VOCABULARY LEARNING AND RETENTION: A COMPARISON BETWEEN A SERIOUS GAME AND MOBILE APPLICATION

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ABSTRACT

The present study aims to examine the impact of Iranian EFL learners' vocabulary learning and retention through two new ways, using a serious game (i.e., Influent) or a mobile application (i.e., *AnkiApp*). To this end, 90 Iranian EFL learners were given a homogeneity test. They were subsequently classified into two groups. A serious game group (n=45) instructed vocabulary through the serious game, and a mobile application group (n =45) taught vocabulary by the mobile application. The participants in both groups were administered a pretest, posttest, and delayed posttest. The findings of the independent-samples *t*-test showed that participants of the serious game group had the edge over the mobile application group. Additionally, the results of the independent-samples *t*-test and repeated measures analysis indicated that participants of the serious game group remembered the effects of the treatment and that both time and group affected their performance. Moreover, the results of the paired t-tests revealed that participants of the mobile application group benefitted from their treatment, but not as significant as those of the serious game group.

Keywords: Computer-Assisted Vocabulary Learning (CAVL), EFL vocabulary learning, EFL vocabulary retention, Gamification, Mobile-Assisted Vocabulary Learning (MAVL), Serious games

INTRODUCTION

English is the most widely spoken language all over the world as a direct result of globalization and the immense impact that English-speaking countries have on the world economy. Consequently, extensive English vocabulary knowledge is one of the important skills that EFL learners and teachers should obtain. With the constant improvement of Information and Communication Technology (ICT), Computer-Assisted Language Learning (CALL) and Mobile-assisted Language Learning (MALL) have proved to influence conventional EFL learning and teaching dramatically (Chang, Warden, Liang, & Chou, 2018; Isbell, Rawal, Oh, & Loewen, 2017; Kasemsap, 2017).

With the emergence of ICT, contemporary students have become 'digital natives,' in that they learn and process information differently (Prensky, 2001). The so-called *Millennials* and *Generation Z* share information and use ICT via blogging, gaming, and social networking. They are typically focused on everything web-based and are not afraid of expressing or sharing their visions. Based on this type of learner, many instructors of different subjects, including language teachers, are implementing several teaching strategies that take advantage of ICT (Flores, 2015). In addition, these educators are aware of new trends in educational technology and are integrating gamification into their teaching (Johnson et al., 2013).

Gamification allows millennials to control what they learn, when, where, and how they learn. The needs for instant gratification, success, and recognition are met by tools like gamification, competitive leader board, social learning, and quick feedback mechanisms incorporated within the gamified platform (Jain & Dutta, 2019; Kotob & Ibrahim, 2019; Tan, Lee, Ganapathy, & Kasuma, 2019). Serious games are "Games that do not have entertainment, enjoyment, or fun as their primary purpose" (Michael & Chen, 2005, p. 21). The "seriousness" part of these games pertains to the information that is utilized as teaching material by instructors, and the playful elements from video games allude to the "games" part (Alvarez & Djaouti, 2011).

According to Cellat (2008), the emergence of CALL seems to provide a fresh outlook on language teaching and learning, including vocabulary learning. Moreover, it equips learners with easy access to a vast number of learning environments regardless of their place and time and also increases their motivation and effectiveness via learning with multimedia content. Additionally, teachers use computers to design materials which help learners to develop language skills efficiently. The use of CALL increases learners' motivation towards learning a new language, and it allows them to play a significant role in their autonomous learning process (Hani, 2014). Technology has an unstoppable aspect to it, which has numerous effects in the field of language learning and language teaching.

Through the conveyance of personal computer features to ubiquitous mobile devices which can be used in education, MALL came into being and has affected the learners' approach to second language (L2) learning (Kukulska-Hulme, Lee, & Norris, 2017). It is claimed that MALL "differs from CALL in its use of personal, portable devices that enable new ways of learning, emphasizing continuity or spontaneity of access across different contexts of use" (Kukulska-Hulme & Shields, 2008, p. 273). Mobile learning (m-learning) comprises both formal education within the conventional classroom settings and informal learning outside the classroom, across multiple devices and platforms, in a variety of physical and virtual environments, and it is the interaction with these environments that leads to learning (e.g., Kukulska-Hulme, 2009; Traxler 2007). Mobile learning is defined as "the processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies" (Sharples, Taylor, & Vavoula, 2007, p. 225).

Today, mobile users have hundreds of thousands of Apps at their fingertips, and these apps have changed their devices into portable language laboratories, which allow them to practice and learn whenever and wherever they want (Barcena et al., 2015; Klimova, 2018; Kukulska-Hulme, 2009). Research on some apps, such as Duolingo (Vesselinov & Grego, 2012), Babbel (Vesselinov & Grego, 2016), and '50 languages' (Nushi & Eqbali, 2018) have found promising results for their users, leading to claims that these apps may offer the same or even higher efficiency as in-person teaching (Rachels & Rockinson-Szapkiw, 2018).

LITERATURE REVIEW

Serious Games and Vocabulary Learning

Vocabulary acquisition plays a vital role in language learning and teaching. The rapid development of science and technology has dramatically changed English language learning and teaching settings in recent years. The popularity of mobile applications has exerted a far-reaching influence on traditional language learning and teaching approaches (Rezaei, Mai, & Pesaranghader, 2014). Computer Assisted Vocabulary Learning (CAVL) can provide a variety of vocabulary learning opportunities for language learners (Alnajjar & Brick, 2017). Nation (2013b) suggests there are numerous advantageous sets apart CAVL from other ways of vocabulary learning. For example, CAVL may lay the foundation of fast and easy access to some resources, such as online dictionaries, video games, digital flashcard websites, vocabulary

lists, and all sorts of computer-assisted exercises. CAVL programs may also foster autonomous learning, and learners can adjust the pace and time of their own learning (Nikolova, 2002).

A few studies on serious game-aided English vocabulary learning confirm the positive influence of serious games on English vocabulary learning. Backed by serious games and online resources, players could statistically significantly increase their range of vocabulary ($p < .0005$) more than those who acquired vocabulary through conventional texts, wordlists, and multiple-choice questions (Smith et al., 2013). Students could also significantly increase their English vocabulary range when supported by the serious game, "The SIMS," even though the effect was diminished by the small number of participants who took part in playing the game (Miller & Hegelheimer, 2006).

As suggested by Sandberg, Maris, and Hoogendoorn (2014), serious game-aided vocabulary learning needs less learning time and produces significantly higher effectiveness than non-serious game-aided learning. Because learners were satisfied with serious game-aided vocabulary learning, they carried out adaptive and independent vocabulary practices. Thus, via gaming, students have been found to believe they could boost their vocabulary range and increase their linguistic understanding (Schamroth & Sara, 2014). Additionally, serious games played off-campus were positively correlated with both on-campus English vocabulary ranges and learning outcomes. Serious gamers were also reported to be more effective in acquiring more English vocabulary compared with the traditional vocabulary learning approaches through reading comprehension (Sundqvist & Wikström, 2015).

Moreover, Franciosi (2017) found that serious gaming may facilitate vocabulary transferability in authentic contexts and promote vocabulary recall practice, which leads to advancements in English vocabulary learning. There is also another salient mechanism, in that serious gaming can prolong English vocabulary retention and thus augments the effectiveness of serious gaming in vocabulary learning and teaching (Alshaiji, 2015). Students may implement several learning strategies that are not usually practiced in non-serious gaming-aided contexts through game-aided vocabulary learning. These include contextual inferences, vocabulary repetition, and convenient communication with native English speakers and peers (Janebi Enayat & Haghighatpasand, 2018).

Serious games are deemed a significant innovative technology that could promote language learning and help students achieve their learning goals (Chen & Hsu, 2019). These games may encourage students to interact more and improve their linguistic competence (Marsh & Tainio, 2009); they are able to capture learners' attention and increase the effectiveness of language use (Townsend, 2009), and, hence, assist learners in achieving success in their language learning. Interactive simulation games have also been found to promote language learning by offering high interactivity, intricate animations, and sophisticated scenarios. The multitude of contexts and cognitive engagement in virtual language learning situations can also act as an incentive to strengthen the effectiveness of language learning (Ranalli, 2008). Through cohort activities and peer interlocution, even beginner language learners have been able to successfully acquire English vocabulary using the Scrabble Game application in their mobile phones (Lin, Young, Hung, & Lin, 2007).

However, researchers' disagreement regarding serious game-aided vocabulary learning still exists, notwithstanding that most of them consider serious games as an effective learning method. For instance, Calvo-Ferrer (2017) contended that learners with immediate access to serious games could outperform those who had no immediate access to them in vocabulary tests. In addition, he points out that whether students have a keen interest in serious gaming has no significant impact on English vocabulary learning effectiveness. Nevertheless, he states that extrinsic motivation might play an essential role in vocabulary learning, such as the player's desire to play serious games, the initial range of vocabulary, and difficulty of perceiving learning materials. Moreover, Yeşilbağ et al. (2020) found no statistically significant difference

in terms of students' attitudes towards English lessons between two groups of students who received the course via educational computer games and students who were subjects of traditional teaching. However, they too validate the use of computer games as an efficient ICT tool to increase students' academic success in learning English.

According to Herusatoto (2012), an isolated learning environment may be more suitable for word retention in comparison with an interactive environment. In an isolated setting, students keep newly acquired words for an extended period in their memory. Therefore, excessive interactivity in games may decrease the effectiveness of vocabulary learning, as well as putting too much force on communicative strategies (Yudintseva, 2015). However, the extraneous cognitive load could be intensified in the interactive process of serious gaming, which leads to reduced effectiveness of vocabulary learning (Dehaan, 2008). Moreover, as some learners might not be familiar with some serious games' highly interactive nature, they could feel anxious. Such anxiety has been found to potentially pose a threat to vocabulary learning effectiveness (Neville, Shelton, & McInnis, 2009). In contrast, Garmen et al. (2018) analysed the effectiveness of two video games on anxiety level and self-concept of children and adolescents with learning difficulties and discovered that participants had reduced their anxiety levels while increasing their self-concept after learning interventions through videogames.

Mobile Assisted Vocabulary Learning

As mentioned earlier, the interest in vocabulary learning is on the rise. Today, various kinds of aids are at the disposal of language learners, among which mobile applications are one of the most effective and popular ones (Rezaei, Mai, & Pesaranghader, 2014). In the literature, there has been an acknowledgment of the benefits of mobile applications for language learning as well as vocabulary learning, which engage learners in multiple activities (Godwin-Jones, 2011; Gürkan, 2018; Hao, Lee, Chen & Sim, 2019; Liu, Navarrete & Wivagg, 2014;). However, as with most language learning resources, the features and potential of apps are quite varied. According to a number of studies, MAVL may improve learners' vocabulary accuracy (e.g., Castañeda & Cho, 2016; Sandberg, Maris, & Hoogendoorn, 2014) and it may also magnify the learners' vocabulary acquisition and reduce their "the burden of memorization" (Wu, 2015, p. 176). Furthermore, some have found the effectiveness of apps comparable to face-to-face instruction (Rachels & Rockinson-Szapkiw, 2018), and researchers have specifically noticed improvements in vocabulary acquisition through their use (Calvo-Ferrer, 2015; Steel, 2012; Yıldız, 2012).

Previous studies have shown that learning vocabulary through tutorials or personalised mobile applications involving flashcard or word games either increases word retention or elevates learners' interest in MAVL (Agca & Ozdemir, 2013; Basoglu & Akdemir, 2010; Chen & Chung, 2008; Hsu & Lee, 2011; Ono, Ishihara, & Yamashiro, 2015; Sandberg, Maris, & Hoogendoorn, 2014; Wu, 2014). Learners might also successfully acquire some of the target words and improve their vocabulary knowledge through the context-aware MALL apps such as GPS (Beaudin, Intille, Tapia, Rockinson, & Morris, 2007; Sandberg, Maris, & de Geus, 2011). Vocabulary learning with mobile devices also has the potential to promote L2 learners' self-awareness (Liu, Tao, & Nee, 2008; Runyan et al., 2013), as well as self-regulation (Kondo et al., 2012). Learners have also expressed a sense of satisfaction with mobile applications, and this positive experience has been found to facilitate the learning of new words at various levels (Cavus & Ibrahim, 2009; Chen & Chung, 2008; Ono et al., 2015).

Many researchers have confirmed the effectiveness and the potential of MAVL and have made use of various mobile technology modes and apps to expedite L2 vocabulary learning. However, in marked difference with previous positive study results, some researchers

have reported no significant difference in learning, and even pointed out some disadvantages (Derakhshan & Kaivanpanah, 2011; Stockwell, 2007, 2010). Some studies have illustrated that learners may consider their mobile device for personal and social use rather than seeing it as a learning tool (Stockwell, 2010). Some may even dismiss using them because these devices, considering their nature, are mostly used in distracting environments (Reinders & Hubbard, 2013). Similarly, Liu and Yu (2013) claimed that some English learners are not willing to take part in projects that use Facebook as a mobile learning interface unless they are permitted to use a second account to their private one. This phenomenon shows that learners draw a line between privacy and learning purposes with their mobile devices (Stockwell, 2010). Some learners have also revealed negative reflections on MAVL, for instance, the difficulty of concentrating on learning while on the move, insufficient example sentences for target words, and unresolved technical problems, which all lead to their unwillingness to use mobile technologies (Lu, 2008).

Many researchers have mentioned the issue of being aware of financial restrictions when teachers or researchers would like to choose mobile devices as their main tools. The cost of using high-tech mobile technologies and cellular networks has been a potential constraining factor, particularly for those learners who may not be able to afford a mobile device (Cavus & Ibrahim, 2009; Kukulska-Hulme & Shield, 2008; Stockwell, 2008). What is more, Stockwell's (2007, 2010) findings, based on surveys and server log data, found when learners were given the options of either a regular personal computer (PC) or a mobile device for them to study target words, up to 61% did not use the mobile device at all, and almost a quarter did less than 20% of the vocabulary activities. It was noted that this might have been due to the preference for familiar computer technology and certain restrictions associated with mobile devices, such as small keyboards and display screens, that lead to a higher cognitive burden (Stockwell, 2007). When everything is considered in the discussion mentioned above, the potential limitations and hurdles mean that the effects of MAVL are inconclusive, thus supporting a call for further research to provide more evidence-based findings.

Therefore, in the light of the above studies, it is crucial to investigate the impact of serious games as well as mobile applications for new vocabulary learning and retention. Moreover, the nature of acquiring concrete vocabulary through both mobile applications and serious games was also unclear; thus, there is an acute need for probing this area. Therefore, this study aimed to answer the following research questions:

1. Do serious games affect the acquisition of vocabulary among Iranian EFL learners?
2. Do serious games have an impact on the retention of vocabulary among Iranian EFL learners?
3. Is there a significant difference between vocabulary acquisition through serious games and *AnkiApp* among Iranian EFL learners?
4. Which of the teaching methods (serious game or *AnkiApp*) more significantly affect retention of vocabulary among Iranian EFL learners?

METHOD

The participants were 90 pre-intermediate Iranian EFL learners engaged in a private language institute in Shiraz. They were selected randomly as two classes out of 10, from a total of 114 students. The age of the participants ranged from 19 to 37. The two factors, namely, the learners' age and gender, were not regarded as independent variables for this study. However, the researchers did their best to conduct the study with an equal number of male (n = 43) and female (n = 47) participants.

A Quick Placement Test (UCLES, 2001) was administered to find out whether the two groups (45 participants each) were homogeneous with regards to their English proficiency level or not. Subsequently, an independent samples *t*-test was utilised to compare the vocabulary knowledge of the participants before the intervention of treatments. The attained results showed that there was no significant difference, t (71) = -.238, p = .674, between the mobile application group (M = 41.35, SD = 1.00) and serious game group (M = 40.78, SD = 5.39). It revealed that before the intervention of treatments, the participants of the study were homogeneous regarding their English proficiency level. Hence, 90 participants who met this homogeneity criterion were categorised into the serious game (n = 45) and mobile application (n = 45) groups.

Participants are thirteen teacher candidates who were members of the Pibid between 2015 and 2016. I invited all participants who worked in the elementary school in that period and those who accepted gave me written consent and access to the journals they had written when developing the projects' activities. It must be said, however, that since the beginning of the activities, all TCs were aware of the national program regulation, which states that all documents produced by participants are open to the public and can be used as research data upon the university Ethics Committee approval. The study is part of a larger investigation that analyses data generated during the project's four-year period, by looking into different aspects of the formative experience. The university institutional Ethics Committee in Brazil granted me approval for the development of the investigation (Ethics approval document number: 2.683.907).

The thirteen participants are identified with the following codes: P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13. Eight participants were male (P1-P3; P5-P9) and five were female. Participants' age ranged from 18 to 35 years old, with just two over 30 years old (P1 and P13). The journals they produced were written at the end of each month from February to November (2015 and 2016). Not all journals addressed the theme of inclusion, so we pre-selected those which discussed specifically that theme, an average of 3 journals per each participant.

The annual reports analysed were produced by the two coordinators of the program (one of which is the researcher), through a compilation of information found in TC's reports, in addition to the coordinators' data. The coordinators of the program had to submit a report to the Ministry of Education Agency, which supported the program, at the end of each year. Finally, it is important to acknowledge the role of the schoolteacher, who acted as a supervisor/mentor for the TCs and is often mentioned in their journals as a source of knowledge, feedback, and emotional support.

Adopting an interpretive and thematic stance to data, this research has a primarily qualitative nature. The research stands as a case study (Yin, 2018), and the case is the Pibid project developed in a specific school where the processes described took place for a year. There is a presupposition that "understanding in-depth educational phenomena may be the first step for real change, based on the needs perceived by the participants of a specific educational context and for that context" (Esteban, 2010, p. 132). In this way, when mapping the strategies proposed to TCs to work with SWDs and the meanings given by participants to their experience of enacting those strategies, I tried to search for patterns, insights, or concepts (Yin, 2018) that

connected to the framework adopted as a reference, that is, the European Agency for Development in Special Needs Education (2012) core values. Additionally, I also considered the themes that emerged from data, that is, I was open to include categories that were not mentioned in the core values. For this reason, the study has both a deductive and an inductive nature.

Although this study addresses a specific experience of teacher education, it is meant to contribute to the international field of language teacher education, as it sheds light into what the challenges for inclusive education are in Brazil currently and, at the same time, it shares insights into innovative strategies that could be relevant to advance inclusive teachers' identities and inclusive practices in local, national and transnational contexts.

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Instruments

The following instruments were respectively used in this study.

Pretest

After the classification of the participants into two groups, namely, serious game and mobile application groups, a 14,000-level test vocabulary size, which was constructed by Nation and Beglar (2007), was given to the participants in order to ensure that their vocabulary skill level was at the same level. This test contained ‘‘140 multiple-choice items, with ten items from each 1000-word family level. A learner's total score needs to be multiplied by 100 to get their total receptive vocabulary size.’’ (Nation, 2013a, p. 1). The reliability of Nation and Beglar s' test (2007) has been attained in different context using a different statistical technique, such as a Rasch-based analysis in Japan, and it was piloted in another context. The pretest was administered to both groups to find out their vocabulary levels. Then, these results were used to uncover those target vocabularies that were new and unfamiliar to the participants. Accordingly, those vocabularies and other vocabularies of the same level, based upon Nation and Beglar s' test (2007), were selected to be taught to students in the instructional stage.

Posttest

In the posttest phase after 20 weeks of instruction, students in both serious game and mobile application groups were given Nation and Beglar s' test (2007) (the 14,000-level test

vocabulary size) again to find out to what extent their performance changed after being taught vocabulary through either *AnkiApp* in the mobile application or serious game group.

Delayed Posttest

To answer the second research question of the study and to find out to what extent vocabulary instruction in the mobile application and serious game groups had been retained in students' minds, a delayed posttest was administered. It was used one month after the posttest. The delayed posttest repeated Nation and Beglar s' test (2007) of a 14,000-level test vocabulary size, as administered to students in the pretest and the posttest in both the mobile application and serious game groups.

The Material of the Study

Influent is regarded as a serious type of video game, which was developed by Rob Howland. It was introduced widely by Three Flip Studios. This serious game can be played on various platforms such as Microsoft Windows, Linux, macOS. In this serious game, which is highly interactive, players are exposed to different environments, which have different vocabularies that students are required to learn. After the students click on different new vocabularies, they can learn them with the related spellings and pronunciations.

In this study, all students in the serious game group were first instructed by their teacher on how to play the game. The teacher was ready to help students should they have further questions regarding the game in the study. In the mobile application group, students were supposed to learn the vocabularies by serious games and were instructed to use electronic flashcards through *AnkiApp*. In the mobile application group, similar to the serious game group, the teacher was ready to help students should they seek further help.

Procedure for the serious game group

The students in the serious game group were first told how to install the related serious game, Influent. The teacher then thoroughly explained the different properties of the game and allowed students to ask their questions if they had any inquiries with concern to the game. Afterwards, the teacher explained how new vocabularies would be taught to them through their accomplishment of different goals. At first, a particular level of the game as accomplished by the teacher was demonstrated. Subsequently, the teacher asked the students if they had questions. Then, in twenty sessions of two hours, different targeted tasks in the game were accomplished. More instructions and feedback were provided in the classroom, either by the teacher or successful players. Students' new vocabulary learning was always being tested through formative assessment in the classroom, and in the necessary time, further feedback was presented by teachers. The students formed a community of players and interacted with and helped each other to learn the vocabulary. The students, moreover, accomplish different levels of the game. In the final session, the twentieth session, students were given Nation and Beglar s' test (2007), a 14,000-level test vocabulary size as the posttest. As noted earlier, this test was given to them one month after the posttest as a delayed posttest.

Procedure for the mobile application group

Students in the mobile application group were given the instruction for installing the mobile application, *AnkiApp*, on how to learn new vocabularies through it. Firstly, a sample of how new vocabularies can be learned through this mobile application was explained by the teacher. Then the students engaged in learning through *AnkiApp*. The teacher was ready to help students if they need assistance. Formative assessment of students' vocabulary learning was conducted by the teacher, who provided additional feedback for students as necessary. This process was accomplished for twenty sessions of two hours; in the final session, the twentieth

session, students were asked to participate in a posttest, Nation and Beglar s' test (2007), a 14,000 level-test vocabulary size. One month after the posttest, the students were administered the same test as a delayed posttest.

Data Analysis

To answer the first research question, investigating the impact of the serious game (the independent variable) on the acquisition of vocabulary (the dependent variable), an independent samples t-test was used. To this end, an independent samples *t*-test was utilised on the pretest for ensuring that the participants in the two groups were homogeneous concerning their vocabulary sub-skill. Subsequently, an independent samples *t*-test was used to compare the results being attained in the pretest and posttest.

For answering the second research question in the study, an independent sample *t*-test was used on the delayed posttest to find out the long-term impacts of the independent variable. Then, in order to correctly answer the third and fourth research questions, a repeated measure analysis of variance (ANOVA) was used to discover whether one group performed better than the other in the acquisition and retention of the new vocabularies.

RESULTS

Results of the Pretest

To investigate the effect of serious game, the independent variable, on Iranian EFL students' vocabulary acquisition and retention, the dependent variables of the study, the participants of the study took the pretest to ensure that they were homogeneous in matters of vocabulary sub-skill knowledge. Table 1 illustrates the explicated results attained in the pretest.

Table 1: *Independent samples test for the pretest*

	Levene's Test for Equality of Variances		*t*-test for Equality of Means				
Pretest	*F*	*Sig.*	*t*	*df*	*Sig.* (2-tailed)	Mean Difference	*Std.* Error Difference
Equal variances assumed	.126	.572	-.824	73	.407	-.32	.33
Equal variances not assumed			-.824	71.914	.407	-.32	.33

According to Table 1, the results of the independent samples *t*-test indicated there is no statistically significant difference between the participants, t (73) = -.824, p = .407, in the mobile application (M = 13.62, SD = 1.84) and the serious game groups (M = 13.47, SD = 1.69). It proposed that the level of vocabulary sub-skills among the study's participants was homogeneous, and any likely changes in the results of the study would be the result of the intervention treatment.

Results of the Posttest

Having accomplished the experiment and teaching the students new vocabularies as thoroughly explicated in the serious game and mobile application groups, the participants were asked to complete the posttest. It was administered to examine whether the treatment, teaching

new vocabularies through serious game, the independent variable, had a statistically significant impact on the participants' vocabulary sub-skill level or not. Thus, an independent samples *t*-test was conducted, the results of which are displayed in Table 2.

Table 2: Independent sample test for the Posttest

	Levene's Test for Equality of Variances		t-test for Equality of Means				
Posttest	F	Sig.	*t*	*df*	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	3.783	.051	4.192	71	.001	2.94	.29
Equal variances not assumed			4.192	65.826	.001	2.94	.29

Based upon these results as shown in Table 2, a statistically significant difference was found, between the performance of the participants in the two groups. Students who participated in the serious game group (M = 18.68, SD = 1.49) out-performed the mobile application group (M = 14.75, SD = 1.92) in matters of their vocabulary sub-skill in the posttest: t (71) = 4.192, p < .05. Hence, the results presented a meaningful and positive answer to the first research question: Do serious games affect the acquisition of vocabulary among Iranian EFL learners? In effect, serious game, the independent variable, was found to be superior in enabling the Iranian EFL learners to acquire the target vocabularies.

Results of the Delayed Posttest

To investigate to what extent the long-term treatment and the retention of the target vocabularies had an impact on the participants, they were given the delayed posttest one month after the final session of their instruction, the twentieth sessions. In a parallel fashion to the results obtained in the posttest, an independent samples *t*-test was utilised, the results of which are shown in Table 3.

According to the results in Table 3, a statistically significant difference, t (71) = 4.283, p < .05, was observed between the two groups. Students who participated in the serious game group (M = 18.82, SD = 1.53) out-performed the mobile application group (M = 14.19, SD = 1.76) regarding their vocabulary sub-skill in the delayed posttest: t (71) = 4.192, p < .05. Moreover, the attained results demonstrated that even after one month, the serious game group participants retained the vocabularies and performed very similarly to how they performed in the posttest. These results provide helpful and meaningful proof to answer the second research question: Do serious games affect the acquisition of vocabulary among Iranian EFL learners?

Table 3: Independent samples test for the delayed Posttest

F	*Sig.*	*t*	*df*	*Sig.* (2tailed)	Mean Difference	Std. Error Difference
.545	.392	4.283	71	.001	3.17	.38
		4.283	74.492	.001	3.17	.38

Thus, according to what these results indicate, the participants in the serious game group remembered and retained the target vocabularies for a longer period, for one month after the intervention treatment. In effect, the serious game had a profound impact on the long-term retention of the serious game group's target vocabularies.

Results of Repeated-Measures Analysis

In order to attain a more vivid picture of the interaction of time and group and find out comprehensively to what extent each group performed at different times, a mixed between-within subjects ANOVA was used to evaluate the effect of the serious game upon their vocabulary score over the three-time spans: pretest, posttest, and delayed posttest. Table 4 displays these results.

Table 4: Multivariate tests for repeated-measures vocabulary performance

Effect		Value	*F*	Hypothesis *df*	Error *df*	*Sig.*	Partial Eta Squared
Time	Pillai's Trace	.73	128.41	2.00	75.00	.001	.755
	Wilks' Lambda	.19	128.41	2.00	75.00	.001	.755
	Hotelling's Trace	3.27	128.41	2.00	75.00	.001	.755
	Roy's Largest Root	3.27	128.41	2.00	75.00	.001	.755
Time * Group	Pillai's Trace	.32	21.08	2.00	75.00	.001	.374
	Wilks' Lambda	.57	21.08	2.00	75.00	.001	.374
	Hotelling's Trace	.55	21.08	2.00	75.00	.001	.374
	Roy's Largest Root	.55	21.08	2.00	75.00	.001	.374

According to the multivariate analysis, the results indicate a statistically significant interaction between group and time. Wilks Lambda = .57, F (2, 75) = 21.08, $p < .001$, partial eta squared = .374. As well, these data show a profound impact for time, Wilks Lambda = .19, F (2, 75) = 128.41, statistically significant: $p < .001$, partial eta squared = .755, with the serious game group demonstrating an enhanced performance in not only the acquisition but the retention of those target vocabularies in this study over pretest, posttest, and delayed posttest.

DISCUSSION

The results of this study show that vocabulary achievement improved among the language learners from the pretest to the posttest, both in the serious game and the mobile application groups. Students in the serious game group had a statistically significant superiority in vocabulary scores over those in the mobile application group. In stark contrast to students in the mobile application group, the students who participated in the serious game group had a golden opportunity to use the game for interacting and receiving further feedback from both peers and their language teacher. This feature, which may be considered as creating a sort of

'dynamic interaction' among the learners, appears to have greatly assisted them in the classroom learning environment. This framework, as well as the attractive and motivational atmosphere of the serious game, helped students in the serious game group to improve their vocabulary knowledge. In contrast to the students in the serious game group, the learning experience for those students in the mobile application group was typically a little more challenging. This was because it was less motivating and did not gain students' attention in the same way. Thus, in the mobile application group, as the time passed by, their vocabulary gains were less, and students could not retain vocabulary knowledge at the same level in the serious game group.

The results of this study are in line with several other studies that considered video games as a new tool for sharpening vocabulary attainment. For instance, Zheng, Bischoff, and Gilliland (2015) also concluded that there was a positive correlation between playing video games and vocabulary learning, and also listening and reading comprehension. Bytheway (2015) similarly found that video games can help students enhance their vocabulary language level and help them adopt appropriate vocabulary learning strategies to attain new words. Moreover, Peterson (2016) found video games helpful for promoting vocabulary knowledge. In a similar vein, Parsayi and Soyoof (2018a, 2018b) and Soyoof, Vazquez-Calvo, and McLay (2020) reported that video games' context is attractive to students and facilitative for optimal vocabulary learning. The motivational nature of video games can provide an optimal context for practicing new language learning (Soyoof, 2018a; 2018b). This is reinforced by the present study, which also aligns with Sedighi and Soyoof's (2013) research, resolving that mobile applications are not only useful for vocabulary learning but all other language skills as well.
As for serious games, similar to the findings of this study, Chen and Hsu (2019) reported that significant content knowledge (i.e., history) and language learning (i.e., vocabulary acquisition) were gained through using a serious game (i.e., Slave Trade). This was in keeping with Johnson, Wang, and Wu's (2007) earlier work, whose results supported the use of serious games for vocabulary development. More importantly, a serious game was found to help children with autism enhance their vocabulary knowledge (Khowaja & Salim, 2018). Likewise, previous studies such as Zhonggen (2018) found the serious game more effective than traditional pedagogy. The findings of this study are in line with DeHaan, Reed, and Kuwada (2010), emphasizing the features of video games, including its context and music in better vocabulary recall. Similar findings were obtained by Janebi Enayat and Haghighatpasand (2018), who found an adventure video game useful for better vocabulary recall.

CONCLUSION

The study was primarily aimed to examine the impact of serious games and the mobile application, *AnkiApp*, on Iranian EFL students' acquisition and retention of new words. It was found that using a serious game and mobile application, *AnkiApp*, was influential in students' language learning and that the students attained the target vocabularies positively. Comparatively, a serious game was found to have the edge over a mobile application, *AnkiApp*, for both learning and retaining new vocabularies. Furthermore, it was also concluded that the improvements in retaining vocabularies were observed over time, which demonstrated that the affordances of digital technologies and English resources for second language learning (Gee & Gee; 2017; Gee, 2012; Peterson, 2010; Soyoof & Jokar, 2014; Soyoof & Sedighi, 2013; Soyoof & Talei, 2013).

Thus, serious games should be taken into account since they can facilitate the process of acquisition and retention of new vocabularies. This study showed that the serious game (i.e., Influent) has superiority over the mobile application, *AnkiApp*, which is a popular method for teaching new vocabularies. So, it is incumbent upon language teachers to ensure that learners

have opportunities to interact and use the target language for meaningful purposes. Accordingly, it is suggested that serious games can be used as supplementary language learning resources to facilitate physical classroom learning experiences. However, serious games should be used under the teacher's or parents' supervision to guide students on how to use serious games effectively.

This study has both theoretical and pedagogical implications. From the theoretical perspective, it provides a better understanding of the role that serious games can play in the process of second language acquisition. By forming social groups or a learning community, as did the participants of this study in the serious game group, this linked closely to social constructivist learning theory applied to second language acquisition (Lantolf, 2000; Lantolf & Thorne, 2006; Vygotsky, 1978). It is noteworthy that the idea of forming social groups for a serious game created meaningful communication, involving "necessary coordination of . . . thinking with that of others" (Crook, 1991, p. 158). This implies that participants needed to understand themselves and adequately coordinate with the perspective of their peers during the game. Likewise, Gay and Grosz-Ngate (1994) and Skwarchuk, Sowinski, and LeFevre (2014) expounded that the development of knowledge, as well as the interactive process, can be augmented through group work activities. This extends to foster other vital skills in students, such as critical thinking and social skills.

Additionally, with regards to the study's pedagogical implications, the learning success attributed to the serious game is highly relevant not only to language teachers and language learners but also to policymakers and curriculum developers. In summary, the findings of the study provided a moment of contemplation to reconsider how technological tools, especially serious games, and mobile applications, can be beneficial to facilitate the process of language learning in general and vocabulary learning in particular. Pedagogically, the results present further empirical evidence of how beneficial serious games are for vocabulary achievement. More importantly, serious games should be considered as a pedagogical tool in language teachers' kits both to provoke language learners' meaningful communicative interactions in the virtual world and to create an influential and eye-catching, and attractive atmosphere.

Ultimately, however, some areas for further research and study can be proposed. Firstly, second language scholars are advised to study serious games to investigate their potential impacts on second language proficiency in terms of complexity, accuracy, and fluency. Furthermore, the impacts of serious games should be probed in relation to various language skills and sub-skills, such as language writing, pronunciation, and collocations. Also, the effect of different genres of video games, such as discovery, action-adventure, and action, on language achievement should be examined in future studies.

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