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On the Comparative Impacts of Virtual Reality and Augmented Reality: EFL Learners' Listening and Speaking Skills in Focus

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ABSTRACT

The emergence of new technologies has urged researchers to investigate their efficiency in English language teaching classes. The current study compared the effects of Augmented Reality (AR) and Virtual Reality (VR) on EFL learners' listening and speaking skills. The participants were 30 intermediate male and female learners selected based on convenience sampling. They were assigned to AR-aided and VR-aided groups (n1=n2-15). They were homogeneous in general proficiency, listening, and speaking skills according to the results obtained from an IELTS at the onset of the study. The participants were exposed to 12 videos in AR and VR environments, followed by class discussions during the treatment. The videos had various topics to encourage learners to participate in classroom activities. Paired samples t-tests performed on each group's listening and speaking pretests and posttests showed statistically significant differences, indicating the usefulness of AR and VR technologies in promoting the skills. However, Multivariate Analysis of Variance (MANOVA) showed no significant differences between the listening and speaking of the AR-aided and VR-aided groups, indicating that both technologies similarly impacted the participants' oral communication skills. The study can give insights into technology integration to teachers, program developers, and administrators who search for innovations in L2 teaching.

KEYWORDS: Augmented Reality (AR); EFL learners; Virtual Reality (VR)

INTRODUCTION

Technology has become prominent in human life during the twentieth and twenty-first centuries. Although referred to as new forms of technology, Augmented Reality (AR) and Virtual Reality (VR) are not newborn technological advances. However, they have recently achieved renown due to more accessibility in different areas. AR augments the real surroundings through different applications. Conversely, VR is commonly described as feeling unreal reality through almost all human senses.

In Second Language Learning (SLA), virtual environments have taken their initial steps, and many studies have employed virtual world tools. In a review of papers regarding the effectiveness of AR and VR in language teaching from 2015 to 2020, Timovski et al. (2020) concluded that they positively impacted learners' engagement, motivation, interest, and learning achievement. Besides, AR and VR could improve users' memory, boost their interaction with objects and the environment, and increase positive emotions. Several studies have focused on AR and VR in L2 learning; however, unlike the current study, no study has compared the two technologies. The related

literature shows that studies have investigated whether AR or VR per se are useful L2 teaching tools, comparing the absence and presence of AR-based or VR-based instructions (Akçayır & Akçayır, 2017; Bonner & Reinders, 2018; Huang et al., 2021; Merchant et al., 2014).

The role of VR or AR in improving different language elements has been the focus of several studies. Vocabulary learning constitutes the most frequent AR and VR studies (Alfadil, 2020; Chen & Chan, 2019; Fuhrman et al., 2020). Writing (Chen et al., 2020; Huang et al., 2020; Yang et al., 2020), reading (Cheng & Tsai, 2014, 2016; Hellermann et al., 2017), and listening (Hao & Lee, 2019; Ho et al., 2017) have also been areas of research in the application of AR or VR. However, Huang et al.'s (2021) systematic review of the use of AR and VR in language learning shows that though the frequency of research in speaking stands higher than listening, writing, and reading, it has been investigated mainly through employing VR (Van Ginkel et al., 2020; Ironsi, 2023; Chen & Hwang, 2020) and improving listening and speaking through AR has been the focus of very few studies (Taskiran, 2019; Ustun et al., 2022).

Among language skills, speaking and listening are much worthy of attention. Progress in speaking and listening is vital for language learners because their ability to manage communication and conversations in L2 is synonymous with success (McCarthy & McCarten, 2023). Moreover, speaking and listening developments go hand in hand since interaction in the target language is necessary for learners' language improvement. Access to different forms of technology has necessitated their implementation in English classes to facilitate language learning, attract learners, and meet their interests and needs (Gruba & Suvorov, 2019).

Research findings are inconclusive regarding AR and VR applications' superiority over other technologies or conventional teaching methods in improving listening and speaking skills (Chen et al., 2022; Huang et al., 2021; Schorr et al., 2024). However, previous studies justify using AR and VR due to their capacity to create meaningful situations for interaction (Lacle-Melendez et al., 2024) and cultivate mastery of language skills, resulting in higher learning outcomes (Chen, 2020; Huang et al., 2018). Thus, replacing traditional methods with AR and VR can attract language learners and encourage them to experience new language learning methods.

Furthermore, despite being among the most emerging technologies in education, AR and VR's effects in language learning environments are still questionable (Bonner & Reinders, 2018), which signifies the gap the current study intends to address. Another critical point to consider, which adds to the significance of the study, is that some researchers believe a chasm exists between research and practice in L2 speaking and listening instructions due to the technological improvements in the modern world and the techniques and strategies teachers incorporate in their classes (Hung et al., 2017). With the accessibility to high-quality means of telecommunications, human communication cannot achieve satisfaction without a certain amount of technological update, necessitating the application of modern pedagogical tools to enhance learners' proficiency in speaking and listening skills. Thus, the current study's researchers compared the effects of AR and VR on Iranian EFL learners' listening and speaking skills in their quest to help teachers engage learners in new methods and techniques for developing the two skills.

REVIEW OF THE RELATED LITERATURE

The role of input has been verified as an indispensable component of L2 learning (Gass, 1997; Krashen, 1981; Long, 2017; Marcelino, 2018). Receptive skills (listening and reading) are typically considered channels through which input necessary for L2 learning can be received (Gass, 1997). However, many researchers have recently focused on audio-visual input as an appropriate source of input provision (Montero Perez, 2022) because it activates two receptors (auditory and visual) instead of only one, providing learners with a multi-faceted input. Several studies have reported that input through two channels (audio and visual) is easily transferred to long-term memory and is retrieved faster than when only one mode is involved (Chao et al., 2015; He et al., 2015). AR and VR are technologies that provide multimodal input combining sounds and images and are successful in activating learners' different senses. Showing objects, places, and persons in 3D form encourages learning and provides a new experience other than typical classrooms (Sümer & Vaněček, 2024).

With the dominance of technology in English language teaching classes and different forms of technology implemented to facilitate language learning, AR and VR have also found their place in English teaching classes (Patel, 2014; Tseng, 2019). As two modern technologies, they have attracted researchers' attention and have

intrigued them to explore their role in language teaching. The apps use mobile phones and videos to provide learners with new experiences in language learning (Reinders, 2012).

Studies on AR and VR support their beneficial cognitive and affective impacts on learners (Wu et al., 2013; Yoon et al., 2017). Lin and Lan (2015) argue that the technologies facilitate sensory immersion and promote positive feelings toward learning. Besides, they facilitate learning by providing audio-visual input since information is easily processed when visual and audio are simultaneous, and learning complicated notions becomes less challenging. Dual coding theory justifies the advantage of audio-visual input (Clark & Paivio, 1991; Paivio, 1986, 2007), as it simultaneously activates audio and visual codes, lowers cognitive load, and elevates memory capacity. Therefore, with less effort, the maximum result is obtainable. The input provided by audio-visual materials has been in the limelight of multiple studies (Hardiah, 2019; Mayer et al., 2014; Rashtchi et al., 2021). Besides, using the virtual world and augmented learning environment, AR and VR activate learners' schemata and scaffold learners in meaning-making, leading to learning (Khoshnevisan & Le, 2018). The efficacy of AR and VR partially relies on the context they provide for learning, which, according to Herrera's (2020) situated learning theory, facilitates the interaction between the learning environment and learners to accelerate learning. Cognitive Theory of Multimedia Learning (Mayer, 2005) is another theory that can explain the role of AR and VR in improving language skills. As Mayer puts forward, multimedia helps learners efficiently process technology-based input by providing appropriate context. Students exposed to explanations via multimedia can build two mental representations: verbal and visual models and connections between the two, which can cultivate learning.

Varied scholars have generally defined AR and VR with almost unanimous definitions. According to Dunleavy (2014), AR allows users to mingle with an unreal world by utilizing "digitally generated objects which are projected into the physical environment (p. 30). Arena et al. (2024) state that by providing authentic interactional situations through enhancing objects, AR creates semantic webs and graphic information to facilitate learning. On the other hand, VR technology simulates the real world in a virtual setting (Huang et al., 2021). VR systems enable the user to feel physically present in a virtual environment. VR users benefit from authentic materials from films in an environment with the least distractors that boost their concentration (Alfadil, 2020). The AR and VR materials activate background knowledge and leverage information storage in long-term memory (Baddeley, 1986; Bozdogan et al., 2017; Nguyen & Pham, 2022). Research findings show that AR and VR technologies increase learners' autonomy by having control over the pace of study (Chiang et al.,2014; Yeh & Lan, 2018; Mendoza-Ramírez et al., 2023), facilitate understanding (Ismayatim et al., 2019; Sharmila, 2024), increase motivation and reduce anxiety (Chen & Hwang, 2020; Na & Yun, 2024).

Nevertheless, using technologies like AR and VR has not been without complaints. Research findings indicate that cognitive overload and distraction are noteworthy factors in using VR (Candra Sari et al., 2024; Kim et al., 2020). Besides, maintenance of the devices, technical problems, teachers' lack of adequate training, insufficient class time, and limited educational content and curriculum in AR and VR are challenges teachers and learners might face in AR-based or VR-based classes (Khoshnevisan & Le, 2018; Lin et al., 2011; Mundy et al., 2019). Besides, the use of AR and VR can be questionable regarding the sustainability of their application in big classes (Cosio et al., 2023).

Technology use substantially improves L2 listening comprehension (Hendy, 2013). Rost (2011) believes that listening is a dynamic process that involves meaning construction through engagement, imagination, and empathy. Listeners should synchronize what they hear with their previous knowledge. Speaking is a two-way process to communicate opinions, information, or emotions (Hsieh, 2014). Spoken texts are the collaboration between two or more people sharing time and context. Speaking and listening skills, as deeply interrelated (Melchor-Couto, 2017), are investigated widely in applied linguistics and have pushed the learning process forward. Applying modern pedagogical tools to enhance learners' proficiency levels in speaking and listening seems necessary.

Multiple studies have used AR to teach listening and speaking. For example, Ho et al. (2017) designed a Ubiquitous AR application to explore 90 participants' listening and speaking skills through self-study. The results showed that the application cultivated the participants' listening and speaking skills and successfully provided an authentic context for language learning. In another study on the applicability of AR for improving listening and speaking skills, Taskiran (2019) selected 41 intermediate and 42 lower intermediate 18 and 24-year-old university

students. The researcher used four games using the AR application in four different classes. The quantitative findings urged the researcher to conclude that such games could affect language learners' listening, speaking, and retention. Ismayatim et al. (2019) collected 177 undergraduate students' perceptions about the role of the MyEVO module, which integrates AR and mobile technologies in improving comprehension after exposure to listening practices. The participants verified that their listening had improved after using the videos, indicating their positive views toward the technology. Wang (2024) designed a quasi-experimental AR-based study and investigated its impact on 24 learners' speaking proficiency through role-playing activities with and without the AR application. The results revealed that the AR group outperformed the non-AR group regarding content, vocabulary, and pronunciation. Ustun et al. (2022) investigated the effect of AR on 42 high school students' attitudes toward learning English. After 10 weeks of treatment, they found that AR could affect learners' motivation toward language learning. The AR-based tasks on listening and speaking during the intervention improved the skills.

Studies on VR also show its beneficial impact on listening and speaking skills. For example, Hassani et al. (2016) examined the impact of VR on ten participants' listening and speaking skills. They designed programs to enable the participants to communicate in public places. The study showed that VR could enhance students' answers to questions, reduce grammar errors, and enhance language proficiency. Reitz et al. (2016) used a VR-based game to teach oral communication skills to 26 male and female learners aged between 12 and 34 and measured the participants' speaking amount while playing the game. The results showed that the participants' motivation to talk increased while playing the games in different phases. In another study, Lan et al. (2018) used VR to explore 69 school children's improvement in listening at the beginners' level. Three groups received manipulations: one group listened and acted out the body movements, another group watched the movements of the 3D avatar, and the third group watched comic books and listened to the audio without doing body movements. The researchers found no significant differences among the groups, although they reported that the students in the first and second groups scored higher in listening posttest than the third group. Tai and Chen (2021) compared the impacts of VR-aided and video learning on EFL learners' listening comprehension in their study. The results showed that the VR-aided learners outperformed video watchers in listening comprehension and retention.

Similarly, Chien et al. (2020) used Spherical Video-based Virtual Reality (SVVR) to create contexts to increase high school students' speaking ability using peer assessment in the experimental group. The findings indicated that peer assessment with the help of SVVR could enhance participants' speaking, motivation, and critical thinking and decrease their anxiety. In another study, Van Ginkel et al. (2020) compared a VR-based immediate feedback provision with a teacher-mediated delayed feedback provision on pre-university students' presentation skills. However, no statistically significant difference was found between the two groups, although the students found VR-based feedback motivating. Ou Yang et al. (2020) found that VR improved learners' speaking skills positively. Ebadi and Ebadijalal (2022) also found that VR significantly impacted upper-intermediate EFL learners' speaking performance and willingness to communicate. Ironsi (2023) explored the attitudes of 75 students and 10 teachers regarding using VR after employing the technology for 14 weeks in speaking classes. The results indicated the participants' positive attitudes regarding VR's role in enhancing their speaking skills.

As mentioned, studies on comparison between the effects of AR and VR in L2 teaching are scarce. Thus, the current researchers designed a quasi-experimental study to investigate the comparative effects of AR and VR in improving Iranian EFL learners' listening and speaking skills. They proposed the following research questions to achieve the objectives of the study:

RQ1: Does exposure to AR-aided instruction have any statistically significant effect on Iranian EFL learners' listening ability?
RQ2: Does exposure to VR-aided instruction have any statistically significant effect on Iranian EFL learners' listening ability?
RQ3: Does exposure to AR-aided instruction have any statistically significant effect on Iranian EFL learners' speaking ability?
RQ4: Does exposure to VR-aided instruction have any statistically significant effect on Iranian EFL learners' speaking ability?
RQ5: Do AR-aided and VR-aided instructions have statistically significant differential effects on Iranian EFL learners' listening ability?

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RQ6: Do AR-aided and VR-aided instructions have statistically significant differential effects on Iranian EFL learners' speaking ability?

METHODOLOGY

PARTICIPANTS

Thirty Iranian EFL learners, 17 females and 13 males between 17 and 26, were selected through convenience sampling. The participants had registered in an IELTS preparation course in a language institute located northwest of Tehran to pursue their education in either a European country or Canada. They volunteered to participate in one of the researcher's extra classes, and as a token of appreciation, he offered them five free IELTS training sessions.

Since the participants had different English language proficiency backgrounds and wished to obtain an IELTS certificate, the researcher used IELTS (Cambridge IELTS 11, 2016) to examine their homogeneity at the onset of the study. The participants' listening scores were between 18 and 22, their reading scores were between 22 and 29, and their writing and speaking scores were mainly 5 to 5.5.

The test helped the researchers ensure no significant difference among the participants regarding their speaking and listening abilities. The IELTS scores of the participants (between 50 and 62) showed that they were at an intermediate level (B2 in the Common European Framework of Reference for Languages, CEFR).) with proficiency level equal to 5.5. Thus, the researchers concluded they were homogeneous regarding their general English proficiency, listening, and speaking skills. Afterward, the participants were assigned to AR-aided and VR-aided groups (n1=n2=15). (The IELTS band score calculator is available at (https://www.examenglish.com/IELTS/IELTS_Band_Scores.html).
All participants signed an informed consent form and were told that they could leave the study at any point if they thought so.

INSTRUMENTS

IELTS (Test 3) taken from Cambridge IELTS 11 (2016) was used to examine the English language proficiency level of the participants before the treatment. The test could also ensure the researchers that the participants had the same listening and speaking levels before the treatment. The test consists of four sections: listening (4 parts, 40 items, 30 minutes), reading (3 sections, 40 items, 60 minutes), and writing (2 tasks, 60 minutes). Using the IELTS writing band descriptors, two raters scored the writing tasks, and the inter-rater reliability (r=0.96) ensured the consistency of ratings.

After taking the written sections in three parts, participants were tested on the speaking section of the test. The speaking test took 11 to 14 minutes for each participant, and the learners were tested orally in three sections. Their voices were recorded with the learners' consent and then scored by two IELTS examiners. The inter-rater reliability computed through the Pearson product-moment correlation coefficient showed perfect consistency between the ratings (r= .98).

APPLICATIONS OF INSTRUCTION

Instruction was provided using Virtual Reality Applications (VR Player PRO), virtual reality headsets (TSCO-TVR), Augmented Reality Applications (AR-Lab app), and cell phones.

AUGMENTED REALITY APPLICATION: AR-LAB

AR-Lab Application integrates digital visual, audio, and other types of content into the user's real-world environment. It transforms a smartphone screen into a virtual mirror. The App enjoys combining real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. Since the App is free, the AR group downloaded and received the lessons through it. The App can be installed on Android 10 and above cell phones.

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VIRTUAL REALITY APPLICATION: VR PLAYER PRO

The VR group employed VR Player PRO, a virtual reality application that allows users to play 360, 3D, and 2D videos suitable for VR devices. VR Player PRO presents a theatrical experience for the users. The VR group downloaded the App and watched the videos while their cell phones were installed in the virtual reality headset.

VIRTUAL REALITY HEADSET: TSCO-TVR 568

The VR-aided group received the treatment in the study through 360-degree videos and TSCO-TVR 568 virtual reality headsets. In this kind of VR, a simulated real-life encounter type, learners should use videos to feel they are facing real people. The learners received training via a video for each session during the treatment.

MOBILE PHONE

The AR and VR applications are available on all Samsung S22, S21, S20, and S10 devices, as well as Android devices that run Android 10 and above.

MATERIALS

The primary materials of the study were videos shown through VR and AR applications. The videos used for VR and AR were the same; however, they were presented to the learners in different modes (see Table 1).

PROCEDURE
PRETEST

After administering the IELTS, the researchers assigned the participants to AR-aided and VR-aided groups, considering the characteristics of their mobile phones. Participants with good-quality phones were assigned to the AR-aided group, and the rest were assigned to the VR-aided group.

TREATMENT

One of the researchers taught the study, which took 15 sessions, the first and two last of which were allocated to pretests and posttests. During the 12 90-minute instruction sessions, the participants watched short videos on a particular topic. The videos were extracted from YouTube and transformed into AR or VR modes.

In each session, the teacher introduced the topic and gave time to learners to share ideas and brainstorm on the given topic in three groups of five learners. Thirty minutes before the class started, the learners were supposed to be present in the class so that the teacher could share the video of the day with them. Then, the teacher played the audio related to the topic, and the learners were required to write down their understandings. Afterward, they put on their headsets and watched the related videos, which took five to eight minutes. In the next step, the teacher brainstormed with the learners and wrote their ideas on the board. After that, the learners watched the video for the second time, and the teacher modified the ideas on the board when necessary. After watching the films, the teacher involved the class in a discussion related to the video in three cyclic activities. The teacher prepared the discussion questions in advance for each session, and the class spent about 30 minutes on them. First, he asked some comprehension questions about the video. Then he asked questions requiring more profound responses on the learners' parts; for example, "Did you know about the film's content before attending the class?" "How did you feel when watching the film?" "What was the most exciting idea in the film?" "Was there anything you did not like?" were some questions. The teacher asked the participants to work in pairs and prepare a role-play about the topic at the final stage. Table 1 provides the list of topics practiced during the study.

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Table 1
List of Topics Practiced by the Groups

Session 1: Pretest
Session 2: Watching a film about a luxurious hotel.
Classroom Discussion: Describe a hotel that you know. What facilities should a hotel have? What are the things necessary to choose a hotel? What are the differences between hotels (like four and five stars)? What are your expectations of staying in a hotel?
Session 3: Watching a film about Louver museum
Classroom Discussion: Describe a museum you enjoyed visiting. When and why did you visit it? What did you do there? What are the most well-known museums you know? Do you think museums are essential for giving life to a nation's history? Why?
Session 4: Watching a film about extracting sugar from sugar cane
Classroom Discussion: Did you know how sugar is extracted before watching the video? Can you talk about what you saw? What is your idea about removing sugar from one's diet? Have you ever visited a factory? Please explain.
Session 5: Watching a film about life in a village
Classroom Discussion: Have you ever been to a village? Do you like to live in a village? What is the most attractive thing about a village? What are the disadvantages of living in a village?
Session 6: Watching a film about online shopping.
Classroom Discussion: Do you have any experience with online shopping? Talk about its advantages and disadvantages. What did you buy? How satisfied were you with what you bought? Why do some people prefer online shopping?
Session 7: Watching a film about a flower garden.
Classroom Discussion: Do you have a favorite flower or plant? What kinds of flowers or plants grow where you live? Is it necessary to have flowers in your home? Why/why not? Is buying flowers for someone a waste of money?
Session 8: Watching a film about Shakespeare.
Classroom Discussion: What did you know about Shakespeare before watching the film? Can you name other English writers or poets? What was the most crucial thing about Shakespeare's life? Have you read or watched any of his plays?
Session 9: Watching a film about Michael Jordan.

Classroom Discussion: Why do you think people like to be famous? Do you like to be a famous person? Talk about the problems you might have if you were famous. Can you talk about your favorite character (a player, an actor, an athlete, etc.)?
Session 10: Watching a film about lions' life.
Classroom Discussion: Do you like to watch documentaries? What is the most exciting thing about watching animals' lives? How often do you watch documentaries? What is your favorite animal?
Session 11: Watching a film about Cristiano Ronaldo.
Classroom Discussion: What do you think about Cristiano Ronaldo? How often do you watch football matches? What is the most fantastic thing about Ronaldo? Who is your favorite football player? Why?
Session 12: Watching a film about an African safari.
Classroom Discussion: What did you like about the film? Which animal is your favorite animal? Would you like to have a trip to Africa? Where else do you think you can see wildlife? How do you feel about watching animals' life?
Session 13: Watching a film about volcanoes
Classroom Discussion: What do you think about volcanoes? Can you tell the class what you learned from the video? What do you think about natural disasters? Do you have any experience with a natural disaster?
Sessions 14 and 15: Listening and speaking posttests

LISTENING AND SPEAKING POSTTESTS

The listening and speaking sections of Cambridge IELTS 13 (Test 2) were used to measure the participants' improvement. The speaking test took about 15 minutes for each participant and was divided into three sections. Two IELTS examiners cooperated in examining the learners' speaking. The participants' voices were recorded after receiving their consent during the speaking posttest sessions. The examiners listened to the participants' voices and scored their performances. The inter-rater reliability between the two raters showed high consistency (r = .98). The whole procedure took two days after the treatment.

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RESULTS

Initially, IELTS was administered to all participants. Table 2 shows the descriptive statistics before assigning the groups to VR-aided and AR-aided groups (M = 58.66, SD = 2.45). As shown, the skewness ratio (statistic divided by standard error) is .749 (within the range of ±1.96), indicating the normal distribution of the scores. Since participants' scores on the speaking module were between 5 and 5.5, the researchers ensured they were at the same proficiency level, and no further statistical analysis was needed.

Table 2
IELTS Descriptive Statistics Before Treatment

Groups	N	Min.	Max.	Mean	SD	Skewness	
						Statistic	Std. Error
IELTS Scores	30	54.00	62.00	58.6667	2.45418	-.320	.427
Valid N (listwise)							

Table 3 shows the descriptive statistics of the AR-aided group (M = 20.46, SD = 1.40) and VR-aided (M = 20.53, SD = 1.50) on the listening pretest.

Table 3
Descriptive Statistics of the Groups' Listening, Pretest

Groups	**N**	**Min.**	**Max.**	**Mean**	**SD**	**Skewness**	
						Statistic	**Std. Error**
Listening AR-aided	15	18.00	22.00	20.4667	1.40746	-.276	.580
Listening VR-aided	15	18.00	22.00	20.5333	1.50555	-.508	.580

The results of independent samples illustrate no significant differences between the means of the groups on the listening test before the treatment t(28) = 0.125, p = .9 (Table 4).

Table 4
Independent samples T-test on Listening Pretest

	F	**Sig**	**t**	**df**	**Sig (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
								Lower	**Upper**
Equal Variances Assumed	.072	.791	.125	28	.901	.6667	1.15671	1.02338	

Table 5 shows the descriptive statistics of the listening posttests. The means of the AR-aided group (M = 24.46, SD = 1.50) and VR-aided group (M = 24.93, SD = 1.70) are very close. Skewness ratios verify the normality of the distributions.

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Table 5
Descriptive Statistics of the Groups' Listening, Posttest

Groups	N	Mean	SD	SEM	Skewness	Min.	Max.
AR-aided	15	24.46	1.50	.388	0.87	23	27
VR-aided	15	24.93	1.70	.441	1.22	23	28

Table 6 shows the paired samples t-test results between the listening scores of each group before and after the treatment (Research Questions 1 and 2). As shown, a statistically significant difference exists between the listening pretest and posttest of the AR-aided group t(14) = 16.73, $p < .001$ and VR-aided group t(14) = 13.12, $p = .001$, leading to the conclusion that AR and VR could improve the participants' listening skill.

Table 6
Paired Samples T-test, Listening Pretests and Posttests of Each Group

				95% Confidence Interval of the Difference				
Groups	**Mean**	**SD**	**SEM**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Listening AR Pre & Post	-4.0	.92582	.23905	-4.512	-3.48730	16.733	14	.000
Listening VR Pre & Post	-4.40	1.2983	.33523	-5.119	-3.68100	-13.125	14	.001

The effect sizes of AR and VR on the participants' listening were .88 for the AR-aided group and .81 for the VR-aided group (using eta squared), which, according to Cohen (1988), was large. Thus, 88% of the change in the participants' listening performance in the AR-aided group and 90% of the change in the participants' listening performance in the VR-aided group was due to the treatment (.2 = small effect, .5 = medium, and .8 = large).

The study also examined the effect of AR and VR technologies on improving speaking in groups. Table 7 shows the descriptive statistics of the groups on the speaking posttest for the AR-aided (M = 6.33, SD = .24) and VR-aided (M = 6.46, SD = .35) groups. Skewness ratios show that the distribution of scores was normal (falling between ±1.96).

Table 7
Descriptive Statistics of the Groups' Speaking, Posttest

Groups	N	Mean	SD	SEM	Skewness	Min.	Max.
AR-aided	15	6.33	.2439	.0629	1.35	6	6.5
VR-aided	15	6.466	.3518	.0908	.158	6	7

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The results of the paired samples t-test run on the speaking pretests and posttests (Research Questions 3 and 4) show a statistically significant difference for the AR-aided group t(14) = 11.374, p<.001 and VR-aided group t(14) = 11.068, p = .001, indicating that AR and VR could improve the speaking ability of the participants (Table 8).

Table 8
Paired Samples T-Test, Speaking Pretests and Posttests

				95% Confidence Interval of the Difference				
Groups	**Mean**	**SD**	**SEM**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Speaking AR Pre & Post	-1.033	.3518	.09085	-1.2281	-.83848	-11.374	14	.001
Speaking VR Pre & Post	-1.166	.4082	.10541	-1.3927	-.94059	-11.068	14	.001

The effect sizes of AR and VR on the participants' speaking were .81 for both groups (using eta squared), which, according to Cohen (1988), was large. Thus, 81% of the change in the participants' speaking performance in the groups was due to the treatment.

To examine whether AR and VR technologies have different impacts on the listening and speaking abilities of the two groups (Research Questions 5 and 6), the researchers conducted a Multivariate Analysis of Variance (MANOVA). Initially, the assumptions of MANOVA were tested. The first assumption is to check multivariate normality. In other words, the researchers had to ensure that no individuals had very high or low scores. In doing so, Mahalanobis distance (Table 9) was calculated (5.413), which was not larger than the critical value of 18.47 (5.413 < 18.47); thus, the assumption of normality is observed (see Pallant, 2016).

Table 9
Residual Statistics

	Min	**Max**	**Mean**	**SD**	**N**
Predicted Value	1.23	1.85	1.50	.162	30
Std. Predicted Value	-1.649	2.178	.000	1.000	30
Standard Error of Predicted Value	.100	.234	.153	.040	30
Adjusted Predicted Value	1.21	1.82	1.49	.166	30
Residual	-.677	.714	.000	.482	30
Std. Residual	-1.355	1.429	.000	.965	30
Stud. Residual	-1.438	1.502	.007	1.013	30
Deleted Residual	-.763	.788	.007	.532	30
Stud. Deleted Residual	-1.469	1.539	.007	1.020	30
Mahal. Distance	.185	5.413	1.933	1.530	30
Cook's Distance	.009	.120	.035	.033	30
Centered Leverage Value	.006	.187	.067	.053	30

The next assumption is the linearity assumption, which should be ensured before running a MANOVA. This assumption indicates that a "straight-line relationship exists between each pair of the dependent variables" (Pallant,

2016, p. 73). As the scatterplot (Figure 1) shows, there is a linear relationship between the variables of listening and speaking.

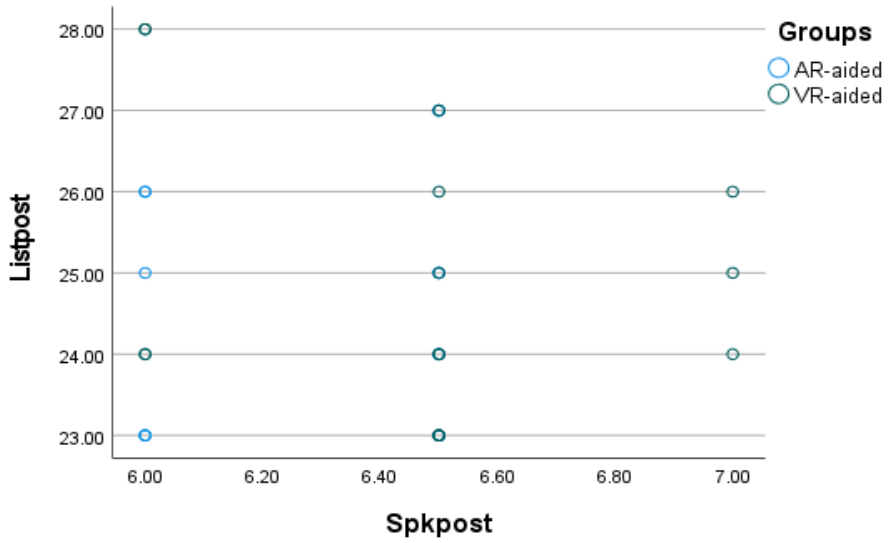

Figure 1.
Scatterplot for the assumption of linearity

As the next step, and after meeting the necessary assumptions, it was legitimate to run MANOVA. As Table 10 indicates (p >.001), the assumption of homogeneity of variances has not been violated.

Table 10
Box's Test of Equality of Covariance Matrices

Box's M	2.230
F	.686
df1	3
df2	141120
Sig.	.561

As shown in Table 11, the p-values for the means are larger than the alpha level of .05, indicating that the assumption of the equality of variances is met.

Table 11
Leven's Test of Equality of Error Variances

		Levene	**df1**	**df2**	**Sig.**
Listening Posttest	Based on Mean	.110	1	28	.742
Speaking Posttest	Based on Mean	.020	1	28	.889

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Wilks' Lambda value of .898, with a significance value of .235>.05, shows no statistically significant difference between the listening and speaking of the AR-aided and VR-aided groups (Table 12). Thus, it can be concluded that AR and VR have similar impacts on the participants' listening and speaking performances. However, following Cohen's criteria (1988), the partial effect size of 10.2% shows a large effect of AR and VR on the participants' listening and speaking abilities. Therefore, 10.2% of the changes in the participants' listening and speaking abilities are due to the treatment they received.

Table 12
Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.999	10909.232[b]	2.000	27.000	.000	.999
	Wilks' Lambda	.001	10909.232[b]	2.000	27.000	.000	.999
	Hotelling's Trace	808.091	10909.232[b]	2.000	27.000	.000	.999
	Roy's Largest Root	808.091	10909.232[b]	2.000	27.000	.000	.999
Groups	Pillai's Trace	.102	1.527[b]	2.000	27.000	.235	.102
	Wilks' Lambda	.898	1.527[b]	2.000	27.000	.235	.102
	Hotelling's Trace	.113	1.527[b]	2.000	27.000	.235	.102
	Roy's Largest Root	.113	1.527[b]	2.000	27.000	.235	.102

DISCUSSION

The positive answers to the first and second research questions indicated that AR and VR could improve Iranian EFL learners' listening skills. The findings show that audio-visual input provided by AR and VR technologies effectively enhanced participants' listening. The role of audio-visual input in L2 learning can be discussed from different perspectives. First, the audio-visual input provided by AR and VR technologies can significantly improve learners' listening skills. Drawing on Dual Coding Theory (Clark & Paivio, 1991; Paivio, 1986, 2007), visual input synchronized with narration facilitates information processing. As the theory postulates, memory embraces two distinct verbal and visual codes by which information is processed. Information received is processed more successfully if the two codes are activated simultaneously, as the two codes are interrelated. Films presented via the apps can enhance learners' attention and focus and improve their listening. The type of input can enable learners to overcome the problem of limited memory capacity, which results in forgetting, as the films provide exciting environments for presenting materials. The role of audio-visual input in enhancing language learning has been the focus of several studies (Hardiah, 2019; Mayer et al., 2014; Rashtchi et al., 2021), which showed that such input lowers cognitive load and thus increases memory capacity.

The second view can be derived from Mayer's (2005) cognitive theory of multimedia learning, which can explain the improvement in listening skills of AR-aided and VR-aided groups. As the theory postulates, multimedia facilitates input processing by providing learners with meaningful contexts. Besides, films can facilitate guessing by offering authentic language. Listening to audio files seems challenging since many distractors slacken learners' attention. However, audio and video integration in films captures learners' attention and promotes their listening (Ismayatim et al., 2019). The finding of the current study regarding the usefulness of AR in improving learners' listening supports previous studies (Ismayatim et al., 2019; Suwancharas, 2016). The current study's findings also align with those of Lan et al. (2018) and Tai and Chen (2021), who showed that VR-based listening activities result in significant changes in the listening comprehension of the groups that benefited from such instructions. AR and VR activate learners' background knowledge and enable them to make inferences by providing real-life listening tasks. This finding is verified by Tai and Chen (2021), who argue that VR-aided learners outperformed video watchers in listening comprehension and retention.

The positive answers to the third and fourth research questions also verified that AR and VR technologies could affect learners' speaking abilities. The results of the paired samples t-tests indicated significant differences between the participants' speaking scores before and after treatment. Then again, the current study's researchers assume that such differences result from the type of input learners receive. Watching films activates schemata and enables learners to store valuable information in their long-term memory (Baddeley, 1986). Thus, when speaking, the idea-generation process requires less effort, and learners can remember words and structures with less difficulty. By providing a meaningful context, the audio-visual input provided by AR and VR allows them to have a more profound cognitive involvement (Rashtchi et al., 2021). One interpretation regarding the positive impacts of AR and VR-oriented environments on improving learners' speaking ability is that such environments integrate virtual and real worlds to enhance learning. Learners' experiences with such environments enable them to move cognitively from the real world to the virtual world, equipping them with language to express abstract concepts. The technologies also help learners experience language in real-life-like environments (Bujak et al., 2013). Therefore, in line with Bozdogan et al. (2017), the researchers hypothesize that the possibilities provided by technology-aided learning give them priority over conventional learning environments.

The results of the current study align with Nguyen and Pham (2022), who emphasize the decisive role of any form of technology in promoting the communication skills of L2 learners. This study also supports the idea proposed by Zou et al.(2023) that AI tools are appropriate for practicing speaking in a second or foreign language. Besides, the assumption of the current researchers regarding the decisive role of context (Herrera, 2020) provided by AR and VR is verified by the findings of Ho et al. (2019), who emphasized the role of application-based real-life contexts in encouraging learners to listen and speak in second language classes.

More specifically, the present study aligns with Taskiran (2019) and Ustun et al. (2022), who reported that interaction with AR in language classes promotes learners' oral performance. This study finds support from several studies regarding the specific use of VR to improve the participants' speaking (Chien et al., 2020; Ebadi & Ebadijalal, 2022; Ironsi, 2023; Ou Yang et al., 2020; Reitz et al., 2019; Van Ginkel et al., 2020). The studies underscore the beneficial role of VR in promoting students' speaking skills. The current researchers hypothesize that AR and VR increase learners' focus on the content, facilitate the transfer of information to long-term memory, and increase learners' access to language elements in their future communications. However, this study contrasts with Bailey et al. (2016), who found that visual feedback alone is insufficient and must be accompanied by motor movements to affect cognition. Another counterargument comes from Huang et al. (2018), who stated that learners need more mental effort when immersed in a virtual world, which may cause cognitive overload and block learning.

Conversely, the answers to research questions five and six were negative. The MANOVA results indicated no significant differences between the impact of AR-aided and VR-aided environments on the listening and speaking abilities of the participants. Although no differential impacts were found, the results indicated that AR and VR technologies enhanced participants' speaking and listening skills. The results underscored the benefits of implementing technology in promoting learning outcomes in EFL classes. The technologies can replicate real-life language and create interactive situations for language learning (Hua & Wang, 2023). Then again, the efficacy of AR and VR technologies could rest in situated learning theory (Herrera, 2020), which argues that contextualized teaching results in effective learning. Thus, AR and VR can provide context, enhance learning, and deepen the language learning experience.

CONCLUSION

The study confirms AR and VR's value in improving listening and speaking skills. The potential of AR and VR to bring authentic situations to the classroom environment, particularly in EFL situations where learners do not have social contact with native speakers, allows students to improve their listening and speaking skills. The findings could interest EFL teachers, educationalists, and program developers who seek creativity in English language classes and try to break away from traditional teaching methods. However, it is worth mentioning that engaging L2 learning through AR and VR has its complications, including affordability, sufficient Internet infrastructures, and teachers' and students' willingness and technological literacy. This study was limited in that it did not consider the participants' interests in materials selection. Another limitation was that the participants were IELTS candidates who volunteered to participate in the classes; thus, their characteristics might differ from typical students in terms of motivation and perseverance. The limited number of participants, due to the required affordances of AR and VR

technologies, can question the generalizability of the study. Future studies can consider participants' personality factors that influence their success in using AR or VR. Besides, measuring learners' cognitive load, degree of engagement, and grit in AR and VR-based classes can be exciting areas for future studies.

This investigation has implications for teachers, program developers, and administrators. Teachers who look for innovative ways of teaching English can benefit from the study. AR and VR are mainly useful for EFL learners who do not have access to authentic situations. Through AR and VR applications, teachers can promote learning outcomes by providing real-life environments and situations. Program developers can consider such technologies as part of the classroom programs. Developing educational films in AR and VR environments can help EFL learners have authentic contact with foreign language learning settings and thus overcome challenges they face regarding the lack of exposure to authentic situations. Administrators can also consider the possibility of using AR and VR in language classes and schools to motivate language learners, facilitate their learning process, and bring changes to English teaching classes.

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