learners were allotted 5 min to practice page 2 of the booklet. Page 2 listed English–Farsi word pairs and a sample sentence for each one. The teacher repeated the word pairs and their sample sentences and had learners repeat them chorally. In addition, the learners were given 2 min to practice the meanings of new words.

In step four, the learners were given 5 min to drill the words in pairs. This step was the same as step two, except that learners had to give the Farsi words as a response to English words. Upon completion of all learning trials, the booklets were collected.

2.5. Test session

Learners received two identical retention tests 1 week and 5 weeks after the second learning session. In the test sessions, the learners had to write down the English words as an appropriate definition to given Farsi words.

3. Results

Figure 2 shows the mean percentage of correctly recalled word pairs on the retention test for both the massed condition and the spaced condition, as a function of learning condition and RI. On the 1-week test, the mean percentages of correctly recalled words were 64.28 and 45.35% for the spaced and the massed condition, respectively. On the 5-week test, recall was lower: 50.71 and 28.57%, respectively (for the same two learning conditions [see Table 2]). A 2 (learning condition: massed vs. spaced) × 2 (RI: 1-week vs. 5-weeks) repeated measures ANOVA was conducted to analyze the data. The dependent variable was long-term retention, as measured by the scores on a retention test. The analysis confirmed a main effect of learning condition, $F(1, 27) = 100.670$, $p < .001$, $\eta p^2 = .789$: Participants' performance in the spaced condition was better than participants' performance in the massed condition. Also, there was a main effect of RI, $F(1, 27) = 71.851$, $p < .001$,

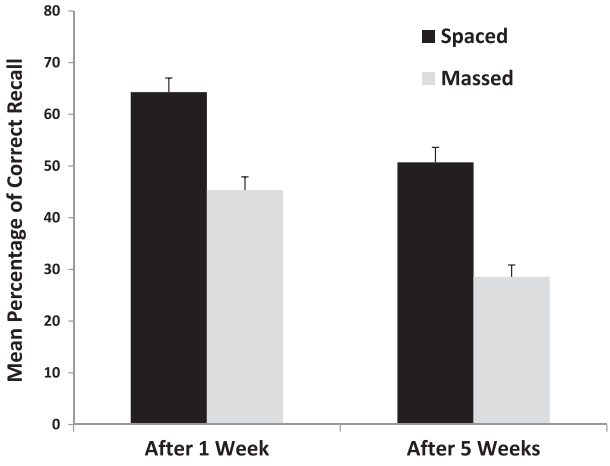

Figure 2. Mean percentage of correct recall of massed and spaced items.

Note: Error bars represent +SE.

Table 2. Means and standard errors of all tests for each presentation condition

Test	Presentation conditions			
	Spaced		Massed	
	M	SE	M	SE
1	64.28	2.74	45.35	2.54
2	50.71	2.90	28.57	2.28

$\eta p^2 = .727$: Participants recalled more words after RI of 1 week than after RI of 5 weeks. Moreover, pairwise comparison on learning condition showed that retention in spaced condition was better than retention in the massed condition ($p < .001$), and learners performed better on the words after 1 week than after 5 weeks ($p < .001$). There was no significant interaction between learning condition and RI, $F(1, 27) = .629$, $p = .435$.

In summary, the results of this study showed that spacing leads to better long-term retention than massing. These data evidenced that spacing effects appear to be robust even when subjects do not use paper pencil exercises to practice the to-be-learned words. Furthermore, although forgetting occurred for both conditions, the amount of forgetting was less for the participants who had learned the words under the spaced condition.

4. Discussion

This study indicates that applying the findings of laboratory-based research to EFL classes can have a great impact on vocabulary learning. This study had more ecological validity than the previous studies. That is, we made the conditions in which words were learned similar to those in real EFL classrooms at primary levels. For instance, drawing learners' attention to both meaning and form of a word, having the learners' practice the words in collaboration, having the learners repeat the words after the initial presentation and before practicing in pairs, etc. Thus, this study investigated the spacing effect in EFL vocabulary learning by using educational materials with typical vocabulary learning activities presented within a meaningful EFL context and with educationally meaningful time intervals.

Moreover, we kept the duration of the learning sessions in session 1 and session 2 the same. In the study by Sobel et al. (2011), participants studied the words under three learning conditions in session 1 and one learning condition in session 2. Therefore, the duration of the learning phase was different for session 1 (day 1) and session 2 (day 7), and probably the words studied in session 2 (the spaced words) got more attention than the words studied in session 1. In our study, the duration of the

learning phase was the same for the massed and the spaced condition within each learning session. Furthermore, this study used a balanced procedure to investigate the effects of spacing. That is, conditions were not confounded with presentation order.

The present study extends the previous studies in that the participants in our study did not practice the words through paper pencil exercises in the learning phase. For example, Goossens et al. (2012) had children practice the words using fill-in-the-blank questions, true/false questions, and multiple-choice questions. In our study, we used ecologically valid activities; that is, we had the learners practice and retrieve the words in collaboration in the learning sessions. Moreover, we drew learners' attention to both form and meaning of the words. In most previous studies, learners' attention was drawn to the meanings of the words at the time of the study. In general, the teaching and learning activities in our study resembled those in real EFL classrooms.

4.1. Implications

The findings of this study can be of valuable help to learners, teachers, and curriculum developers in different ways. Learners can space their self-study sessions out in time to enhance the amount of their learning. It could be a good idea for teachers to schedule classroom learning activities according to a spaced schedule to increase learners' performance at the tests. Also, it will help syllabus designers and curriculum developers through which they will be able to plan the course books to facilitate foreign vocabulary learning. That is, because spacing has an enhancing effect on learners' long-term memory (for a review see e.g. Cepeda et al., 2006), syllabus designers and curriculum developers will have the opportunity to decide when in a course and where in a book a word needs to be repeated.

4.2. Limitations and future research

There are some limitations of this study that should be addressed. First, the participants in this study consisted of 28 young EFL learners recruited from a language Institute. In order to be able to improve the statistical power and generalize the results, a larger sample size is preferable. Second, since learners retrieved the words once in the first test session, they had the opportunity to re-study the words, which this probably may have minimized the amount of forgetting after five weeks. Third, the scope of this study was limited. In order to determine the underlying mechanisms of the spacing effect, further studies should be conducted over longer periods of time. The present study took place in an English language institute during the EFL learners' regular class hours. The study was restricted to a limited-course time. Thus, the current study only looked at the retention of the words over 6 weeks. Future studies should replicate the study employing longer time intervals and several delayed posttests. Such data may provide more profound insights into young learners' word learning processes and spacing effects.

The present study was conducted to determine the effects of spacing on young EFL learners' vocabulary learning. A worthwhile question for future research is how the learning of vocabulary may be affected by different learning styles (i.e. visual, auditory, and kinesthetic). Future researchers should attempt to use a spaced methodology that takes into account learners' differences and combines different learning styles. Another question for future research is whether the effects of spacing vs. massing might vary across time for learning different aspects of language (e.g. pragmatics). Moreover, it would be interesting to investigate whether the results of this study are generalizable to different language learning contexts and different language learning materials. Furthermore, in future research, it would be interesting to explore the role of spacing and frequency in vocabulary learning of young learners. In addition, future studies can investigate the benefit of spaced practice in which an appropriate context is used for vocabulary learning. In future research, it would be interesting to use the methodology presented here but present the words in a meaningful context. It would be possible to present the new words in a story context in which L2 learners listen to a story two times followed by repeated retrieval of the learned words. They then are repeatedly tested on the learned words in different intervals.

5. Conclusion

Spaced practice is a powerful method to improve learning and retention, and the time has come to look at ways of implementing this technique into EFL classrooms. The present study took a sharp look at the use of spaced schedule in a real EFL classroom. The evidence obtained from this study suggests that distributing learning events across time promotes learning in EFL classes. The results of the study confirmed that spaced practice takes on an added importance when the long-term retention of information is desired. Moreover, this study implies that vocabulary learning using word lists is not only beneficial for adults at high levels, but also it can be beneficial for children at elementary levels. To sum up, our findings extend earlier studies by Sobel et al. (2011) and Goossens et al. (2012) that show the beneficial effects of spacing in vocabulary learning, and it puts an end to the belief that learners benefit from cramming more than spacing.

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Appendix 1

English words and their Farsi translations

English word	Farsi translation
Artist	هنرمند
Town	شهرستان
Player	بازیکن
Uncle	دایی
Peel	پوست کندن
Snorkel	غواصی
Heavy	سنگین
Rent	کرایه کردن
Spoon	قاشق
Visit	ملاقات کردن
Mail	پست کردن
Bottle	بطری
Buy	خریدن
Strong	قوی
Cute	جذاب
Sunrise	طلوع خورشید
Earth	زمین
Subject	موضوع درسی
Shut	بستن
Scary	ترسناک