Research in English Language Pedagogy (2023) 11(2): 169-191

 DOI: 10.30486/RELP.2022.1957463.1376

Original Article

The Effects of Gender, Age, and Educational Level on Language Achievement in AR-integrated Language Learning

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Submission date: 12-05-2022 Acceptance date: 16-07-2022

Abstract

The current study investigated the integration of one recent technology, i.e., Augmented Reality (AR), in language education and its effect on language achievement. To this end, the investigators designed and implemented a quasi-experimental pretest and posttest study involving two stages. The initial stage examined if Augmented Reality improved language achievement in EFL learners. The second one explored the existence of any interaction between such an effect and variables of learners' gender, age, and educational background. The participants were 40 adult beginner-level adult learners in a language institute in Shiraz, Iran, and were randomly divided into control and experimental groups. In contrast, those in the control group studied the conventional materials. Data was collected through achievement tests included in the course materials package and analyzed with ANCOVA via SPSS. The findings revealed that language achievement was significantly enhanced for the experimental group. Moreover, results indicated that only educational background showed a meaningful relationship with the way learners benefit from using AR in improving their language achievement among the three moderator variables. The findings have implications for researchers and language instructors, and policymakers.

Keywords: Augmented Reality, CALL, Educational Technology, Language Achievement, MALL

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1. Introduction

English, the world's most used lingua franca, is nowadays the most important means of communication. With the advent of technology and its inevitable integration in almost all aspects of humans' lives, its influence on education and learning grounds cannot be neglected. Various technologies have been incorporated into the teaching and learning of English during the past years. There are different forms of educational technology applications.

Cheung and Slavin (2013) defined educational technology as electronic tools and applications that support learning and help deliver educational content. One recent technology is Augmented Reality (AR) which bridges the real and virtual worlds. This brings up capacities that can enhance learning and teaching. AR is "a modern computer-assisted learning environment that combines the observed real-world phenomena with graphically added information or images; even spatially positioned sounds can be used" (Salmi et al. 2012, p. 285).

Lee (2012) specified that AR could make the learning settings more dynamic, enjoyable, and collaborative than before. Moreover, AR provides a richer learning experience for the learners, which results in improved educational outcomes (Liu et al., 2008, p. 39). Researchers also added that this technology adds enjoyment and fun to the learning environment, thus enhancing learner motivation (Lazoudis et al., 2012, p. 18). In research, the application of AR in different education domains has attracted a lot of interest lately. Kiryakova et al. (2018) revealed the potential of Augmented Reality to transform education into Smart education. The AR technology enables learners to engage actively in the process of learning (Pérez-López & Contero, 2013, p. 26)

Today, most language learning is still done through conventional paper books, while only some integration of computers or media is witnessed. More recent advancements, such as mobile-assisted language learning, have been introduced in the field. Due to its rapid-developing nature, many other opportunities such as Virtual Reality (VR) or Augmented Reality (AR) learning have been created. There is an urge to consider such potential in designing and implementing language learning courses to maximize the learning outcome.

The current study, therefore, fills the gap in the literature by examining the possible effect of employing AR on language achievement in adult male and female EFL learners of various ages and language backgrounds. The problem addressed in this study was to

investigate the efficiency of integrating AR in Iranian EFL learners' language achievement, examine its advantages and disadvantages and explore the possible effects on learners. The AR experience investigated in this study was maintained through personal mobile devices, providing a systematized sub-study of Mobile Assisted Language Learning (MALL).

2. Literature Review

It is essential to employ the best and newest tools and strategies in the classroom to support learning and get students engaged in maximizing teaching and learning capacities. According to Balkun (2011, p. 15), when using technological advancement in the classroom, "the goal is to provide an enriched experience that gives students access to information and materials not readily available elsewhere." Using audio and video was introduced into teaching a long time ago. Augmented Reality moves this further by adding different multimedia formats and allowing interaction with them.

Augmented Reality is a recently developed technology that has impacted different fields, one of which is education. Below an introduction to this technology and its applications in education is presented. It is followed by empirical research on the employment of AR in language teaching and learning, which sets the scene for the current study.

2.1. Augmented Reality (AR)

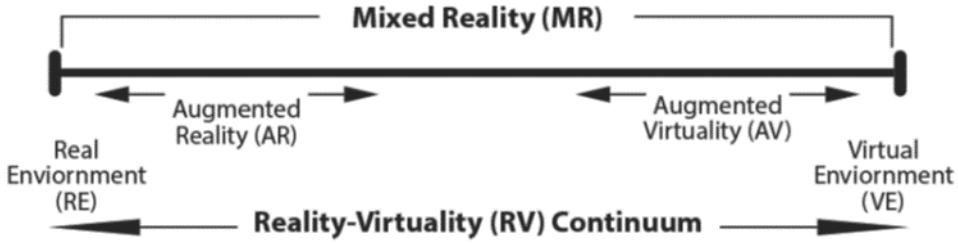
Augmented Reality technology is an increasingly developing tool that has dramatically affected the education sector. According to Lee (2012), it is one technology that dramatically shifts the location and timing of learning. AR enables learners to interact with the world. Images and physical objects can come to life with the power of interactive digital audio, video, and 3D items. It is believed that AR can help students learn better as it generates novel, thought-provoking opportunities (Koutromanos et al., 2015).

This concept is well shown in Milgram's continuum (Milgram et al., 1995). It positions Augmented Reality in a continuum of reality-virtuality and defines it as related to such environments. At the left extreme of the continuum are pure Reality and extreme virtuality at the right (Figure 1). The area between these two extremes allows the definition of mixed-reality (MR) environments where components of virtuality and Reality are mixed in one way or another. Inclined to the right side, one can define Augmented Virtuality (AV), which

includes a virtual environment with some element of Reality. On the other hand, inclined to the left, Augmented Reality (AR) involves superimposing some virtual elements to the real environment. According to Steuer (1992), AR does not substitute the real world with a virtual one. Instead, it combines the real and the virtual in real-time, while the virtual elements are interactive.

Figure 1.

Milgram's Reality-Virtuality (RV) Continuum.



When AR is applied in the classroom, it takes the teaching and learning process to a new and different level. As Bower et al. (2014) claimed, learners praised how they could do the AR activities and enjoyed them, which should not be possible without using AR. This has fostered motivation in students, as proved in several studies. For instance, Lee (2012) considered AR a motivating instructional tool that can enhance learners' reality-based exercises.

Rather than being a replacement, AR materials can be a complement to a conventional curriculum. When implementing AR features into traditional materials, the goal is to provide the learners with some supplementary information in a more recent multimedia format. Moreover, one other significant capacity that AR offers is that it allows the teacher and the learner who are not in the same physical location to share the same virtual content simultaneously, thus promoting collaborative learning. They can share the same content and materials and interact simultaneously.

Many platforms and applications are available to employ this technology, one of which is Zappar employed in the current study. Zappar is a marker-based app that uses complex computer algorithms to bring to life the picture it scans through the camera. This app can analyze at least 30 images at a second, thus providing a rich 3D experience to the user. Zappar provides its own ZapWorks content authoring tool to create AR content, which

provides different modules for users with various proficiency in creating digital content. One can create the content themselves or get help from Zappar professionals. After creating the content, the platform will assign a specific trigger called Zapcode. One can put the zapcode in any position or place that they prefer. Then, users will scan the Zapcode and access the digital content behind them.

The application of AR as new technology has been of interest recently in many terrains, including education. It brings about opportunities to various unique, attractive, and collaborative fields. The possibilities created by AR cannot be experienced in any other way, hence the unique value of this technology. Research has also supported its use and proved beneficial in different fields. Relevant to the subject of this study, research revealed that AR helps promote educational achievement in various fields. Examples are studying the effect of AR in Biology (Erbas & Demirer, 2019), Instrument Design (Naese et al., 2019), Construction (Fauzi et al., 2019), and Chemistry (Behmke et al., 2018).

2.2. Augmented Reality in Language Education

Focusing on the language learning context, the effect of employing AR in language achievement has also been investigated in the literature. Beder (2012) ran a study to explore the effectiveness of AR in English language vocabulary learning with 20 participants in Sweden. An AR tool was developed to facilitate the learning of words by presenting 3D items, spelling, and pronunciation of the words. The researcher compared the achievement in the control group who used traditional vocabulary learning flashcards with the experimental group who used the AR app. Data was collected using a vocabulary knowledge scale administered immediately and one week after the treatment to both groups. Results revealed that using AR improved the long-term recall rate, hence a helpful tool in vocabulary learning.

Moreover, Solak and Cakır (2015) conducted a study with 130 undergraduate students at a university in Turkey. The aim was to explore the motivation level of students towards AR-infused course materials and to examine the correlation between motivation level and academic achievement. The AR materials were designed to teach beginners English vocabulary, including animation and pronunciation. Data was collected through Material Motivational Survey, translated into the participants' mother tongue, i.e., Turkish. Results showed that AR-enhanced materials increased the motivation of students toward vocabulary

learning. Also, a significant positive correlation was found between motivation and academic achievement in the vocabulary learning classroom.

In addition, Tandogan (2019) ran a mixed-methods study to investigate the impact of an AR-enhanced course on students' vocabulary achievement. The study participants were 76 upper-intermediate level students studying ESP vocabulary using an AR application in Turkey. Results revealed that students who used the AR-infused learning performed significantly better in the vocabulary achievement test than those who did not use AR.

Besides, Khoshnevisan (2020) examined the effects of using an AR-integrated course on students' level of idiom achievement by employing an explanatory, descriptive case study. Participants were 50 graduate-level international students in the United States. Results revealed no significant difference in learners' idiom achievement levels while using AR-enhanced and traditional materials. However, learner motivation was reported to be higher in AR-infused learning.

Moreover, Tsai (2020) examined the effects of employing AR in EFL vocabulary learning through an unequal pretest and posttest experimental design. The study participants included 42 fifth graders in an elementary school in Taiwan. The researcher found out that the students' performance who learned the vocabulary using AR was superior to those who followed the traditional learning method.

Last but not least, Koc et al. (2021) studied the effects of using Augmented Reality on producing English texts by high school students and their perceptions of using AR. Participants were 48 students in the B1 level of English proficiency who used AR-integrated materials to perform writing in English. Results of this quasi-experimental study revealed that AR had a medium effect on the students' writing skills and that learners showed a positive attitude towards using AR in learning.

As the literature review suggests, most research findings support that using Augmented Reality supported academic and language achievement. However, since research in this area is still in its infancy, only limited application or integration methods have been examined, which needs more and more research to reach a consensus. Besides, most of the investigations studied learners at the school level or undergraduate level at university. This focus on specific ages and educational backgrounds might intervene with how AR affects learners' different aspects of language, such as language achievement. Furthermore, to the authors' best knowledge, no study explored the impact of gender on the possible effect of

AR on language achievement.

Based on the mentioned objectives, this quasi-experimental study sought to investigate the following:

1. Does Augmented Reality affect adult Iranian EFL learners' language achievement?
2. Does AR affect (if it does) language achievement in Iranian EFL learners of different gender, ages, and educational backgrounds?

It is essential to note that the second research question is if the researchers responded positively to the first research question in the study. This means that the impact of moderator variables could be investigated only when the meaningful effect of the independent variable on any of the dependent variables had been recognized.

3. Methodology

The current study aimed to investigate the effect of using Augmented Reality on improving language achievement. The methods followed to attain this goal are explained in detail in the following sections.

3.1. Design and Context of the Study

A quasi-experimental pretest and posttest study was designed and implemented in the current investigation. First, it was attempted to see if language achievement was affected by employing Augmented Reality in learning at the initial stage. Second, moderator variables, namely gender, age, and educational level of the learners, were also considered to examine any probable interactions with the possible effect of AR on enhancing language achievement.

3.2. Participants

Participants of this study were 40 male and female adult beginner-level EFL learners. They enrolled in a general English course at a language institute in Shiraz, Iran. The sample was selected based on intact sampling, consisting of two classes. The classes comprised students who had already passed the previous level of EFL education in the same institute. The institute's administration assigned students to each class, and the researchers had no interference. Choosing this number of students was to eliminate the instructor effect. The researchers needed both classes to be taught by the same teacher. Therefore, based on the

administrative limitations of the institute, this could only be done in two classes. After the students were assigned to the two classes, the researchers randomly selected one class as the control and the other as the experimental group to participate in the study. Participants' demographic information is as follows.

According to the data, 50% of participants were males (n=20) and 50% were females (n=20). Their age ranged from 20-40, with distribution details presented in Table 1. As shown in Table 4.1, 12.5% of the participants were 20-25 years old, 25% were 26-30 years old, 37.5% were 31-35 years old, and the final 25% were 36-40 years old.

Table 1.

Participants' Age Distribution

Age Range	Frequency	Percentage
20-25 years	5	12.5
26-30 years	10	25
31-35 years	15	37.5
36-40 years	10	25

Participants' educational levels ranged from high school diplomas to Ph.D. The distribution of participants among different educational levels is shown in Table 2. According to Table 4.2, 12.5% had a high school diploma, 37.5% had a Bachelor's degree, 25% had a Master's degree, and another 25% had a Ph.D. degree. This variety in gender, age, and educational level allowed the researchers to examine how the research variables interact with various learners, which has not been focused on much in the literature. Such information is used and reported in the study based on written consent from the participants.

Table 2.

Participants' Educational level

Education Degree	Frequency	Percentage
Diploma	5	12.5
Bachelor	15	37.5
Master's	10	25
PhD	10	25

3.3. Instrument(s)

Several materials and instruments were used for data collection in this study. They included the instructional materials, assessment materials, and AR tools introduced separately below.

3.3.1. Instructional Materials

The instructional materials used in this investigation were Interchange 1, the 5th edition coursebook, and complementary components. The conventional paper version of the book was used for the control group. Based on the institute's program, students had to cover units 9-16 of the book during the 20-session course defined by the institute. Moreover, the experimental group used an AR-integrated version of the same book, which was developed for this study's specific purpose. The AR-infused book included input from the accompanying materials to the Interchange series. The input was presented in the multimedia format through the AR platform. In this presentation mode, such information was readily accessible to the learners while studying the book without needing to refer to the mentioned materials individually.

The input was then turned into AR multimedia interactive content using ZapWorks, the Zappar workplace, to create AR content. The AR features added to the coursebook included a variety of multimedia formats, including text, audio, and video. The content was then saved in the platform's repertoire and was accessible to users. After creating and saving each design, a Zapcode was created, which could be downloaded and used where applicable.

The researchers then downloaded and copied the Zapcodes on sticky papers. Before beginning the course, they put the sticky Zapcodes in the relevant places at a corner on top of each section. The researchers decided to use a minimal number of Zapcodes to avoid any extra cognitive load on the learners. Figure 2 and Figure 3 show a learner from the experimental group exploring the AR content in the book.

Figure 2.

Sample Pronunciation Section Enhanced with AR

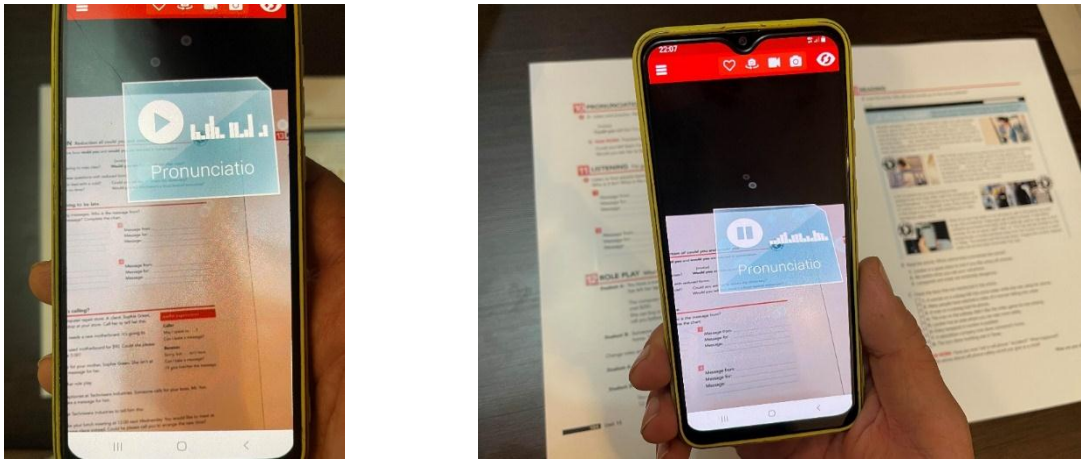
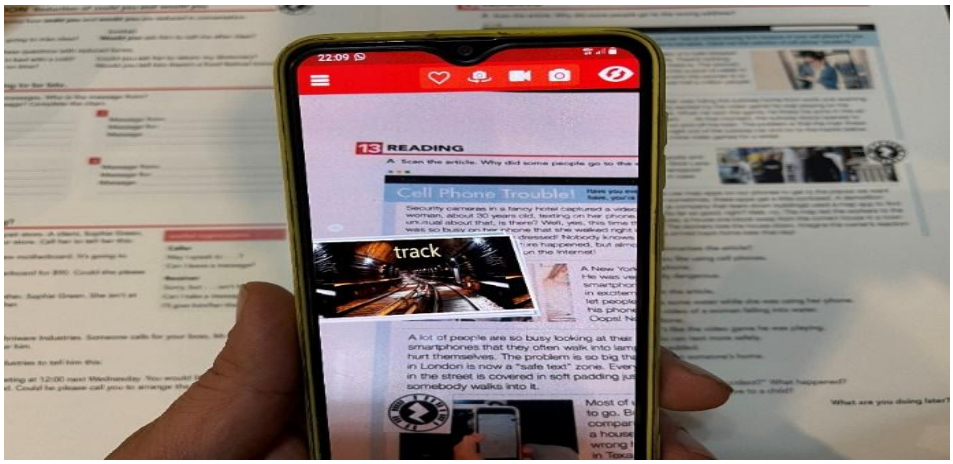


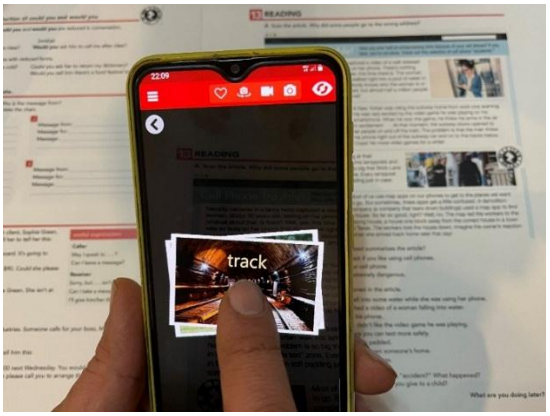
Figure 2 shows the time a learner scanned the AR content in the pronunciation section of a unit (Unit 15). The only difference between the conventional coursebook and the AR-enhanced one is that several Zapcodes are attached to it. The mark can be seen in the corner of each exercise where applicable.

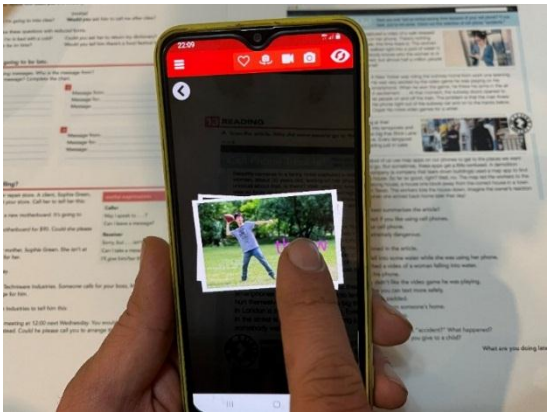
A virtual audio playing widget is shown on the mobile screen when the student scans the code. The learners can see the real environment and virtual augmented content on their mobile screens. The virtual content is interactive, meaning the learner can play and pause the audio as he wants. The virtual content was still available if the learner moved his device within a specific range. By moving away from the mark, the virtual content would disappear.

Figure 3.

Sample Reading Section Enhanced with AR







Moreover, Figure 3 shows the time the learner tried to explore the AR content in one section of the reading passage. When the code was scanned via the camera, a few pictures in the form of an album appeared on the mobile's screen. Each picture showed one new word, and an image described its meaning. As the content was interactive, the learner could explore the images, magnify them, and the like, based on his requirements. All AR content in the book could be accessed in the same way. Students could scan the code with the camera of their mobile phones, which were already connected to the Internet, access the augmented feature, and interact with them where applicable. Scanning the codes by the learners to access the input delivered in the AR was obligatory. The teacher asked the students to do so on every encounter with the code to reveal its content. Then, the learner decided the amount of interaction with the content revealed behind that code based on their requirements.

Twenty copies of the coursebook were prepared to be used by the participants and one by the teacher in the experimental group. Since the institute had to provide the students with books and related materials at each level, it was feasible for the researchers to access the coursebooks and get them distributed to the relevant participants at the beginning of the course. These AR features acted like resources that helped learners get more input in different formats, which aided them in learning each lesson section.

3.3.2. Assessment Materials

An achievement test was used to assess participants' level of language competence before the study to ensure homogeneity. It was the same test provided by the Interchange series as the level exit exam. Only students who managed to pass that exam could enroll in the next level. Therefore, students who participated in this study had already passed the level exit

exam, denoting a certain level of proficiency. Next, a second achievement test, i.e., the level exit exam of the treatment course provided by the Interchange series, was administered both at the beginning and end of the course as pre-and posttests.

The authors checked the validity and reliability of the second achievement test, which functioned as pre-and posttests. The test was examined by the panel of experts for this study and was verified to be face and content-valid. The reliability was checked in a pilot administration in the same institute defined above. It was measured using Cronbach's alpha formula. Furthermore, the test's reliability was checked in the actual administration to the target groups. Results are shown in Table 3 below.

Table 3.

Reliability of the Achievement Test (Used as both pre-and posttests)

Test	Cronbach's Alpha in Pilot Test	Cronbach's Alpha in the actual administration
Achievement	0.81	0.79

According to Table 3, the reliability of the test was 0.81 in the pilot administration and 0.79 in the actual one. These figures both fell in the acceptable range, and the test proved reliable in measuring learners' language achievement for this study.

3.4. Data Collection Procedure

The current study employed quantitative data collection and analysis techniques. After the participants were at hand through intact sampling in two classes, the researchers selected one class as the control and the other one as the experimental group.

Before the course started, a series of preliminary preparations were done. First, the researchers collected participants' scores in the pretest. Then, the books for the experimental group were prepared as explained above and distributed among students. Furthermore, the researchers equipped the experimental classroom with high-speed WiFi Internet for participants to use during class.

Next, the teacher was informed of the teaching approach she should take for both classes and was asked to pursue as much similar procedures in both as possible to avoid any instructor and instructing effects to the extent possible. Then, she was trained on the AR content, how to access them, and how to resolve any potential facility-related flaws that

could appear during the experiment.

Then the two groups started the 20-session course defined by the institute. In the first session, the teacher described and instructed how to access and use the new AR features the students would experience in the experimental group. She also let the students connect to the Internet and download the Zappar application. She ensured all students could use the Zappar app easily, with no issues.

Both groups then underwent the 20-session course. After completing the course, learners were post-tested in the final session. The posttest consisted of the final exam, which assessed learners' achievement in the course. After the data collection phase, the obtained data were analyzed through proper quantitative data analysis techniques, discussed in more detail.

3.5. Data Analysis Procedure

Analysis of covariance with SPSS was used to analyze the quantitative data obtained through the study. In the pretest and posttest, learners' scores were compared using ANCOVA to investigate if the change (if any) that occurred over time in the students' ability was more remarkable in the experimental group. Moreover, ANCOVA was also employed to see if the effect of AR on language achievement was different for different genders, ages, and educational levels.

Based on SPSS Survival Manual (Pallant, 2020), ANCOVA was used when there was a pretest and posttest design, for instance, to compare the influence of two diverse interventions which were taken before and after measures for each group. The scores on the pretest were considered a covariate through which pre-existing differences between groups can be controlled.

4. Results

Analysis of covariance (ANCOVA) was used to respond to the research questions. The results are as follows. Nevertheless, before applying ANCOVA, a normality test was done to ensure it was the proper analysis method for the data at hand.

One of the assumptions made in the analysis of covariance was the assumption that the distribution was normal. It was assessed by Kolmogorow-Smirnov (K-S) test. The test was performed on research variables to check if the normality assumption was satisfied. Table 4 involves the result of the normality test (Kolmogorov-Smirnoff).

Table 4.

Kolmogorow-Smirnov Test of Normality

Variable	Statistic	Sig.
Achievement Post-test	0.182	0.06

As it can be deduced from Table 4, the significance level obtained in the test (K-S) was more than the criterion value of 0.05. Therefore, it could be concluded that the distribution of the variables under study in the statistical sample was normal, and ANCOVA could suitably be done to respond to the research questions.

4.1. First Research Question

The first research question sought to explore if AR affected Iranian EFL learners' language achievement. Levene's Test of Equality of Error Variances was used to test the homogeneity of the regression coefficients. Table 5 summarizes the mean scores of both groups' pretests and posttests.

Table 5.

Language Achievement Descriptive Statistics

Group	Mean	SD	N
Control	85.25	6.29	20
Experimental	90.50	4.92	20
Total	86.38	6.97	40

As Table 5 shows, the experimental group had a higher mean score after the experiment (mean = 90.50) than the control group (mean = 85.25). Therefore, it was evident that there was a difference between participants' achievement scores in the pretest and posttest.

A one-way between-groups analysis of covariance (ANCOVA) was conducted to test whether this difference was significant. The covariate in this analysis is the participants' scores on the pre-intervention test. Before running ANCOVA, the authors ensured that assumptions of normality, linearity, homogeneity of variances, regression slopes, and reliable covariate measurement were met and not violated through preliminary checks. The result is presented in Table 6.

Table 6.

Achievement ANCOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	1684.73	2	842.36	147.96	0.000	0.889
intercept	37.60	1	37.60	6.60	0.014	0.151
Pre-test	1004.10	1	1004.10	176.37	0.000	0.827
Group	273.22	1	273.22	47.99	0.000	0.565
Error	210.64	37	5.69			
Total	300321.00	40				
Correct total	1895.37	39				

As Table 6 shows, after adjusting for pre-intervention scores, there was a significant difference between the two intervention groups on post-intervention scores on the achievement test, $F = 47.99$, $p = 0.000$, partial eta squared = 0.562. A medium-strength relationship was identified between the pre-intervention and post-intervention scores on the achievement test, as indicated by a partial eta squared value of 0.562 based on Cohen's guidelines (2013).

Thus, according to the above results, it could be inferred that the difference in participants' achievement scores before and after the treatment was meaningful, which denoted that Augmented Reality affected students' language achievement positively since there was a rise in learners' scores in the posttest, hence a positive response to the first research question.

Based on the results in the previous stage, AR positively affected language achievement. Consequently, the investigators examined if the moderator variables of gender, age, and educational level impacted how AR affected the students' language achievement.

4.2. Second Research Question

According to the above results, the main research question was answered positively. Therefore, the second research question examined the existence of any effects of participants' gender, age, and educational level investigated below.

ANCOVA was run on the effect of gender on language achievement in AR-enhanced language learning. Table 7 shows the descriptive statistics for gender concerning achievement. A one-way between-groups analysis of covariance (ANCOVA) was conducted to test whether the difference in means of scores in the two groups was statistically significant. Participants' scores on the pretest were used as the covariate in this analysis. Preliminary checks were conducted to ensure no violation of normality, linearity, homogeneity of variances, regression slopes, and reliable covariate measurement. Results are shown in Table 7.

Table 7.

Achievement and Gender Descriptive Statistics

Group	Gender	Mean	SD
Control	Male	84.00	7.37
	Female	50.50	4.74
Experimental	Male	90.40	5.89
	Female	90.60	4.06

To test whether this difference was statistically significant, a one-way between-groups analysis of covariance (ANCOVA) was conducted. The same preliminary checks were run to endure the required assumptions were met. Results are shown in Table 8.

Table 8.

Achievement and Gender ANCOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	1688.051	4	422.013	71.243	0.000	0.891
intercept	37.361	1	37.361	6.307	0.017	0.153
Pre-test	945.976	1	645.676	159.698	0.000	0.820
group	273.404	1	273.404	46.155	0.000	0.569
Gender	3.211	1	3.211	0.542	0.466	0.015
Group*gender	0.085	1	0.085	0.014	0.906	0.000
error	207.324	35	5.924			
total	300321.00	40				
Correct total	1895.375	39				

As Table 8 shows, after adjusting for pre-intervention scores, there was a significant difference between the two intervention groups on post-intervention scores on the achievement test, F = 0.014, p = 0.906, partial eta squared = 0.000. There was no significant difference between pretest and posttest scores. Therefore, according to the above data analysis results, it was evident that gender did not play a role in how AR affected language achievement in learners.

Next, another ANCOVA test was done to see if participants' age interacts with improving language achievement by employing AR in language learning. Table 9 shows the descriptive statistics for age concerning achievement. To test whether the difference in means of scores in the two groups was statistically significant, a one-way between-groups analysis of covariance (ANCOVA) was conducted. Participants' scores on the pretest were used as the covariate in this analysis. Preliminary checks were conducted to ensure no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable covariate measurement.

Table 9.

Achievement and Age Descriptive Statistics

Group	Age	Mean	SD
Control	20-25	81.40	4.93
	26-30	79.60	4.93
	31-35	91.00	0.00
	36-40	79.33	5.71
Experimental	20-25	95.40	1.67
	26-30	84.75	3.77
	31-35	90.75	3.28
	36-40	89.33	6.11

As ANCOVA results shown in Table 10 indicate, after adjusting for pre-intervention scores, there was a significant difference between the two intervention groups on post-intervention scores on the achievement test, F = 0.029, p = 0.993, partial eta squared = 0.003. There was no significant difference between pretest and posttest scores. Therefore, it could be inferred that AR affected all students' language achievement similarly regardless of age.

Table 10.

Achievement and Age ANCOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	1693.452	8	211.681	32.498	0.000	0.893
intercept	19.476	1	19.476	2.990	0.094	0.088
Pre-test	359.927	1	359.927	55.257	0.000	0.641
group	216.815	1	265.815	40.809	0.000	0.568
Age	7.701	3	2.567	0.394	0.758	0.037
Group*Age	0.562	3	0.187	0.029	0.993	0.003
error	201.923	31	6.514			
total	300321.00	40				
Correct total	1895.375	39				

Finally, an ANCOVA test was run to examine the effect of educational level on the language achievement improvement of learners in AR-enhanced language learning. Table 11 shows the descriptive statistics for educational level concerning achievement. To test whether the difference in means of scores in the two groups was statistically significant, a one-way between-groups analysis of covariance (ANCOVA) was conducted. Like the previous analyses, pretest scores were considered the covariate, and preliminary checks confirmed there were no violations of the basic assumptions to allow proper use of ANCOVA.

Table 11.

Achievement and Educational Level Descriptive Statistics

Group	Educational Level	Mean	SD
Control	High school Diploma	76.00	0.000
	College	84.20	7.014
	BA/BS	80.50	7.000
	MA/MS	86.50	3.000
	PhD	88.00	4.243

Experimental	High school Diploma	92.50	3.109
	College	88.00	2.828
	BA/BS	92.20	5.404
	MA/MS	82.00	2.014
	PhD	91.40	6.025

As Table 12 shows, there was a significant difference between the two groups on posttest scores on the achievement test, F = 5.983, p = 0.001, partial eta squared = 0.452, after adjusting for pretest scores. Thus, it could be inferred that there was a medium-strength relationship between the pretest and posttest scores on the achievement test, which was represented by a partial eta squared value of 0.452 based on Cohen's guidelines (2013).

Table 12.

Achievement and Educational Level ANCOVA Results

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	1791.644	10	179.164	50.089	0.000	0.945
intercept	64.453	1	64.453	18.019	0.000	0.383
Pre-test	608.69	1	608.609	169.997	0.000	0.854
group	179.111	1	179.111	50.074	0.000	0.633
Age	12.690	4	3.172	0.887	0.484	0.109
Group*Edu	85.597	4	21.399	5.983	0.001	0.452
error	103.731	29	3.577			
total	300321.00	40				
Correct total	1895.375	39				

5. Discussion

As the results of analyses to find out the response to the first research question showed, there was a significant difference at ($\alpha \leq 0.05$) in the mean scores of the achievement test between the participants in the control and those in the experimental group in the posttest and pretest.

This difference favored the experimental group, indicating that Augmented Reality positively affected language achievement.

The researchers also found that AR affected language achievement differently for participants with different educational levels. The strength of the relationship between such effect and educational level was medium, which denotes that learners with a higher level of education benefit more from the AR-enhanced language learning regarding language achievement.

The researchers believe these results are attributed to the efficiency of Augmented Reality in language teaching and learning. This indicates that using AR technology helps achieve the goal of language education more effectively than the traditional approaches that did not use technology. AR technology provides an exciting potential to give the learners varied input, enhancing language intake and learning. In addition, in learning, not all available input is accessible to the learners easily. AR creates an atmosphere where input gets more accessible through perceptual saliency, which facilitates turning an input into the intake. The significance awarded to input in such a way promotes learner interaction and results in deeper learning.

The results of the current study were similar to those of Beder (2012), Solak and Cakır (2015), Tandogan (2019), and Tsai (2020) in that using AR improved language achievement in students. However, all the mentioned studies examined the effect of AR on only one component of the language, i.e., vocabulary. In contrast, the current study took a holistic view of language and considered language achievement changes. Besides, the results of the current study differ from the work of Khoshnevisan (2020), who found that using AR did not improve learners' idiomaticity. This could be attributed to other factors involved in enhancing idioms learning and the fact that this type of learning cannot occur only with the help of technology.

Moreover, all the research works mentioned above-considered learners' gender, age, and educational level as factors that might relate to the advantage learners receive from using AR in language learning. Also, similar to the present study, Beder (2012) and Tanogan (2019) performed their studies on a specific level of EFL learners, regardless of their age, while Solak and Cakır (2015), Khoshnevisan (2020), and Tsai (2020) limited their participants' age and background educational levels. For instance, Solak and Cakır (2015) examined undergraduate students, Khoshnevisan (2020) studied graduate students, and Tsai

(2020) explored 5th graders in elementary school.

6. Conclusion

Results revealed that Augmented Reality improved language achievement in learners. Besides, findings supported a relationship between educational level and learners' achievement affected by this technology. This meant that not all adult participants benefit from the affordances of AR in language learning the same way. The study findings revealed that Augmented Reality effectively improved language achievement in adult Iranian EFL learners. It was found that adult EFL learners substantially improved the English language.

The researchers concluded that Augmented Reality had superiority over conventional language teaching and learning approaches based on the findings. It created a more engaging and interactive environment where learners could take responsibility for their learning, promoting autonomy. The researchers attributed this to the nature of Augmented Technology, which enables interaction between the real and the virtual and allows learners to actively engage in the learning process, promoting independence and motivation.

This study has implications for curriculum designers, decision-makers, English language teachers, experts, specialists, and supervisors. First and foremost, decision-makers and curriculum developers in language education are recommended to incorporate Augmented Reality in the curricula and provide the required facilities and infrastructure for its implementation. Also, they should hold teacher training sessions and workshops to familiarize instructors with AR technology and its affordances to the language classroom. Also, language teachers are recommended to move from the conventional approaches to more recent ones like Augmented Reality, keep themselves up-to-date regarding available techniques and strategies, and attend educational technology-related workshops and training sessions to raise their knowledge on the matter.

Besides, some limitations were identified in the current study. First, the number and age of students involved in this study were limited. While only 40 adult EFL learners took part in this research, to get more generalizable insights on the nature of the effect of AR technology on language education, more participants in different age groups need to be studied.

Based on the findings of this study, more research should be done on the effects of Augmented Reality on language education with more participants and in longer-term

treatments. Moreover, the impact of using AR on different-age learners in different contexts, focusing on individual language skills and components, needs to be examined. Also, individual differences and preferences should be explored as to how they relate to language learners' benefits from AR. Last but not least, the amount of integration of AR into the curricula should be studied to determine if it works best, for instance, at the level of the materials, more or less.

References

Balkun, M. M. (2011). Teaching with digital media: Widening the framework. Transformations: *The Journal of Inclusive Scholarship and Pedagogy, 22(1),* 15-24.

Beder, P. (2012). Language learning via an android augmented reality system.

Behmke, D., Kerven, D., Lutz, R., Paredes, J., Pennington, R., Brannock, E., & Stevens, K. (2018, January). Augmented reality chemistry: Transforming 2-D molecular representations into Interactive 3-D structures. In *Proceedings of the Interdisciplinary STEM Teaching and Learning Conference (Vol. 2, No. 1, pp. 5-11)*. Proceedings of the Interdisciplinary STEM Teaching and Learning Conference.

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented Reality in education–cases, places, and potentials. *Educational Media International, 51*(1), 1-15.

Cheung, A. C., & Slavin, R. E. (2013). Effects of educational technology applications on reading outcomes for struggling readers: A best-evidence synthesis. *Reading Research Quarterly, 48*(3), 277-299.

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Erbas, C., & Demirer, V. (2019). The effects of augmented reality on students' academic achievement and motivation in a biology course. *Journal of Computer Assisted Learning, 35*(3), 450-458.

Fauzi, A. F. A. A., Ali, K. N., & Amirudin, R. (2019). Evaluating students' readiness, expectancy, acceptance, and effectiveness of augmented Reality-based construction technology education. *International Journal of Built Environment and Sustainability, 6*(1), 7-13.

Khoshnevisan, B. (2020). The effects of augmented Reality (AR)-infused idiom material on Iranian Students' idiom achievements, motivation, and perceptions. The University of South Florida.

Kiryakova, G., Angelova, N., & Yordanova, L. (2018). The potential of augmented reality to transform education into smart education. *TEM Journal, 7*(3), 556-565.

Koç, Ö., Altun, E., & Yüksel, H.G. (2022). Writing an expository text using augmented Reality: Students' performance and perceptions. *Educ Inf Technol*, 27, 845-866. https://doi.org/10.1007/s10639-021-10438-x

Koutromanos, G., Sofos, A., & Avraamidou, L. (2015). The use of augmented reality games in education: a literature review. *Educational Media International, 52*(4), 253-271.

Lazoudis, A., Salmi, H., & Sotiriou, S. (2012). Augmented Reality in Education: EDEN-2011 Open Classroom Conference: Proceedings of the "Science Center To Go" Workshops.

Lee, K. (2012). Augmented Reality in education and training. *TechTrends, 56(2),* 13-21.

Liu, T. Y., Tan, T. H., & Chu, Y. L. (2008, December). QR code and augmented reality-supported mobile English learning system. In *Workshop of mobile multimedia processing* (pp. 37-52). Springer, Berlin, Heidelberg.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995, December). Augmented Reality: A class of displays on the reality-virtuality continuum. In Telemanipulator and telepresence technologies (Vol. 2351, pp. 282-292). International Society for Optics and Photonics.

Naese, J. A., McAteer, D., Hughes, K. D., Kelbon, C., Mugweru, A., & Grinias, J. P. (2019). Use of augmented Reality in the instruction of analytical instrumentation design.

Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS*. Routledge.

Pérez-López, D., & Contero, M. (2013). Delivering educational multimedia contents through an augmented reality application: A case study on its impact on knowledge acquisition and retention. *Turkish Online Journal of Educational Technology-TOJET*, *12*(4), 19-28.

Salmi, H., Kaasinen, A., & Kallunki, V. (2012). Towards an open learning environment via augmented Reality (AR): Visualising the invisible in science centers and schools for teacher education. *Procedia-Social and Behavioral Sciences*, *45*, 284-295.

Solak, E., & Cakir, R. (2015). Exploring the Effect of Materials Designed with Augmented Reality on Language Learners' Vocabulary Learning. *Journal of Educators Online*, *12*(2), 50-72.

Steuer, J. (1992). Defining Virtual Reality: Dimensions determining telepresence. *Journal of Communication*, *42*(4), 73-93.

Tandoğan, B. (2019). *Investigating the effectiveness of ARCS-based instructional materials enhanced with augmented Reality on ESP vocabulary achievement and motivation* (Master's thesis, Middle East Technical University).

Tsai, C. C. (2020). The Effects of augmented reality to motivation and performance in EFL vocabulary learning. *International Journal of Instruction*, *13*(4), 987-1000.