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Research Paper

## Impact of Employing Augmented Reality Technology on Lowering Adult EFL Learners' Foreign Language Anxiety: A Mixed-methods Study

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### Abstract

This study intended to explore the effect of Augmented Reality (AR) on lowering foreign language anxiety (FLA) in adult Iranian EFL learners. To this end, a triangulation study including a quasi-experimental pre-test post-test design in the first phase, and an oral interview in the second phase was designed and implemented. Forty adult Iranian EFL learners took part in the quantitative study and were randomly assigned to experimental and control groups. The authors developed and delivered the AR-infused materials through Zappar application, an AR platform. The treatment involved the conventional language teaching method for the control and the AR-integrated one for the experimental group for 20 sessions. The anxiety level of learners in both groups was assessed before and after the treatment to check for any effects. Data on participants' FLA was gathered through Horwitz's (1986) Foreign Language Classroom Anxiety Survey (FLCAS) questionnaire and analyzed via ANCOVA in SPSS. Also, the participants in the experimental group were interviewed at the end of the experiment to provide feedback on their AR-integrated language learning experience. Results revealed that AR did not affect learners' foreign language anxiety levels. Also, some learners found it not very relaxing and easy to use. This could be attributed to the novelty of the experience and the cognitive load imposed on learners. The study's outcomes were in contrast to several previous research findings; however, since research in this area is still in its infancy, more research should be done on the impact of AR on language education.

**Keywords:** Augmented Reality, CALL, Educational Technology, Mobile Learning

### مطالعه ترکیبی بررسی تاثیر استفاده از فناوری واقعیت افزوده بر کاهش اضطراب زبان آموزان بزرگسال

این مطالعه با هدف بررسی تأثیر تکنولوژی واقعیت افزوده بر کاهش اضطراب زبان خارجی در زبان آموزان بزرگسال ایرانی انجام شده است. بدین منظور، یک مطالعه ترکیبی در دو مرحله، شامل طرح نیمه آزمایشی پیش از مون-پس از مون در مرحله اول و مصاحبه شفاهی در مرحله دوم طراحی و اجرا شد. ۴۰ نفر از زبان آموزان بزرگسال ایرانی در بخش کمی این مطالعه شرکت کرده و به طور تصادفی در دو گروه آزمایش و کنترل قرار گرفتند. مطالب افزوده شده توسط برنامه Zappar که یک پلتفرم واقعیت افزوده است تهیه و در اختیار دانش آموزان قرار گرفتند. آزمایشی که در این تحقیق انجام شد شامل استفاده از روش آموزش زبان سنتی برای گروه کنترل و روش تلفیقی با واقعیت افزوده برای گروه آزمایش به مدت ۲۰ جلسه بود. برای بررسی تأثیر بدست آمده، سطح اضطراب فراگیران در هر دو گروه قبل و بعد از آزمایش ارزیابی شد. داده‌های مربوط به اضطراب شرکت‌کنندگان از طریق پرسشنامه سنجش اضطراب کلاس زبان خارجی هورویتز (۱۹۸۶) جمع‌آوری شده و از طریق آنالیز کوواریانس مورد تجزیه و تحلیل قرار گرفت. همچنین، شرکت‌کنندگان در گروه آزمایشی در پایان آزمایش برای ارائه بازخورد در مورد تجربه یادگیری زبان با استفاده از واقعیت افزوده مصاحبه شدند. نتایج نشان داد که این تکنولوژی بر سطح اضطراب زبان خارجی زبان آموزان تأثیری ندارد. همچنین، برخی از زبان‌آموزان عنوان کردند که استفاده از آن چندان آرامش‌بخش و آسان نیست. این یافته را می‌توان به تازگی تجربه و بار شناختی تحمیل شده بر فراگیران نسبت داد. نتایج این مطالعه در تضاد با چندین یافته تحقیقات قبلی بود. با این حال، از آنجایی که تحقیقات در مورد کاربرد این فناوری در آموزش زبان هنوز در مراحل اولیه است، تحقیقات بیشتری باید در این زمینه انجام شود.

**کلمات کلیدی:** واقعیت افزوده، فراگیری زبان به کمک کامپیوتر، فناوری آموزشی، یادگیری توسط موبایل

## Introduction

Various technologies have been incorporated into the teaching and learning of English during the past years. 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 valuable instructional tool because it integrates digital objects and the actual educational environment (Liu et al., 2010). It can embed digital media content into the real world via a specific device's screen like a tablet or a mobile phone. AR could make the learning settings more dynamic, enjoyable, and collaborative than before (Lee, 2012). Moreover, it provides a richer learning experience for the learners, which results in improved educational outcomes (Liu et al. 2010). Researchers have also added that this technology adds enjoyment and fun to the learning environment, thus enhancing learner motivation (Lazoudis et al. 2013).

Besides, AR is beneficial to the teaching and learning process in different ways. One of the most significant benefits of this technology for education is stimulating various sensory modalities such as sight, touch, and hearing. Consequently, AR technology enables learners to engage actively in the process of learning (Pérez-López and Contero, 2013). Mahadzir and Phung (2013) found out that when learners are faced with the audio-visual learning content provided with the AR technology, they get motivated and learn better, especially young primary school students. Besides, Chen (2019) found that employing AR in learning math reduced learners' anxiety levels and boosted their motivation and performance.

Finally, as Godwin-Jones (2005) asserted, although technology brings exciting capacities to the language classroom, there is no consensus on how it affects learners' foreign language anxiety levels. The reason is that the topic is not attended to adequately by the researchers in the field. Therefore, this paper aims to study the effects of one recent technology, i.e., Augmented Reality, on foreign language anxiety (FLA).

## Literature Review

### Augmented Reality

To “augment something” denotes the increase in the amount of something, its value, size, and so on, of something (Oxford Advanced Learner's Dictionary, 2015). To “augment reality” is to “strengthen” or “extend” reality itself. Thus, Augmented Reality has been utilized to portray the innovation behind developing or strengthening the real world.

Augmented Reality is defined as “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). Some scholars defined AR as a technology that inserts virtual information such as audio, text, and 3D content in real-time (Cascales et al. 2013). Also, Malik (2002) asserted that AR integrates 2D and 3D computer graphics into the real environment. Others believed that Augmented Reality is a live view of the physical, real environment, either directly or indirectly, whose elements are accompanied by computer-generated sensory input like graphics, sound, data, and the like (Olalde and Guesalaga, 2013).

Augmented Reality is a variety of Virtual Reality (VR). VR submerges users in an artificial setting where they cannot see the reality around them. Conversely, AR permits the user to see the reality, with virtual objects superimposed upon or composited with this reality. AR complements reality rather than completely supplanting it (Azuma, 1997).

AR technology is an increasingly developing tool. It is evident from research that it proved successful and popular in any domain it served. Kipper and Rampolla (2013, p.8) mentioned that “it continues to develop over the decades and works its way into the modern technological landscape of today”. AR technology can be used in various areas. Examples include advertising,

navigation, tourism and sightseeing, education, entertainment and games, and medicine. “Several major companies have used augmented Reality for visualization, training, and other purposes” (Lee, 2012, p. 403).

Augmented Reality applications offer much more than images, audio, or videos overlaid in the real world. They propose various helpful applications. One application is that it creates novel potentials for education acknowledged by multiple educational researchers (Wu et al., 2013).

AR has affected the education sector dramatically. According to Lee (2012, p. 40), 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 Augmented Reality can help students learn better as it generates novel, thought-provoking opportunities (Koutromanos et al., 2015). AR applications offer limitless possibilities to the learning environment. Most learners today are used to using technology very quickly. Therefore, integrating these technologies into the instruction can engage learners in the teaching and learning process. As one type of such technology, Augmented Reality can create challenging, engaging, and interactive opportunities for teaching and learning.

In sum, the application of Augmented Reality 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 outstanding value of this technology. Research has also supported its use and proved beneficial in different fields, including education. There are many platforms and apps available to employ this technology. In the next section, the application used in this study, called Zappar, is introduced and elaborated on.

### **Foreign Language Anxiety**

Anxiety is defined as the feeling of fear which appears in a threatening situation (Lazarus, 1966). Although anxiety occurs as a cognitive-affective reaction to what might happen in certain circumstances, people differ in how a situation appears threatening to them (Leary, 1982). This varied response has been the focus of research in this field.

This different individual response to anxiety is divided into three main types: trait anxiety, state anxiety, and situation-specific anxiety. First, trait anxiety refers to an immediate response to a specific stimulus that provokes anxiety. In this type, anxiety is considered a passing psychological state. Second, state anxiety refers to an individual’s disposition. Third, situation-specific anxiety refers to a specific situation in which one feels anxious (Pekrun, 2000).

Regardless of the type of anxiety, it may occur to individuals when positioned in learning, specifically foreign language learning, situations. This is called foreign language anxiety (FLA). Various definitions have been proposed for this construct. It is a multifaceted concept that involves the learners’ psychology as relevant to their attitudes and feelings, self-worth, and self-confidence (Clément et al., 1980). Young (1992) defined it as a complex psychological occurrence unique to foreign language learning. More accurately, MacIntyre and Gardner (1994) described Foreign Language Anxiety as the feeling of strain and nervousness especially linked to second or foreign language settings, or the apprehension and negative emotional response provocation when learning or employing a foreign language.

It is worthy to note that most of these definitions developed from the claim made by Horwitz et al. (1986) that Foreign Language Anxiety is “a phenomenon related to but distinguishable from other specific anxieties” (p. 129). Horwitz et al. (1986) were the first scholars who hypothesized FLA as a unique type of anxiety specific to foreign language learning. Their FLA theoretical model has been critical in language learning anxiety research.

Horwitz et al. (1986) considered foreign language anxiety “responsible for students’ negative emotional reactions to language learning” (Horwitz, 2010, p. 114). These researchers devised a tool for their research to assess anxiety in the language classroom. They called it the Foreign Language Classroom Anxiety Scale (FLCAS), which aimed to evaluate this specific type of anxiety. A large number of researchers have used this scale since its development. Thus, their paper “Foreign language classroom anxiety”, has become the foundation for research on language classroom anxiety.

Many researchers have employed FLCAS since its development in various settings and learners. Spanish language learners did the original study in the first year of university. Other studies examined language anxiety and how it related to performance at different levels of teaching, i.e., beginner, intermediate, and advanced (Saito and Samimy, 1996), with students who revealed diverse levels of anxiety, i.e., low-anxious, average-anxious, and high-anxious students (Ganschow et al. 1994), and also in the exploration of the consistency of foreign language anxiety in students who were learning two languages at the same time (Rodriguez and Abreu, 2003).

### **Empirical Studies**

The effect of employing technology on language learning anxiety has been of interest to several researchers; however, there is a limited number of published works on this issue. For instance, Rahimi and Soleymani (2015) studied the effect of using mobile learning on anxiety in listening in EFL learners. Participants of their study were 50 intermediate-level EFL learners in Iran. They compared listening anxiety in learners who used mobile phones and desktop computers for listening activities. Results revealed that using mobile phones lowered the anxiety in learners compared to using desktop computers.

Web-based language learning as a more common mode of technology-integrated learning was also studied by some scholars regarding FLA. For instance, Bashori et al, (2020) conducted mixed-methods research with 167 vocational high school students to see if the web-based system reduced speaking anxiety. They also interviewed 11 students and 5 teachers about their experiences. Results of their study showed that students revealed a moderate-to-serious level of speaking anxiety. Also, interview results revealed that learners felt reduced levels of anxiety in the web-based setting compared to face-to-face communication. The authors suggested more studies to examine the actual enhancement of SLA over time.

Some researchers investigated the effects of VR on language anxiety and reported the positive impact of such technology on lowering learners’ anxiety (Gruber and Kaplan-Rakowski, 2022). For instance, Wehner et al. (2011) examined a virtual learning environment called Second Life on language learning anxiety. They concluded that learners who studied language in Second Life experienced lower levels of foreign language anxiety than those who followed the traditional curriculum. Also, Kruk (2016) reviewed foreign language anxiety while using Second Life. Data was collected through questionnaires and session logs. Results of the study showed that learners demonstrated a low level of FLA. Moreover, Melchor-Couto (2017) observed language learning anxiety among learners who took part in oral interaction through Second Life. The study concluded that the FLA levels decreased in learners using Second Life compared to those who did not.

Moreover, York et.al. (2021) examined the effects of employing three modes of Synchronous Computer-mediated Communication, i.e., voice, video, and VR, on FLA in 30 undergraduate Japanese university students in a factorial design. Results revealed that the three modes were successful in reducing learners’ FLA, however, no statistically significant differences were shown between mean scores. Results of the analysis of data gathered through the study revealed



that learners' affective features as well as their different dispositions to technology may be the underlying reason for their different opinions in this regard.

Another example of using technology in language learning is Robot-Assisted Language Learning (RALL). Alemi et al. (2015) investigated the effect of such technology on attitude and language anxiety levels in Iranian EFL learners. Participants were 46 female junior high school students divided into two groups. One group went through the RALL experience while the other learned the language by the conventional method only. Data was gathered through questionnaires. Results revealed that the students in the RALL group had lower levels of anxiety and more positive attitudes towards vocabulary acquisition. This was due to the fun nature of the experience, which helped the students learn more effectively and develop higher motivation levels.

In recent years, Augmented Reality technology has been incorporated into language learning, and various researchers have investigated its effect. For instance, as relevant to this study, Bacca (2014), in a systematic review study on the application of Augmented Reality in educational settings, demonstrated that learners who experienced AR-integrated learning had a positive mindset toward the experience and showed a high degree of academic achievement. In addition, they had a sense of satisfaction and a lower amount of anxiety while employing AR technology in the classroom. The study concluded that such effects could be attributed to shifting from a traditional classroom to a more modern and interactive learning environment.

Liu (2009) examined the effect of an English learning environment called Handheld English Language Learning Organization (HELLO) which was developed to facilitate listening and speaking among learners. The study participants were 7th-grade students who experienced educational games in this environment. The study revealed that students showed lower anxiety levels in practicing speaking when interacting with the software than a real human being. Also, it caused more satisfaction and enjoyment in students and helped them learn better.

Kucuk et al. (2014) examined language achievement, attitude, and cognitive load in English language learners while studying the language through Augmented Reality. The study participants were 122 5th graders in Turkey. Through causal-comparative and correlational analysis methods, results revealed that secondary students were satisfied and pleased with their AR-integrated learning experience, had low anxiety levels, and were willing to use such technology in their future language learning.

Silva et al. (2015) examined the effect of using ARBlocks as an AR tool developed to scaffold education in an experiment in an English language school for three months. They compared its application in kids in control and experimental groups. Results showed that students had less anxiety and higher enthusiasm, eagerness, and excitement to participate in AR-infused lessons.

Hsu (2017) conducted a study to compare two AR-based educational games for learning English. The study investigated learning effectiveness, cognitive load, language anxiety, and other variables in 38 elementary school students. Data was gathered through questionnaires in a pre-test and post-test design. Results demonstrated that in cases where learners experienced more anxiety, they had more learning efforts. Also, it was shown that a bit of anxiety and learning effort is helpful in learning. According to Hsu (2017), the self-directed learning approach implemented in AR-based educational games could cause learning anxiety, promoting effective education.

Finally, Bursali and Yilmaz (2019) attempted to investigate the effect of Augmented Reality on learning permanency, reading comprehension, and attitudes in language learners. Participants were 89 students in the 5th grade. The study followed mixed-methods, embedded design research. Students in the experimental group studied reading comprehension with the aid of AR technology. In contrast, those in the control group went through conventional learning without

using AR. Results demonstrated satisfaction and positive attitudes on the part of the learners. Also, they showed low anxiety levels and a desire to use similar applications in other courses.

Based on the above studies and the available literature in general, it should be acknowledged that technology brings up opportunities and capacities to the educational setting, enhancing the learning/teaching experience (Groff, 2013). Today, most language learning is still done through conventional paper books, while some integration of computers or media is being 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 potentials in the design and implementation of language learning courses to be able to maximize the learning outcome.

The problem addressed in this study was to investigate the efficiency of integrating AR in Iranian EFL learners' foreign language anxiety. The AR experience investigated in this study was maintained through personal mobile devices, hence providing a systematized sub-study of Mobile Assisted Language Learning (MALL). This study attempted to bridge the gap between conventional modes of language learning and the most recent MALL technology being introduced in the field, i.e., Augmented Reality (AR). It reconciles theory and practice based on the relevant literature and the authors' experience. The study offered a feasibly applicable AR-enhanced language learning system that aligns with the facilities most language learners have at hand today and could maximize learning by exploiting AR's instructional potential. To the authors' best knowledge, no previous research has been done on the issue of adult EFL learners outside formal academic settings in Iran.

The study was significant because it examined how learners interacted with AR as a relatively recent form of educational technology to see if it can be successfully implemented in language education in Iran. Also, unlike most previous studies, the current research dealt with the mentioned issue through mixed methods to obtain more reliable results. The results of this study are beneficial to language learners who would integrate some self-study into their language learning. Also, language institutes and other educational organizations can employ findings that provide some language teaching in their system. Moreover, language teachers and materials developers can use the results of this study to enhance their role in their profession.

Consequently, to fill the gap in the literature, this investigation was guided by the following research question:

*Does Augmented Reality affect foreign language anxiety levels of adult Iranian EFL learners?  
How do learners reflect on the AR-infused language learning experience concerning FLA?*

### **Method**

This mixed-methods study followed a quasi-experimental pre-test post-test design at the first stage and an oral interview at the second stage. Data was collected through questionnaires and oral interviews elaborated on in the following sections. For this purpose, an AR-enhanced treatment was employed to examine the effect of Augmented Reality on language learning anxiety through which the experimental group experienced the application of AR technology in their language learning.

### **Participants**

The present investigation's population includes adult EFL learners. Participants were 40 male and female adult beginner-level EFL learners enrolled in a general English course in a language institute in Shiraz, Iran. In total, 50% of participants were males (n=20), and 50% were females

(n=20), and their ages ranged from 20 to 40 years. Learners in the experimental group (n=20) also participated in the interview study.

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 researcher had no interference in the process. Choosing this number of students was to eliminate the instructor effect. The researcher needed both classes to be taught by the same teacher. So, 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 researcher randomly selected one class as the control and the other as the experimental group to participate in the study.

### **Materials and Instruments**

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

#### **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. Students had to cover units 9-16 of the book during the 20-session course defined by the institute. Also, the control group used an AR-integrated version of the same book, which the author has developed for the specific purpose of this study. The AR-enhanced book is elaborated on in more detail below.

The Interchange coursebook was selected as the instructional material in this investigation because, first, the study focused on adult learners, and the book suitably serves adults. Second, this coursebook is relatively well-known in Iran. Most language learners and teachers have experienced using it before, thus creating a more familiar learning environment for both the teacher and the learners.

#### **Assessment Materials**

Two types of assessment materials were used in this research. First, to get more accurate results, the level of English of the participants at the time of the treatment was controlled so as not to interfere with the variables under investigation. This was done through their scores on the previous level's achievement test. Second, to assess language learning anxiety, Horwitz's (1986) Foreign Language Classroom Anxiety Scale (FLCAS) was used both at the beginning and after completing the course. It consists of 14 items that assess language learners' level of learning anxiety.

The questionnaire underwent relevant reliability and validity checks. Also, it was pilot tested before actual administration. It was offered to the participants in their mother tongue, i.e., the Farsi language. The purpose for this was that participants in this study were not advanced-level English speakers, so the researcher could not ensure the precision of the results when facing the students with the data collection tool in English. So, it was administered in the participants' mother tongue. Indeed, the translated version of the instrument was validated before administration.

Besides, in the qualitative section of the study, a structured interview was done with participants in the experimental group for them to be able to reflect on their learning experiences. Interview questions were proposed by the researcher based on experience and the relevant literature and validated by five scholars in the field to ensure validity. The questions aimed at eliciting responses from participants to get more detailed insight into the nature of the AR experience in relation to the foreign language anxiety in the learners.

## Augmented Reality Application and Tool

This study implemented and accessed augmented reality technology and features through the Zappar application, which works online. It 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 simultaneously, thus providing a rich 3D experience to the user. (<https://www.zappar.com>)

Zappar can be a delivery channel through which one can turn anything like printed materials or physical object products into interactive content, creating exciting videos, animation, games, and so on. This AR app, like others, adds a new visual dimension to what is typically seen through a mobile device's camera, making novel and engaging real-world experiences. This app is free for both iOS and Android systems. One can scan the available AR codes through the app, but they need to make a subscription to make the codes and employ AR for their purpose.

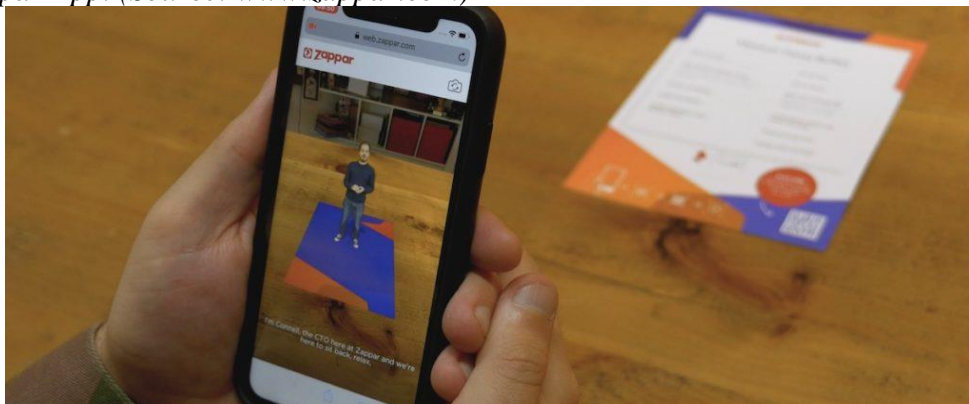
Zappar provides its own ZapWorks content authoring tool to create AR content, offering different modules for users with various proficiency in creating digital content. One can create the content themselves or get help from Zappar professionals. After creating the content, the platform will assign a specific trigger to it called a 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 code that should be triggered, or scanned, by the camera is called the Zapcode. It is like a QR code that allows revealing multimedia content. It shows the user where the AR content is available. It consists of two parts, i.e., bolt and bits. The "bolt" is the Zapcode surrounded by "bits", a specific arrangement of bars. These marks tell the app which digital, pre-made content it should download and show to the user. When created, Zapcodes are only online or accessible, depending on the subscription one has made. There are limitations to the period when it is accessible and the number of times it can be scanned. (<https://www.zappar.com>)

As a user, first, one has to download the app. A new feature provided by this platform is the Web application which allows users to access the features without downloading the app and only referring to the website. This enables ease of access to many more users. Then, one has to scan the Zapcode he has found using their mobile phone camera. The app tries to find the code, scans its different layers, and shows the multimedia content hidden behind the trigger after only a few seconds. The user sees the physical world around them on their mobile screen, augmented by some virtual multimedia content. Users can use the AR feature as long as they hold their device camera about the mark. The AR feature would disappear by moving the device, allowing the learner to access reality alone. This experience is shown in Figure 1 below.

### Figure 1

*Using Zappar App. (Source: [www.zappar.com](http://www.zappar.com))*





As Figure 1 shows, there is a piece of paper on a table in the real physical environment. There is a Zapcode printed on it at the bottom right corner. The user triggered that code and used his mobile phone camera to scan it. Then, a link appears on the phone through which the user is led to the Zappar website. This way, users can access the AR features without downloading the app. The digital figure of a human standing on a blue platform appeared on the mobile screen. This is the digital content behind this code. The content is probably accompanied by audio and other media formats and is interactive, i.e., the user can interact with it to explore additional features.

Zappar has been used for many different purposes. Among its significant applications defined on its website, one can name retail, packaging, events, and education. It can bring to life whatever was previously regarded as 2D and add an engaging, collaborative, and interactive dimension. It provides a creative and exciting platform to benefit from the potential of both the real and the virtual worlds and present ideas and information more accessible and comprehensible to the users.

The authors developed the AR-infused version of the Interchange paper book for this study, which the control group used. To this end, first, they decided what information could be added to each section of the unit in the paper book to be immediately accessible to students while studying. They decided, for instance, that the grammar section should include a few immediate interactive exercises, and the pronunciation section should be complemented with the audio playing of the sentences or words of focus. The reading section should offer new vocabulary definitions and synonyms, and so on.

Then, they collected the information needed to be turned into the AR materials from the accompanying books, CDs, and online materials. The reason for choosing the extra information only from what was available in the series was that the researcher wanted both control and experimental group classes to be offered the same amount of data in the classroom, not to make a difference in the results.

The collected data was then turned into AR multimedia, and 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 by the researcher, and used where applicable.

The researcher then downloaded and copied the Zapcodes on sticky papers. Before beginning the course, the researcher put the sticky Zapcodes in the relevant places at a corner on top of each section. The researcher decided to use a minimal number of Zapcodes to avoid 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*

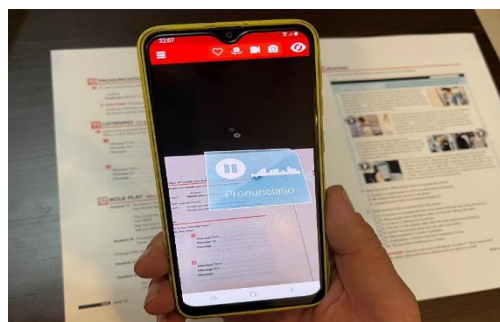
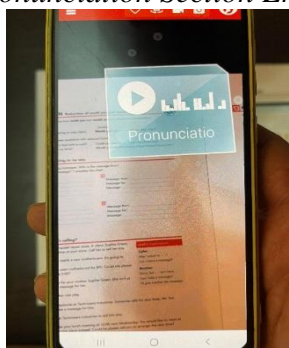
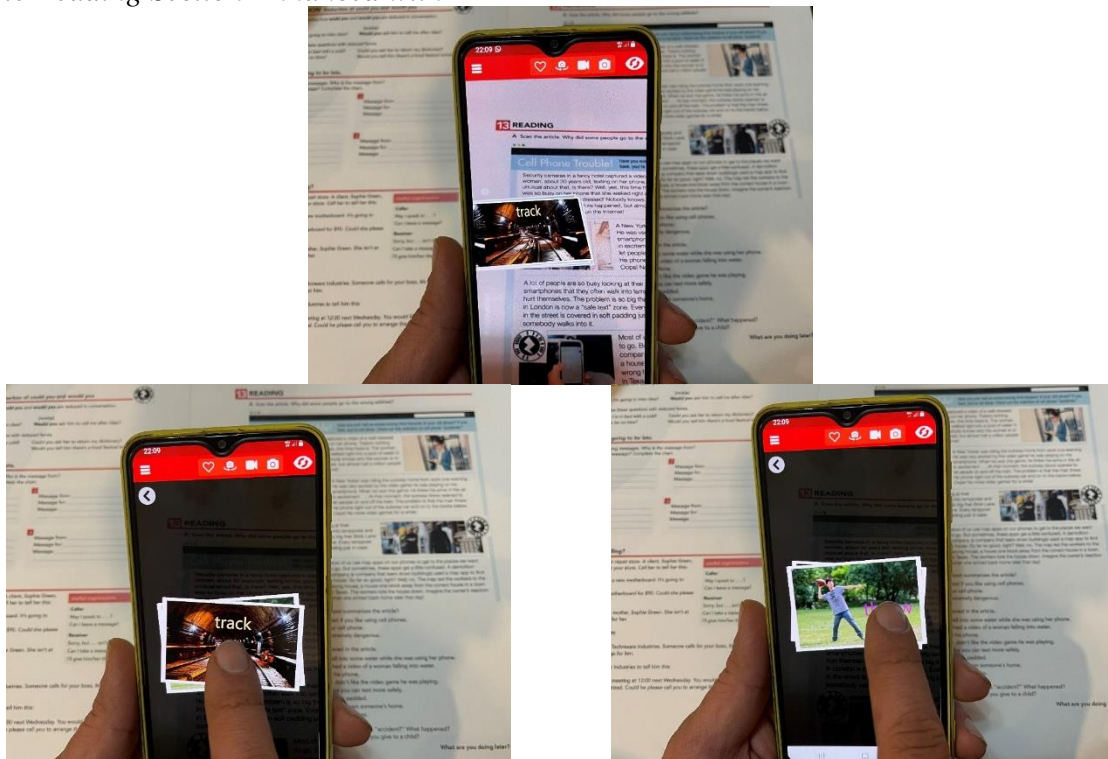


Figure 2 shows the time when a learner scanned the AR content in the pronunciation section of a unit (Unit 15). The only difference between the conventional coursebook and the AR-enhanced one is that several Zapcodes are attached to it. The mark can be seen in the corner of each exercise where applicable.

When the student scans the code, a virtual audio playing widget is shown on the mobile screen. The learners can see the real environment on their mobile screen, and the virtual augmented content. The virtual content is interactive, which means that 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*



Also, Figure 3 shows the time when the learner was trying 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 to describe its meaning. As the content was interactive, the learner could explore the pictures, 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.

Twenty books were prepared, in this fashion, to be used by the participants and one to be used 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 researcher 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.

### **Procedure**

The current study employed quantitative data collection and analysis techniques. After the participants were at hand through intact sampling in two classes, the researcher 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 researcher collected participants' previous-level exit exam scores to control their level of English at the time of the treatment. Then, the books for the experimental group were prepared as explained above and submitted to the institute to be distributed among students. Also, the researcher equipped the experimental classroom with high-speed WiFi Internet for participants to use during class times.

Next, the teacher responsible for teaching both groups was informed of the teaching approach she had to follow 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 had to start 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 connection and download the Zappar application. She ensured all students could use the Zappar app properly with no issues.

Also, in the first session, participants in both groups were asked to fill out Horwitz's (1986) Foreign Language Classroom Anxiety Scale (FLCAS) questionnaire, while those in the control group were asked to fill out the first two questionnaires only.

Both groups then underwent the 20-session course. After completing the course, learners were post-tested in the final session. The post-test consisted of a re-administration of the FLCAS in both groups. Besides, experimental group participants were interviewed individually to reflect on their AR learning experience. After the data collection phase, the obtained data were analyzed through proper quantitative data analysis techniques, discussed next.

### **Data Analysis**

Analysis of covariance with SPSS was used to analyze the quantitative data obtained through the study. To observe the effect of the AR on the learners' anxiety, the researcher analyzed the results of the data gathered through questionnaires at the two administrations using ANCOVA. Learners' scores on the previous level's achievement test were considered a covariate and controlled in the analysis.

Based on SPSS Survival Manual (Pallant, 2007), ANCOVA is used when there is a pre-test post-test design, e.g., comparing the impact of two different interventions, taking before and after measures for each group. The pre-test scores are considered a covariate to control pre-existing differences between the groups. This feature makes ANCOVA very useful in situations with relatively small sample sizes or medium effect sizes.

For questionnaire validation, a panel of five experts who held doctorate degrees in TEFL were selected and invited to participate in this study. They were contacted via email, phone, and face-to-face meetings by the researcher when required. The reason for pilot-testing and consulting the panel of experts was to check the tool's reliability and validity initially before the beginning of the study.

Foreign Language Classroom Anxiety Scale (FLCAS) was adopted from Horwitz's (1986). It was translated to Farsi by the researcher and validated by the panel of experts. It was confirmed

for face and content validity. Also, before applying the tool for data collection, it was pilot tested to check its reliability. Using Cronbach's alpha formula, the reliability of the instrument was measured. Also, the reliability of tools was assessed a second time after administering them to the study's participants. Table 4.5 reports the reliability of FLCAS in the pilot and actual study.

**Table 1***Reliability of FLCAS*

Questionnaire	Cronbach's Alpha in Pilot Test	Cronbach's Alpha in the actual administration
FLCAS	0.82	0.84

As shown in Table 4.5, the tool's reliability was 0.82 in the pilot study and 0.84 in the data collection phase. So, the instrument proved to be a reliable source of data collection for this study.

Finally, data gathered through oral interviews with learners in the experimental group were analyzed via thematic analysis to specify the recurring themes in learners' experience in applying AR in language learning. Results of data analyses are presented in the following section.

## Results and Discussion

### Quantitative Analysis Results

Analysis of covariance (ANCOVA) was used to respond to the quantitative research question. To begin with, before applying ANCOVA, a normality test was done to ensure it was the proper analysis method for the data at hand. The normality assumption was assessed using Kolmogorov-Smirnov (K-S) test. Table 4.13 presents the result of the normality test (Kolmogorov-Smirnoff).

**Table 2***Kolmogorow-Smirnov Test of Normality*

Variable	Statistic	Sig.
Achievement Post-test	0.182	0.06
Anxiety Post-test	0.197	0.27
Attitude and Motivation Post-test	0.171	0.09

As can be deduced from the findings in Table 4.13, the significance level obtained in the test (K-S) was more than the criterion value of 0.05. So, 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.

Next, Levene's Test of Equality of Error Variances was used to test the homogeneity of the regression coefficients. Results showed that homogeneity was established ( $F = 6.16$ ,  $\text{Sig.} = 0.18$ ), and this assumption is met to run ANCOVA. Table 4.14 summarizes the mean scores of both groups' pre-tests and post-tests derived from the FLCAS questionnaire. As Table 4.16 shows, the experimental group had a higher mean score after the experiment (mean = 3.17) than the control group (mean = 2.87).

**Table 3***Anxiety Descriptive Statistics*

Group	Mean	SD	N
Control	2.87	0.44	20
Experimental	3.17	0.52	20
Total	3.02	0.50	40



To test whether this difference was statistically significant, a one-way between-groups analysis of covariance (ANCOVA) was conducted. Participants' scores on the pre-test were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. The result is shown in Table 4.17.

**Table 4**  
Anxiety ANCOVA Results

Source	Sum Squares	Of df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected model	1.329	2	.665	2.854	0.070	<b>0.134</b>	
intercept	8.28	1	8.283	35.568	0.000	<b>0.490</b>	
Pre-test	.408	1	.408	1.750	0.004	<b>0.045</b>	
group	.399	1	.399	1.714	0.199	<b>0.044</b>	
error	8.617	37	.233				
total	376.403	40					
Correct total	9.946	39					

As Table 4.17 shows, after adjusting for pre-intervention scores, there was a significant difference between the two intervention groups on post-intervention scores on learning anxiety, i.e., FLCAS test,  $F = 1.714$ ,  $p = 0.199$ , partial eta squared = 0.044. There was no significant difference between the pre-test and post-test scores. This indicated that the Augmented Reality experience did not affect reducing the learning anxiety level of students.

### Interview Results

In the interview, students were asked to reflect on their experience focusing on language learning anxiety. Most students claimed to have had a novel and positive experience, while some had faced difficulties during the course. More specifically, learners reported that the AR learning environment was “less formal,” thus “reducing stress and apprehension in learners,” as one participant (Amin) claimed. Also, using this technology, “learning was, in part, similar to a game for students,” as mentioned by some other participants, and made them feel relaxed (like Mohammad and Bob).

However, about half of the participants believed that the learning experience could be affected by the “type”, “availability”, or “quality” of the facilities. For example, one participant (Farshid) claimed that “if my mobile phone had a larger screen, I could have a better experience to read the written content.” “Although this could be resolved to an extent by moving the device back and forth,” as he reported, “it took time for me to discover such a feature and made me a bit disappointed at the beginning.”

Also, as stated by another participant (Hedy): “older mobile devices with lower functioning speed might make the experience a bit time-consuming and made me stressed.” Besides, as mentioned by another participant (Ray) “internet access in general” and “low internet speed” can be considered as other limitations in AR-enhanced language learning.

Finally, the lack of interest in technology is a challenging factor in employing AR in language learning. In this regard, three students (Mojgan, Max, and Saeed) asserted that they could not prefer the AR experience because they “did not like” or “feel comfortable with technology” in general. One of them (Mojgan) felt “somehow indifferent” to it and thought “it was not crucial to be used in the classroom.” Also, as Saeed stated, “it could be a sort of game or fun experience in the class, but that learning could still occur without implementing it.” In this sense, using such a technology in the language classroom was thought of as “unnecessary,” as mentioned by Max.



## Discussion

The current study aimed at examining the impact of using AR as a recent type of educational technology in language learning. It reported on developing and employing AR-infused course materials to compare their efficacy with the conventional language teaching methods. More specifically, it investigated the effect of AR on reducing foreign language anxiety in adult Iranian EFL learners. Results revealed that AR did not reduce the FLA in adult EFL learners. However, the interview results revealed that most learners enjoyed the AR learning experience while some faced challenges.

The obtained quantitative outcomes are in contrast to most available literature in that they did not affect reducing participants' FLA. According to Rahimi and Soleymani (2015), Wehner et al. (2011), Kruk (2016), Melchor-Couto (2017), Bashori, et al. (2020), and York et al. (2021) employing technology in the form of mobile learning, Virtual Reality (VR), and Robot-Assisted Language Learning, web-based learning, and CMC lowered anxiety levels in language learners. Such an effect was not obtained in the current study. The reason might be that first, AR is a new technology; learners in Iran have hardly employed it in education and for purposes other than fun like the entertainment applications such as Snapchat and games like Pokemon Go. Such a novelty of the experience is possible not to cause a relaxing and non-threatening learning environment for the learners.

Next, in the case of using mobile phones, VR, and robots in learning, students interact with a machine, not a real human being, which according to Kruk (2016), lowers their inhibitions and anxiety, whereas, in the case of AR-integrated learning, most of the interaction is happening in the real world, with some elements of virtuality added. Of course, this should be further investigated in the research. In case of confirmation, AR-infused activities should be designed to maximize non-human interaction.

Another important point to consider in this regard is that previous studies, such as those of Liu (2009), Kucuk et al. (2014), Silva et al. (2015), Hsu (2017), and Bursali and Yilmaz (2019), focused on participants of relatively lower age groups, for instance, kids or high school students and none considered examining FLA in adult learners which was the focus on this study. Accordingly, one can assume that age, or at least age groups, is a differentiating factor in the nature of the effect foreign language learners get from technology in learning. AR might cause a less threatening environment for young learners compared to adults. Adults sometimes do not find themselves proficient in using technology or even not interested. This might cause more cognitive load and inhibition in their minds while learning a foreign language. Subsequently, this calls for more research on the effect of AR, and other recent educational technology advancements, on language learners of different age groups.

Also, it is worth noting that the interview results confirm that AR indeed reduced participants' FLA levels which is itself in contradiction to the quantitative results. According to participants' expressions, it created a more relaxing learning setting and the game-like nature of the experience was fun for them. This contradiction can be justified by considering the probable cognitive load that using technology imposes on some learners and not others. Again, this contradiction confirms that to achieve a clearer understanding of the way AR affects FLA in participants, more research should be done, especially with the consideration of affective and demographic differences.

## Conclusion and Implications

The study has implications for language researchers, policymakers, and instructors. Researchers are suggested to perform more investigations to add to the bulk of knowledge on the new topic of employing AR in language education. Language policymakers and curriculum

developers should encourage more technology in language learning, mainly in Iran, to familiarize learners and teachers with its potential. Finally, language instructors should update their knowledge on the most recent technologies used in language learning in the world to benefit from their capacities in their teaching.

This study had some limitations. First, the number of participants could be more to allow for more comprehensive data. Second, the study could be designed in a mixed-methods research format to get more insights into the nature of the effect of AR on language learners and monitor their inhibitions and anxiety in the course of learning. Researcher observation, think-aloud protocol, or oral interviews with the participants could provide more data to elaborate on the quantitative results obtained in the study.

Finally, further research can explore the effect of using AR on different age language learners. Also, it is suggested that other affective and demographic factors be considered, which might interact with how AR impacts FLA.

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