University of Tehran press

JOURNAL OF FOREIGN LANGUAGE RESEARCH
p-ISSN:2588-4123 e-ISSN:2588-7521
https://jflr.ut.ac.ir **Email**:jflr@ut.ac.ir

The Effect of Virtual Reality (VR)- and Augmented Reality (AR)-based Langauge Instruction on High School EFL Learners' Receptive and Productive English Vocabulary Recall

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ABSTRACT
Technology-assisted education is becoming increasingly popular due to its contribution to more efficient learning. As regards foreign language education, the use of new technologies to help language learners has attracted great interest from researchers and classroom teachers. Two such technologies are Virtual Reality and Augmented Reality. The current study aims at investigating the effects of using Virtual and Augmented Reality on Iranian English learners' vocabulary recall followed by an examination of learners' views concerning the new experience. To this end, 48 high school students in East Azerbaijan were divided to two experimental (Virtual and Augmented) groups and a control group. After an eight-week treatment program, two posttests with multiple choice and completion tasks were given to measure students' receptive and productive vocabulary recall. ANOVA and thematic content analysis were used to analyze quantitative and qualitative data respectively. Results suggested that Virtual Reality and Augmented Reality have statistically significant effects on students' receptive vocabulary recall; for productive vocabulary recall, such positive effects were observed with Augmented Reality group only. Students' lived experiences of the new program were categorized under four major opportunities and one challenge. Findings are used to argue for integration of technological tools and language education followed by a discussion of the implications of the study for teachers, material and curricula designers.

ARTICLE INFO
Article history:
Received: 15 August 2022
Received in revised form 02 December 2022
Accepted: 10 December 2022
Available online: Spring 2024

Keywords:
Virtual reality, augmented reality, receptive recall, productive recall, Iranian EFL learners

Soleimani, A., Mazlum, F., & Janebi Enayat, M. (2024). The effect of virtual reality (VR)- and augmented reality (AR)-based language instruction on high school EFL learners' receptive and productive English vocabulary recall. Journal of Foreign Language Research, 14 (1), 15-32. http//doi.org/ 10.22059/jflr.2024.367480.1079.

 Publisher: The University of Tehran Press.
DOI: http//doi.org/ 10.22059/jflr.2024.367480.1079.

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1. Introduction

Nowadays, what is known as technological revolution has had an increasing effect on different domains such as social life, work place, and education. Portable devices such as smart phones and laptops have already become an inseparable component of modern life and different platforms such as YouTube, Tweeter, and Facebook have changed the nature of relationships between people. Greenhow and Robelia (2009) believe that such technological advancements can be exploited for educational purposes. Lin et al. (2020) believe that the relationship between technology and education is beyond educational application and contend that the application of technology in education is one of the key steps that should be taken to address the evolving, technology-related needs of education systems worldwide.

As regards language education, the use of computers, the Internet, and different installable applications or software has attracted researchers' and classroom teachers' attention during the past three decades and new notions such as Distance Language Learning, Virtual Language Environment, and Mobile Assisted Language Learning have appeared in the literature. Such notions and technology assisted language education have addressed a wide array of foreign languages including English. Technology has affected different aspects of English education such as materials designing, the nature of classroom interaction, students' and teachers' roles, and language assessment (Hsu, 2017).

One of the important issues in technology and English education is the use of Virtual Reality (VR) and Augmented Reality (AR) to teach language skills and components. VR refers to an electrical environment that simulates reality using three-dimensional visual effects but lacks physical materiality; it is the software-computer production of a concept or environment that is supposed to be sensible (more visually) equivalent to reality and refers to the three-dimensional space created by a computer (Tai, Chen, & Todd, 2022). In this environment, the user interacts with virtual objects and events comparable to the real world using designed converters and special sensors, and observes dramatic and moving images so that the person thinks he is in a real environment. Within the smart implementation of these virtual worlds and the stimulation of multiple senses, the users are tricked into accepting that they are experiencing everything in actual life (Lee & Park, 2020). When a person uses VR headsets, they see a simulated environment in front of their eyes that changes based on their physical position. Some of these environments are in the form of 3D computer graphics, and others are 360-degree videos or images of real-world environments that have already been filmed (Schwienhorst, 2010). VR headsets can be divided into two groups: headsets using a dedicated screen and those using a mobile phone to display the content. Thanks to EdTech Nearpod, language learners can use Google Cardboard and more affordable headsets in order to take advantage of VR benefits. Chen et al. (2020) believe that the new environment not only enriches learning opportunities and make

them more exciting but also makes students' thinking and information organization more efficient.

For Ebadi and Ebadi Jalal (2022), VR is a direct or indirect view of the real and material world the elements of which are enhanced by audio and video sensors (i.e. they are added to the elements of the environment). In fact, the difference between VR and AR is that the former uses the headset to take users into a computer generated virtual world and let them explore it whereas the latter adds digital shapes to users' environment. For instance, VR takes learners to virtual oceans and provides them opportunities to explore its depth but AR brings fish to their environment (e.g. classroom).

The application of such platforms to teach and learn different language components such as vocabulary can be very useful. Due to its essential role in language learning and use, English learners' vocabulary knowledge has been the educational concern of several researchers (e.g. Janebi Enayat & Derakhshan, 2021; Matthews, 2018; Matthews & Cheng, 2015). In this study, vocabulary knowledge entails receptive and productive levels. Henriksen (1999) holds that receptive vocabulary recall refers to one's ability to recognize or understand words upon encountering them in oral or written language. Productive vocabulary recall, however, enables individuals to recall or produce words while writing or speaking. It is believed that both levels of vocabulary knowledge play a key role in learning and using the four basic language skills. As such, integrating technology and vocabulary learning is deemed a promising venue to help teachers and students with vocabulary teaching and learning. The integration warrants more significance as one acknowledges the pedagogical offshoots of technology assisted language learning such as learner autonomy, interaction, discovery learning, and personalized learning.

Valuable studies dealing with using technology to teach language skills and components have been conducted in Iran. Despite this, there are limitations in studies focusing on VR and AR. First, despite the fact that there is a general consensus over the usefulness of VR in general, empirical data endorsing its effectiveness in classrooms are limited. Second, most of the available studies adopt a qualitative approach and seek to examine students' views about advantages associated with VR and their perceptions of the new experience. Such studies also tend to primarily focus on motivational elements of VR use in language classes. Finally, few studies compare the pedagogical and educational effectiveness of VR with AR.

Experimental studies examining the effectiveness of VR and AR in Iranian English classes are in infancy but Iranian teachers' positive attitudes toward technology friendly English education classes have been already reported (Nushi & Ghasemi, 2021). In other words, the literature needs further reflection, both qualitative and quantitative, of classroom experiences with a focus on skills (listening, speaking, reading, and writing) and different language components (grammar, pronunciation, and vocabulary). To this aim, the following research questions were formulated:

1) Would VR- and AR-assisted language

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learning enhance receptive vocabulary recall of Iranian EFL learners?

2) Is there any significant difference between Iranian EFL learners' receptive vocabulary recall in VR and AR classes?

3) Would VR- and AR-assisted language learning enhance productive vocabulary recall of Iranian EFL learners?

4) Is there any significant difference between Iranian EFL learners' productive vocabulary recall in VR and AR classes?

5) What do students in VR and AR classes think of the advantages and advantages of the new learning experience?

2. Literature Review

2-1 Theoretical framework

Theoretically, the application of VR and AR to teach language skills and components aligns with Vygotsky's constructivism (Rieber & Carton, 1988). According to constructivism, learning is the dynamic and active participation of the learners in constructing meaning which is done by experiencing and thinking about such experiencing. In this approach, students' different experiences, hence different constructions of meanings and concepts, are recognized and teachers play the role of facilitators who create opportunities for students' active participation, exploration, interaction, and personalization of learning experiences. Chen and Yuan (2023) believe that VR and AR platforms are characterized by similar features since they foster student centeredness, promote students' dynamic and active participation, hence pave the ground for personalization of learning. This, in turn, helps them construct their own meanings of learning experiences. They also believe that both learning environments nurture students' desire and motivation for exploration and discovery.

2-2 Vocabulary knowledge

The construct of vocabulary knowledge is multidimensional and complex since it consists of several components and elements. Following this, different frameworks have been proposed to define vocabulary knowledge (Schmitt, 2014). In an attempt to explain this complicated construct, Nation (1990) introduced a framework that divided vocabulary knowledge into three key components of form (consisting of subcomponents written, spoken, and word parts), meaning (consisting of concept and reference, form and meaning, and associations), and use (including grammar, frequency, & collocations). This framework covers different intricate dimensions of vocabulary knowledge (e.g. affixes & collocations) and takes vocabulary knowledge from a word level to the larger discourse level of language.

Henriksen's (1999) introduced three dimensions for vocabulary knowledge: (a) breadth of vocabulary knowledge, (b) depth of vocabulary knowledge, and (c) the reception-production dual. Breadth of vocabulary knowledge enables learners to translate an L2 word to L1 or recognize its proper definition in a multiple-choice item. Depth is the quality of vocabulary knowledge one knows in L2. Finally, the reception-production dual refers to the ability to use vocabulary knowledge to comprehend language in listening and reading or produce language in written and spoken forms (Nation, 2001). Vocabulary knowledge is

also viewed from a quantity-quality perspective according to which the number of words one knows in a language and how well one knows L2 words and their relationships make up the construct. According to Schmitt (2008), to know a word means knowing not only its form-meaning relationship (quantity) but also its family (quality).

2-3 Effect of VR and AR on vocabulary learning

VR is described as a multimedia interactive computer-generated environment in which the users use computers to take part in the virtual world (Pantelidis, 1993). This technology is similar to a media that simulates reality to language learners (Lin, et al., 2022), creates a powerful sense of presence in the stimulated environment (Wang, Petrina, & Feng, 2017), creates space for exploration and interaction and, consequently, improve their learning (Wang et al., 2019).

Some L2 studies suggest that the desktop version of VR can help facilitate L2 learning by providing real virtual situations and contextual support. Garrido-Iñigo and Rodriguez-Moreno (2015), for example, investigated the effects of OpenSim platform on 108 tourism students' French learning and found that the virtual world had positive effects on the participants' L2 learning and increased their motivation. Chen (2016) also studied the effects of desktop VR on learning English as a foreign language and concluded that VR provides ideal opportunities to immerse learners in L2 for better learning resulting in improvements of their reading comprehension ability and pronunciation in English.

In addition to virtual space, some studies on L2 learning underscore interaction in real time. For example, Peterson (2006) studied 24 Japanese EFL learners' interaction with avatars in a three dimensional (3D) virtual environment and found that the new environment helps learners refine their interaction management skills, employ communication strategies, and prepare them for real social interactions. Lan et al. (2016) studied the effects of different language exercises in Second Life—a free 3D virtual world— on Chinese students' oral accuracy in English and concluded that all students, particularly those doing reasoning activities, benefitted from the program.

Different studies have shown that using VR and AR is effective in improving students' language learning. In a qualitative study, for example, the effects of using VR and AR on Greek EFL learners' views were studied (Kastoudi, 2012) and the results indicated that the technology is effective in creating positive views of vocabulary learning. In another study, Berns et al. (2013) studied the effects of using VR on Spanish EFL learners' classroom achievement and, comparing the results of pre- with post-tests, came up with similar results. Solak and Çakır (2016) used AR platform to teach English words to primary school children in Turkey and concluded that AR students, compared to the control group, did better on the post-test. Tai et al. (2020) reported similar results with Thai EFL learners and argued that VR contributes to students' vocabulary learning since the new environment is rich in contextualization and interaction based learning. Similarly, Lee and Park (2020)

believe that AR provides learners with opportunities (e.g. interaction and meaningful contextualization) they are usually denied of in traditional teacher led classes.

In Iran, Akmali et al. (2022) used AR environment to teach some English words to seventh graders in the experimental group for two weeks and, compared to the control group, concluded that the amount of learning and recall in the experimental group is statistically higher. The effect of using AR to teach English alphabet in Iran has shown that the technology improves learning by increasing interaction, excitement, and fun among fresh English learners (Ghaffari et al., 2017). Alemi and Khatooni (2021) used VR to teach English vowels to eighteen students for ten weeks and, comparing the participants' pre- and post-test scores, concluded that the treatment was pedagogically effective.

Overall, the review underscores the fact that VR as a learning tool has a unique potential and is capable of improving language learning. The potentials include creating scenarios and fulfilling students' visual needs and interactions with information and items.

3. Methodology

3-1 Participants

Forty-eight male students from a state school in Bostan Abad, East Azerbaijan at tenth, eleventh, and twelfth grades took part in the study. Following convenience sampling and based on their KET (Key English Test) scores, they were grouped into two experimental groups (VR and AR) and one control group. There were sixteen students in each group. It should be noted that there were ninety-six participants initially but students whose KET scores were one standard deviation below or above the mean were excluded from the program.

3-2 Instruments

Key English test

KET is used to measure and determine English proficiency level of pre-intermediate learners. It consists of three sections: Reading Comprehension, Listening, and Speaking. Due to administration constraints, we used its Reading Comprehension section containing 32 items. KET scores were used to homogenize students before the program. Cronbach's coefficient alpha turned out to be 0.84.

Word knowledge test

To design the test, the following procedures were followed. First, twenty general lexical categories or topics (e.g. family, education/learning, age, animal, occupation/job, address and number, health and illness, friend and relative, etc.) related to students' English textbooks were selected. The categories were later abbreviated to eight categories including *animal, fruit, kitchen, education, body, house, clothes/dress*, and *building*. For each general category twenty lexical items were selected, making the total number of words one hundred and sixty. For example, words such as *boar, eagle, zebra, giraffe*, etc. were chosen for the *animal* category and *towel, fridge, floss, tap*, etc. were selected for the *kitchen* category. At the next stage, sentences in which the words appeared were selected. The sentences were taken from different dictionaries including Cambridge, Oxford, American Heritage, and

Webster. Then the participants were required to write the meaning of words they knew in order to come up with the list of words they did not know. Finally, eighty six such words made the basis of material preparation.

Applications

Once the word list was finalized, the content of VR and AR groups was designed and added to the applications of each platform. The content of each session was given to participants in each teaching session; in every teaching session, a new application with new content was sent to the participants. The rationale behind developing separate content was, first, to avoid sizable application which could cause possible crashes during the performance in some smartphones and, second, to prevent earlier access of the participants to the content of the upcoming sessions. The applications consisted of a vocabulary presentation feature where the vocabulary items were presented through a contextualized 3D environment for VR and 3D models for AR groups. Each object representing a vocabulary item contained two elements: spelling and pronunciation.

To design materials for VR group, *Unity Pro*—a cross-platform game engine—was used. In most cases, the available-for-free 3D and 2D samples (low poly models) were downloaded and used for the preparation of content for the target words. Zapper platform and 3D Paint were used to prepare 3D samples for the AR group. Figures 1 and 2 are examples for the category of *animal*.

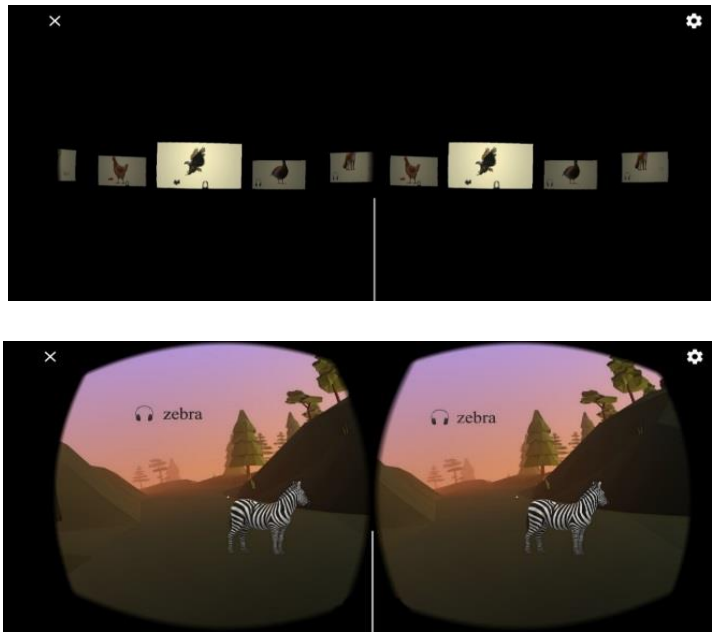

Figure 1. VR environment for animal category

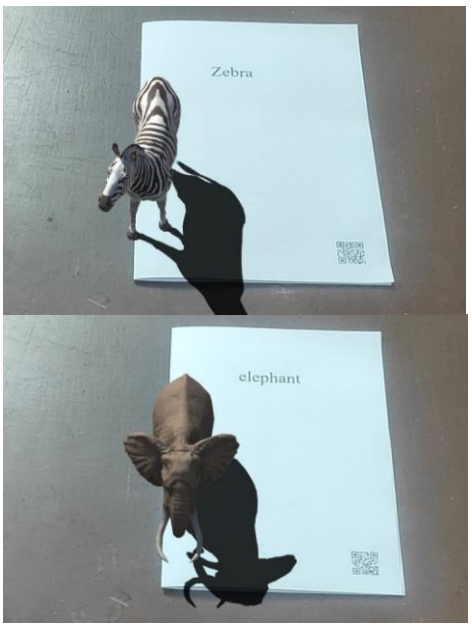

Figure 2. AR environment for animal category

Receptive and productive vocabulary knowledge posttest

The first post-test was designed to measure learners' receptive recall of the vocabulary items. To design it, we focused on words for which we prepared treatment materials and words no or few students knew their meanings. Following such criteria, we included thirty-six vocabulary items in the

first posttest. In each question, we provided students with the picture of each unfamiliar word and asked them to choose the most semantically relevant sentence among the options. To compensate the guessing effect (Janebi Enayat & Haghighatpasand, 2019), an "I don't know" option was included.

The purpose of administering the second posttest, administered two weeks later, was to measure the participants' productive recall of the target words. Words in the test were those in the first post-test that at least one student had answered correctly. Words not recalled receptively were excluded since receptively unknown words are less likely to be productively recalled after a time interval as productive recall is deemed to be more demanding (Janebi Enayat & Haghighatpasand, 2019) but words receptively recalled by at least one participant were included. Nineteen (out of thirty six) such words made up the second post-test that included the mutilated shapes of corresponding vocabularies in the first post-test. More specifically, pictures of the target words were given to the students on one page and, on the next page, were required to complete the sentences. As mentioned above, the first or last letter of the target words were provided to guide learners to target words only.

Semi-structured interview

To investigate and study the opinions of the participants in the two experimental groups, 19 students (10 from the virtual reality group and 9 from the augmented reality group) were interviewed. The interview questions were compiled with the benefit of the interviews conducted in similar researches and to reflect the opinions, views, and experiences of the participants.

3.3. Data collection

After administering the KET and the selection of homogeneous groups, based on the eight selected topics and the vocabulary selected for each one, the vocabulary pre-test was performed to obtain the initial scores and, based on the results, specific unfamiliar words were specified to prepare the educational materials of each group. In the first session, the students were given general explanations about the program, the duration of the program, how to work with the program and the new content. Eight one-hour sessions (2 sessions per week) were held for the groups, and each session consisted of two stages: presenting content in a new space in the first 30 minutes and practicing the presented vocabulary in the second 30 minutes. It is worth mentioning that the practice phase was done in sheets that contained matching, sentence completion, and word recognition activities, and the practice sheets were collected immediately at the end of each session.

In the virtual reality group, the students learned new vocabulary independently using the features of the virtual reality program. In the program that was designed by the first researcher, each word was contextualized by environmental simulation, which also contained the pronunciation and spelling of the word. The students explored and practiced the words several times in this environment. In the augmented reality group, the students were asked to scan the designed models, watch the 3D models and pay attention to the pronunciation and spelling of

the words. In the control group, the so-called conventional teaching was used.

3.4. Data analysis

One-way ANOVA was used to compare the means of the three groups and thematic content analysis was employed to analyze the interview data.

4. Results

In order to present the results more systematically, the research questions related to the impact of virtual and augmented reality on receptive vocabulary knowledge are answered in the first part and the research questions related to the impact of virtual and augmented reality on productive vocabulary knowledge are answered in the second part. In the last part, the results of content analysis of the interviews are presented and discussed.

4.1. The effects of virtual reality and augmented reality on receptive vocabulary knowledge

According to Table 1, the mean of the virtual, augmented and control groups differed after the completion of the course. The mean score of the virtual group (M = 21.63, SD = 3.13) was higher than the augmented group (M = 19.25, SD = 2.35), and the mean scores of both experimental groups were higher than the mean of the control group (M=14.25, SD=5.40).

Table 1. Descriptive statistics for the posttest of receptive vocabulary knowledge

Group	Mean	SD	Min.	Max.
Virtual reality	21.62	3.13	17.00	28.00
Augmented reality	19.25	2.35	15.00	23.00
Control	14.25	5.40	7.00	27.00

In the next step, inferential statistics were used to find out whether or not the difference between the means was significant (Table 2). It is worth mentioning that the Kolmogorov-Smirnov and Levene's tests were used to ensure the normal distribution of the data and the equality of variances, respectively. The results indicated that the mean difference between the groups was statistically significant (F = 15.23, $p < .001$).

Table 2. One-way ANOVA results for the receptive vocabulary posttest

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	453.500	2	226.750	15.235	.000***
Within Groups	669.750	45	14.883		
Total	1123.250	47			

*** significant at $p < .001$

Table 3 shows the results of Tukey's test. According to this table, the mean difference between the two groups of virtual reality and control, as well as the difference of the mean between the two groups of augmented reality

and control, is significant, but the difference of the mean scores between the two groups of virtual reality and augmented reality is not significant.

Table 3. Results of Tukey's test for the receptive vocabulary posttest

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Virtual reality	AR	2.37500	1.36397	.201	-.9307	5.6807
	Control	7.37500*	1.36397	.000***	4.0693	10.6807
Augmented relaity	VR	-2.37500	1.36397	.201	-5.6807	.9307
	Control	5.00000*	1.36397	.002**	1.6943	8.3057
Control	VR	-7.37500*	1.36397	.000***	-10.6807	-4.0693
	AR	-5.00000*	1.36397	.002**	-8.3057	-1.6943

*** significant at $p < .001$

** significant at $p < .01$

4.2. The effects of virtual reality and augmented reality on productive vocabulary knowledge

Tables 4 and 5 show the results of descriptive and inferential statistics analysis, respectively. According to Table 4, the mean scores of the virtual, augmented and control groups differed after the completion of the course. The mean score of the virtual group (M = 4.62, SD = 1.45) was lower than that of the augmented group (M = 6.75, SD = 1.57) and even lower than the mean of the control group (M = 5.12, SD = 2.09).

Table 4. Descriptive statistics for the posttest of productive vocabulary knowledge

Group	M	SD	Min.	Max.
Virtual reality	4.62	1.45	2.00	7.00
Augmented reality	6.75	1.57	4.00	10.00
Control	5.12	2.09	2.00	10.00

Table 5 shows the results of ANAOVA indicating that the difference in the mean of the groups is significant (F = 6.60, $p < .001$). Table 6 shows the results of Tukey's test. According to this table, the mean difference between the two groups of virtual reality and control is insignificant, but the mean difference between the two groups of augmented reality and control is significant. Also, the mean difference between the two

groups of virtual reality and augmented reality regarding the effects on productive vocabulary knowledge is significant.

Table 5. One-way ANOVA results for the productive vocabulary posttest

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	39.500	2	19.750	6.608	.003**
Within Groups	134.500	45	2.989		
Total	174.000	47			

** significant at $p < .01$

Table 6. Results of Tukey's test for the productive vocabulary posttest

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Virtual reality	AR	-2.12500*	.61124	.003**	-3.6064	-.6436
	Control	-.50000	.61124	.694	-1.9814	.9814
Augmented reality	VR	2.12500*	.61124	.003**	.6436	3.6064
	Control	1.62500*	.61124	.029	.1436	3.1064
Control	VR	.50000	.61124	.694	-.9814	1.9814
	AR	-1.62500*	.61124	.029	-3.1064	-.1436

** significant at $p < .01$

4.3. Virtual reality and the perceptions of the students

Table 7 shows the categories and themes resulting from the thematic content analysis of the interviews. The themes of the interview are classified into two general categories: advantages and disadvantages.

Table 7. Categories and themes of the interviews

Categories	Themes	Sample excerpts
Advantages	Motivation Increase	In my opinion, the main positive feature of this program is the excitement of learning in it... the space was completely new; the class was not boring and the variety and high excitement made me feel good in the class.
	Contextualized learning	When information about words is given in three-dimensional space with pictures, it becomes easier

		to learn and memorize it…before, it was very difficult for me to memorize the words. With this tool, it's easy for me because the images remain completely in my mind.
	Independent learning	By using this tool, the content is always at hand... I can work whenever I want; I think it is better than the previous classes where the teacher said and we wrote... here we ourselves have a bigger role... we work more.
	More Student Interaction	It is true that my mobile phone sometimes did not work well, but with the help of my friend, we worked together. In other classes, we are usually quiet... here we talked about the new method and it helped me to learn the words better.
Disadvantages	Dizziness, Lack of Concentration	After using this tool, I felt a little dizzy... I don't think we should use it too much and in the long run. At the end of the show, I felt a little dizzy... I think it's from my headset.

5. Discussion

The results pertaining to receptive vocabulary recall indicated that both technological environments can help Iranian language learners in understanding new English vocabulary. From this point of view, the results of the present study are in line with the findings of previous studies, such as Berns et al. (2013) in Spain and Solak and Çakir (2016) in Turkey. Researchers in the field of technology and education believe that the reason for the positive effect of virtual and augmented reality on language learning in general is that such spaces make the learning process more meaningful, active and context-oriented, make the learning environment more attractive and motivate language learners. (Tai et al., 2022; Lee & Park, 2020). In the present study, the opinions of the interviewees show that the approach of most of the participants to the educational program is positive, because both technological environments have increased diversity and excitement in learning and, as a result, more motivation. Regarding the studies that did not report a positive effect for one of these two educational environments (augmented reality) and are inconsistent with the results of this research, it is necessary to point out that the possible reason for this discrepancy is the age of the participants in the educational program. In other words, the participants in Alemi and Khatooni's research (2021) are in the age group of 6-12 years old, while the participants in this research were 17-15 years old. What further confirms this interpretation is a point that Belda-Medina and Marrahi-Gomez (2023) have pointed out in this regard. According to them, one of the key factors in the effectiveness or lack of

effectiveness of augmented reality in teaching and learning English vocabulary is the learner's previous experience. It is obvious that young children have very limited technological experience and are at the beginning of their journey into this world. Although the lives of teenagers and young people today are familiar with these spaces, their use of virtual spaces is more and as a result, they have more previous experience.

In general, the results of the current research show the superiority of virtual and augmented reality over traditional methods regarding the impact of each of these methods on vocabulary production. The fact that the virtual reality group had the lowest performance compared to the augmented and control groups can be discussed from several perspectives. A possible factor can be caused by the different effect of these two educational environments. Legge et al. (2012) and Zarzo (2015) believe that the virtual environment mainly strengthens the power of memory. However, the augmented reality environment is more effective in improving and strengthening skills such as analysis, evaluation and production. It seems that this difference, which is less mentioned in the reviewed researches, has affected the participants in this research, because strengthening the vocabulary at the production level is more practical with the augmented reality environment.

From another point of view, the superiority of augmented reality over virtual reality can be explained in its effect on productive vocabulary knowledge. In recent researches in the field of education and virtual and augmented reality, a new concept called index or degree of immersion is mentioned, which simply means the level of mental involvement of users in the new space (Zhang et al., 2021). In simpler words and comparing these two spaces, researchers believe that in the continuum of real and virtual worlds, virtual space is more virtual with more and deeper immersion of the user's mind, and for this reason, the amount of immersion in this space is higher. Wang et al. (2019) also believe that despite the common features between these two spaces, virtual reality is more immersive than its counterpart. One of the consequences of immersing the mind more in virtual space can be lack of concentration and some short-term physical problems. In the current study, more immersion in the virtual reality group was reflected in the opinions of this group in the form of dizziness, lack of concentration, and temporary problems in vision. By contrast, the experimental group of augmented reality did not have any problems in doing exercises and probably benefited more from the benefits of doing exercises that included vocabulary production. It is possible that these factors have an adverse effect on the ability to produce vocabulary, which requires more focus than recognizing vocabulary.

Analyzing the qualitative findings of the research shows that in line with most of the research in this field (Khazaei & Derakhshan, 2023), the participants in both experimental groups believed that the use of virtual reality and augmented reality increased their motivation to learn and participate in the class because learning in both new spaces was found to be exciting, offers a different experience to language learners, has an

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element of diversity and is different from teacher-centered classes. For example, one of the students in the virtual reality class stated, "I think the main advantage of this tool is that it is both exciting and the environment is different...it motivates us". Another student from the augmented reality class said, "It was a different experience for me…most of our classes are boring, but using these creates a good and happy atmosphere that you don't feel time passing in the class." It is worth mentioning that similar results have been reported in different countries and with other language skills and elements (Chen et al., 2020; Schwienhorst, 2002; Lai & Chen, 2021; Ebadi & Ebadi Jalal, 2022).

The second advantage mentioned in the interviews was the creation of a suitable context by virtual and augmented reality for vocabulary learning. Visual contextualization and creating a three-dimensional environment are the main factors of creating context in these two platforms, which, based on the findings of Berns et al. (2013), play an important role in learning, remembering and improving students' language performance. The participants in both groups believed that learning and presenting vocabulary in three-dimensional space and in its visual context is effective for remembering. For example, two students from the virtual reality group said that "when the words are accompanied by images, it helps me remember well", and "as soon as I see the words, their 3D models come to my mind...I didn't have to memorize". A student from the augmented group stated that "for example, a windmill...I didn't know what it was...when I scanned it and saw its image...it's three-dimensional...I won't forget it at all".

Learner autonomy was one of the other benefits of using virtual and augmented reality for vocabulary learning, which was reported in the interviews. The use of augmented and virtual reality to increase the sense of autonomy in learning English has been discussed and confirmed in recent studies (Chen et al., 2022; Lin et al., 2022). Based on these researches, with the increase of involvement, interaction and personalization of the learning experience in the virtual and augmented reality space, the teacher-centered index of the class is reduced and users and language learners get the opportunity to play a more active role in learning. In the present research and in the first part of the work in both experimental groups, the first researcher only acted as a guide and the participants in the new environment were mainly responsible for learning, and the result of this experience was an increase in the student's sense of independence. For example, one of the students in the virtual reality space said, "In this case (use of virtual space), it is not necessary for the teacher to be with us anymore... it is enough to use this tool and only ask the teacher to give feedback". One of the students of the augmented reality space pointed out that "with this tool you can practice and repeat regularly... anywhere and everywhere... there is no limit... I can say that you will become versatile".

In addition to learning independence, both new spaces provided the participants with the opportunity to participate and interact in learning. As mentioned earlier, in the second

thirty minutes of the educational program in the virtual and augmented reality groups, the students were doing vocabulary exercises, which, based on the interview data, were influenced by the first thirty minutes and the experience of the new space. Considering the importance of interaction, cooperation and participation in learning, it can be argued from the interview data that the use of technological tools can reduce one of the concerns of traditional classes (i.e., students' unwillingness for teamwork and interaction). It is worth noting that this interaction was not limited to the second part and it also took place during the use of compiled programs. For example, a student from the virtual reality group said, "When I was working with this tool, my friend and I talked about words and sometimes he helped me" and a student from the augmented reality group said, "In the other classes, we usually don't talk to each other, but this new experience encourages one to talk to his classmates and to ask them questions".

Considering all the above benefits (creating a context, personalizing the learning experience, increasing participation and interaction, a sense of autonomy in learning) and referring to the theoretical framework of this research (Vygotsky's constructivism), it can be argued that the virtual and augmented realities help language learners to be actively and dynamically involved in creating the meaning of words. In other words, with the increase of the students' collaborative role in learning vocabulary, their role changes from a receiver of meaning to a creator of meaning or a participant in creating the meaning of vocabulary. In the same direction and in line with this theory, the central and traditional role of the teacher as a content transmitter has become less prominent and as a facilitator of the learning process, he guides and scaffolds the students in constructing the meanings of words and becomes a support.

Finally, as for the challenges or disadvantages of using these two platforms, we can mention the short-term dizziness caused by the use of special glasses. As mentioned earlier, the phenomenon of virtual space sickness, which may appear in the form of headache and short-term dizziness, is one of the challenges that has been mentioned in other studies. Of course, based on the interview data, this challenge was mainly reported in the experimental group of virtual reality. For example, one student stated that "after removing the headset, I felt dizzy for a few minutes", and another mentioned that "As I said, after using this tool, my physical condition was a little affected; my neck hurt a little and I was a little dizzy... I think I should rest sometimes". In the experimental group of augmented reality, the only challenge worth mentioning was the time-consuming nature of scanning images and the problem of not being able to scan in the first instance and the need to repeat it, which was not a critical challenge.

6. Conclusion

This research was conducted with the aim of investigating the effectiveness of virtual reality and augmented reality on the receptive and productive recall of English vocabulary. According to the first and second research questions, which targeted the effect of using virtual reality and augmented reality on the

recall of words, the results showed that both technological environments can help Iranian language learners in understanding new English words, and, from this point of view, the positive effect of both spaces is similar. Also, the results showed that compared to the control group, both experimental groups performed better on the receptive vocabulary test. Regarding the effects of using these two educational spaces on the production of vocabulary, which were considered for research questions three and four, the results showed that the use of augmented reality has a significant positive effect on the production of vocabulary, but this positive and significant effect was not observed for virtual reality. Possible reasons for this were discussed. Also, considering the significant difference in the mean scores between the two groups of virtual reality and augmented reality on the productive vocabulary posttest, it can be concluded that the augmented reality space is a more effective platform for improving productive vocabulary knowledge. Finally, using the interview data, the main challenge of using the virtual reality space (temporary dizziness) was discussed.

The main limitation of this research was the need of the participants in the educational groups to have mobile phones. Although today most of the students of the same age as the participants in this research have smartphones, since this research was conducted in a small city, some students who did not have smartphones were excluded from the program. It is worth mentioning that the common limitation in similar researches (the cost of headsets) was solved by choosing the practical and at the same time economical Google cardboard headset (which at the time of the research had a price of one hundred and twenty thousand rials) and was purchased by the first researcher. Another limitation of this research may be measuring productive vocabulary recall in the form of sentence completion in writing, which includes only a part of productive vocabulary knowledge.

References

Akmali, M., Zaree-Zavaraki, E., & Pourrostaee-Ardakani, S. (2022). Investigating the effect of using augmented reality technology on students' learning and retention in English language course. *Quarterly Journal of Pouyesh in Education and Consultation*, *7*(15), 90-104. (in Persian)

Alemi, M., & Khatooni, Sh. (2021). The impacts of virtual reality on young EFL learners' pronunciation. *Language Related Research, 11*(6), 449–480. https://lrr.modares.ac.ir/article-14-36609-en.html

Belda-Medina, J., & Marrahi-Gomez, V. (2023). The impact of augmented reality (AR) on vocabulary acquisition and student motivation. *Electronics*, *12*(3), 749. Retrieved from http://dx.doi.org/10.3390/electronics12030749

Berns, A., Gonzalez-Pardo, A., & Camacho, D. (2013). Game-like language learning in 3-D virtual environments. *Computers & Education*, *60*(1), 210–220. https://doi.org/10.1016/J.COMPEDU.2012.07.001

Chen, C., & Yuan, Y. (2023). Effectiveness of virtual reality on Chinese as a second

language vocabulary learning: perceptions from international students. *Computer Assisted Language Learning*. https://doi.org/10.1080/09588221.2023.2192770

Chen, M. P., Wang, L., Zou, D., Lin, S., Xie, H., & Tsai, C. C. (2022). Effects of captions and English proficiency on learning effectiveness, motivation and attitude in augmented-reality-enhanced theme-based contextualized EFL learning. *Computer Assisted Language Learning*, *35*(3), 381–411. https://doi.org/10.1080/09588221.2019.1704787

Chen, Y. (2016). The effects of virtual reality learning environment on student cognitive and linguistic development. *The Asia-Pacific Education Researcher*, *25*(4), 637–646. https://doi.org/10.1007/s40299-016-0293-2

Chen, Y., Smith, T. J., York, C. S., & Mayall, H. J. (2020). Google Earth virtual reality and expository writing for young English Learners from a funds of knowledge perspective. *Computer Assisted Language Learning*, *33*(1–2), 1–25. https://doi.org/10.1080/09588221.2018.1544151

Ebadi, S., & Ebadi Jalal, M. (2022). The effect of Google expeditions virtual reality on EFL learners' willingness to communicate and oral proficiency. *Computer Assisted Language Learning*, *35*(8), 1975–2000. https://doi.org/10.1080/09588221.2020.1854311

Enayat, M. J., & Haghighatpasand, M. (2019). Exploiting adventure video games for second language vocabulary recall: a mixed-methods study. *Innovation in Language Learning and Teaching*, *13*(1), 61–75. https://doi.org/10.1080/17501229.2017.1359276

Garrido-Iñigo, P., & Rodríguez-Moreno, F. (2015). The reality of virtual worlds: pros and cons of their application to foreign language teaching. *Interactive Learning Environments*, *23*(4), 453–470. https://doi.org/10.1080/10494820.2013.788034

Ghaffari, A., Namani, P., Fallah, J., & Jafarzadeh, P. (2017, February 15). *Application of games in augmented reality environment to teach English alphabet*. Second National Conference on Computer Games: Opportunities & Challenges. University of Isfahan, Isfahan, Iran.

Greenhow, C., & Robelia, B. (2009). Informal learning and identity formation in online social networks. *Learning, Media and Technology*, *34*(2), 119–140. https://doi.org/10.1080/17439880902923580

Henriksen, B. (1999). Three dimesnions of vocabulary development. *Studies in Second Language Acquisition*, *21*(2), 303–317. https://doi.org/10.1017/S0272263199002089

Hsu, T. C. (2017). Learning English with augmented reality: Do learning styles matter? *Computers and Education*, *106*, 137–149. https://doi.org/10.1016/j.compedu.2016.12.007

Janebi Enayat, M., & Derakhshan, A. (2021). Vocabulary size and depth as predictors of

second language speaking ability. *System*, *99*, 102521. https://doi.org/10.1016/J.SYSTEM.2021.102521

Kastoudi, D. (2012). Using a quest in a 3D virtual environment for student interaction and vocabulary acquisition in foreign language learning. *The EuroCALL Review*, *20*(1), 97–99. https://doi.org/10.4995/EUROCALL.2012.16189

Khazaie, S., & Derakhshan, A. (2023). Multiplayer virtual reality-based English for medical purposes learning: The middle Eastern students' communicative competence. *Journal of Foreign Language Research, 13* (2), 267-285. http//doi.org/ 10.22059/jflr.2023.355604.1017

Lai, K. W. K., & Chen, H. H. (2021). A comparative study on the effects of a VR and PC visual novel game on vocabulary learning. *Computer Assisted Language Learning*, *36*(3), 312–345. https://doi.org/10.1080/09588221.2021.1928226

Lan, Y. J., Kan, Y. H., Sung, Y. T., & Chang, K. E. (2016). Oral-performance language tasks
for CSL beginners in Second Life. *Language Learning and Technology*, *20*(3), 60–79.

Lan, Y. J., Lyu, B. N., & Chin, C. K. (2019). Does 3D immersive experience enhance Mandarin writing by CSL students? *Language Learning and Technology*, *23*(2), 125–144.

Lee, S., & Park, M. (2020). Reconceptualization of the context in language learning with a location-based AR app. *Computer Assisted Language Learning*, *33*(8), 936–959. https://doi.org/10.1080/09588221.2019.1602545

Legge, E. L. G., Madan, C. R., Ng, E. T., & Caplan, J. B. (2012). Building a memory palace in minutes: Equivalent memory performance using virtual versus conventional environments with the Method of Loci. *Acta Psychologica*, *141*(3), 380–390. https://doi.org/10.1016/j.actpsy.2012.09.002

Lin, L., Shadiev, R., Hwang, W.Y., & Shen, S. (2020). From knowledge and skills to digital works: An application of design thinking in the information technology course. *Thinking Skills and Creativity*, *36*, 100646. https://doi.org/10.1016/j.tsc.2020.100646

Lin, V., Liu, G., & Chen, N. S. (2022). The effects of an augmented-reality ubiquitous writing application: a comparative pilot project for enhancing EFL writing instruction. *Computer Assisted Language Learning*, *35*(5–6), 989–1030. https://doi.org/10.1080/09588221.2020.1770291

Matthews, J. (2018). Vocabulary for listening: Emerging evidence for high and mid-frequency vocabulary knowledge. *System*, *72*, 23–36. https://doi.org/10.1016/J.SYSTEM.2017.10.005

Matthews, J., & Cheng, J. (2015). Recognition of high frequency words from speech as a predictor of L2 listening comprehension. *System*, *52*, 1–13. https://doi.org/10.1016/J.SYSTEM.2015.04.015

Nation, I. S. P. (1990). *Teaching and learning vocabulary*. Newbury House.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge University Press.

Nushi, M., Ghasemi, F. (2021). Teachers' teaching styles and their beliefs about incorporating technology into L2 instruction: The case of Iranian EFL context. *Foreign Language Research Journal*, *11* (3), 511-539.

Pantelidis, V. S. (1993). Virtual reality in the classroom. *Educational Technology*, *33*(4), 23-27.

Peterson, M. (2006). Learner interaction management in an avatar and chat-based virtual world. *Computer Assisted Language Learning*, *19*(1), 79–103. https://doi.org/10.1080/09588220600804087

Rieber, R. W., & Carton, A. S. (Eds.). (1988). *The collected works of L. S. Vygotsky*. Springer US. https://doi.org/10.1007/978-1-4613-1655-8

Schmitt, N. (1999). The relationship between TOEFL vocabulary items and meaning, association, collocation and word-class knowledge. *Http://Dx.Doi.Org/10.1177/026553229901600204*, *16*(2), 189–216. https://doi.org/10.1177/026553229901600204

Schmitt, N. (2008). Review article: Instructed second language vocabulary learning. *Http://Dx.Doi.Org/10.1177/1362168808089921*, *12*(3), 329–363. https://doi.org/10.1177/1362168808089921

Schmitt, N. (2014). Size and depth of vocabulary knowledge: What the research shows. *Language Learning*, *64*(4), 913–951. https://doi.org/10.1111/LANG.12077

Schwienhorst, K. (2002). The state of VR: A meta-analysis of virtual reality tools in second language acquisition. *Computer Assisted Language Learning*, *15*(3), 221–239. https://doi.org/10.1076/call.15.3.221.8186

Schwienhorst, K. (2010). The state of VR: A meta-analysis of virtual reality tools in second language acquisition. *Computer Assisted Language Learning*, *21*(1), 221–239. https://doi.org/10.1076/call.15.3.221.8186

Solak, E., & Çakır, R. (2016). Investigating the role of augmented reality technology in the language classroom / Istraživanje uloge tehnologije proširene stvarnosti u nastavi jezika. *Croatian Journal of Education-Hrvatski Casopis Za Odgoj I Obrazovanje*, *18*(4). https://doi.org/10.15516/cje.v18i4.1729

Tai, T. Y., Chen, H. H. J., & Todd, G. (2022). The impact of a virtual reality app on adolescent EFL learners' vocabulary learning. *Computer Assisted Language Learning*, *35*(4), 892–917. https://doi.org/10.1080/09588221.2020.1752735

Vygotsky, L. S. (1987). *The collected works of L. S. Vygotsky* (Vol. 1). New York: Plenum Press.

Wang, C. P., Yu, L., Tseng, W. T., Lin, Y., & Gupta, K. C. (2019). On the effects of 3D virtual worlds in language learning – a meta-analysis. *Computer Assisted Language Learning*, *33*(8), 891–915.

https://doi.org/10.1080/09588221.2019.1598444

Wang, Y. F., Petrina, S., & Feng, F. (2017). Virtual immersive language learning and gaming environment: Immersion and presence. *British Journal of Educational Technology*, *48*(2), 431–420.

Zarzo, E. (2015). The art of memory in the digital age. *Procedia - Social and Behavioral Sciences*, *178*, 222–226. https://doi.org/10.1016/j.sbspro.2015.03.185

Zhang, H., Diaz, M. T., Guo, T., & Kroll, J. F. (2021). Language immersion and language training: Two paths to enhanced language regulation and cognitive control. *Brain and Language*, *223*, 105043. https://doi.org/10.1016/j.bandl.2021.105043