Impacts of augmented reality on foreign language teaching: a case study of Persian language

Sonia Mozaffari · Hamid Reza Hamidi

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Abstract

The use of information technology in the field of foreign language teaching as an auxiliary tool is very important. In a foreign language classroom, place is just an abstract concept; where the language is separated from the community, culture and places in which it is used. Augmented reality is a technology in which virtual components are simultaneously combined with the real environment. Our aim in this study is to investigate the effects of location-based augmented reality in teaching Persian as a foreign language. In this study, after consulting with professors in the field of Persian language teaching and reviewing similar researches, we came to the conclusion that nothing has been done to teach Persian language using augmented reality. Therefore, a Persian game based on augmented reality was designed and implemented and then evaluated. For evaluation, two methods have been used; the user and the heuristic evaluation. Experts in the field of Persian language teaching, human-computer interaction and a number of language learners participated in the evaluation. Their feedback shows that the use of augmented reality increases satisfaction, enthusiasm and interaction with the environment and people, and also makes the process of learning and memorizing concepts more efficient.

Keywords Augmented reality · Language Teaching · Foreign Language · Persian
1 Introduction

Augmented reality allows the user to have a combination of real and virtual environment. In fact, virtual objects are combined with the real environment and presented simultaneously [3]. Each augmented reality system has three characteristics [3]: (1) it combines real and virtual environments, (2) it interacts with real-world environments, and (3) it displays content in three dimensions.

Augmented reality is used in two ways: Vision-based or Location-aware. Vision-based augmented reality is divided into two categories. The first category is marker-based: the content is registered as a two-dimensional marker or label. The label, which contains the information is then displayed in 3D by a camera. These labels can be on the wall, or in a book, or on objects. The second category is without markers: that any part of the real environment can be used to activate virtual components [16]. In location-aware augmented reality, the sensors on the mobile devices (tablet or mobile phone) are used. Virtual content is placed in a specific location which can be tracked and identified by the camera and when the device reaches to the desired location, the needed information is displayed [2, 11].

Almost all augmented reality projects aim at training, even if it is not very clear [10, 30]. Research has shown that augmented reality can be an attractive way to improve teaching methods such as writing quality, math skills and foreign language learning [10]. This technology can strengthen and develop skills in students. For example, it allows people to interact more with the environment, have the ability to think creatively and solve problems [26, 30].

In teaching and learning a foreign language, the environment is very important and can have a great impact on the learning process. When a learner is in the environment of using a language, he receives words, phrases and sentences in accordance with that environment and interacts with them, the learning process becomes faster and their retention in the mind increases [13, 26]. Therefore, learning should be done in an environment related to educational content because it is a social process through which new people learn to be a member of an active community by participating in daily activities [7].

In this study, an attempt was made to evaluate the effect of using augmented reality for teaching Persian language to foreign learners. We first provide an overview of similar research in the field of augmented reality-based foreign language teaching. Then we introduce an augmented reality game designed and produced for this research and then evaluate it.

2 Applying augmented reality in foreign language teaching

We could not find any research on the use of augmented reality in Persian language teaching. However much research has been done on teaching other languages [14, 20]. Most of the research (77%) focused on English and Chinese, and about 40% was conducted within the educational institutions. The majority of these studies fall under the category of skills training (60.4%) as they aim at cultivating specific language skills. Vocabulary represents the most investigated topic area (23.9%), followed by reading, speaking, writing, listening and cultural learning [14, 20].

The following is an overview of some of these studies depending on the type of augmented reality used.
2.1 Using vision-based augmented reality

Ammar et al. used augmented reality for teaching English to children and tried to evaluate the effectiveness of this method [2]. This practical research was conducted in a kindergarten in Kuwait in which 42 randomly selected children were used. People were divided into two groups, one using the traditional method and the other using augmented reality. Then they examined the effectiveness of augmented reality to present scientific content and to provide student interaction, as well as the extent to learn the English alphabet. They further concluded that the group in which augmented reality was used had a much higher level of interaction and learning of English letters and words than the other group [2].

Santos et al. used marker-based augmented reality to teach German and Filipino words [24]. In this study, two methods of learning with and without augmented reality were compared. To test Filipino learning, they used 31 participants, including 26 men and 5 women between the ages of 23 and 42. Also, 14 participants were used to teach German, 8 of whom were male and 6 were female in the age group of 16 to 20 years. This experiment was performed within 5 days. After the learning process, participants answered the questions in the form of a questionnaire. They concluded that the use of augmented reality can have consequences such as differences in learning experience, improved attention and increased satisfaction [24].

Bojorquez et al. developed Loteria application for teaching Mayo (Malaysia) based on images and sounds that used augmented reality and cards with different images. This program was used in the environment of a university by a number of undergraduate students and was tested in terms of ease of use, usefulness and willingness to use it, which had good results [5].

Liu et al. have developed a game called HELLO¹ to teach English to Taiwanese students. To evaluate the effectiveness and user-friendliness of the game, a questionnaire was given to 20 students who played the game. As a result, most students believed that HELLO was very effective in learning the language and that it was easy to work, and also increased their desire to learn, so that most of them wanted to use HELLO in non-university hours as well. They believed that this game strengthens their reading, listening and speaking skills, however has no effect on their writing skills [18].

Hadid et al. have used augmented reality to teach English in the classroom. This software is called ReaderBuddy, which is derived from QR code. These codes are placed on different pages of the book and when the student points his mobile phone towards it, a picture, a pronunciation and a video about that word are displayed. This software is mostly designed for scientific books [12].

2.2 Using location-aware augmented reality

Mentira is a location-based mobile augmented reality game designed to develop Spanish language skills. This is a murder mystery game that consists of current and unique story events. The player seeks to solve the puzzle in a real environment and through interaction with the game characters. The main structure of the game is the conversations between the player and the characters related to the murder and its solution. The results of game evaluation show the satisfaction of students to interact with the environment and to increase their enthusiasm [13].

¹ HELLO (the Handheld English Language Learning Organization).
Pokémon GO is a game that was introduced in 2016 and is used to teach English [1, 12]. This game made people more active and focused on the environment and reduced their anxiety [30].

Wilson and Brick used TaleBlazer to teach Italian on campus. In this game, students try to solve a mysterious time travel problem. This game tries to teach all 4 skills of listening, reading, writing and speaking at the same time [6].

Perry designed Explorez application for teaching French to first-year students at the University of Victoria in France. Using the Geographic Information System (GPS), Explorez transforms the University of Victoria into a French virtual world where students interact with characters, elements and media to improve their French language skills and discover their university. This application allows students to improve their language skills in both writing and speaking form. This program consists of three levels with at least 3 questions in each level. Missions include challenges such as taking pictures of identified objects, collecting virtual objects and exploring locations on a map. Players found the game instructive, fun and useful [4].

The scientific reports of the projects examined in this section generally focused on one or more language skills and the manner in which product performance was assessed. These reports do not address, or describe very briefly, issues such as UX design and gamification elements.

The researches have shown that the augmented reality could increase the motivation, satisfaction, attention, participation and enjoyment of learners. It can help students visualize cultural content and enhance interpersonal communication between teacher and students. It has also been able to increase students’ ability to interact with others, communicate and negotiate to solve problems [20].

After reviewing different researches, we concluded that no research has been done in Persian language. In the field of Persian language teaching for foreign learners, one of the main problems is the distance between educational materials and the real environment [23].

3 Parsishoo game

In this research, a computer game that can be run on mobile computers (Android) called Parsishoo was designed. The main goal is to increase students’ enthusiasm and interaction with the environment.

To implement Parsishoo, we used location-based augmented reality software development tools. ARCore tools and Unity game engine were used. We used the MapBox software package to pick up virtual content in locations with specific latitudes and longitudes, and we used the Android SDK to generate suitable output for phones running the Android operating system.

3.1 Game scenario

We designed and implemented the scenario of Parsishoo game with the help of Persian language teachers. The interactive game environment is the campus of Imam Khomeini International University where the students of Persian Language Training Center need to interact with people in the campus during the language training course. In this scenario, we considered all the skills; reading, speaking, listening and writing. We focused to engage interacting with the environment and the people in it.

Parsishoo game consists of twelve stages that we have tried to deal with the crowded places that students deal with during their studies. One of these places (the main entrance of the university) is shown in Fig. 1. At this stage, learners have to answer the questions posed and write the answer in the appropriate place. This stage is designed to learn and practice the words writing.
The game is played step by step and to find the next stage, guides are designed inside the game. This guide either clearly displays the next location in text (for reading practice) or is asked as a question so that the learner can discover the next step based on the information or by referring to people in the environment. The tips in the game or talking to people are designed to practice reading and understanding the text and then practicing speaking and interacting with people. An example of the tips is shown in Figs. 2 and 3.

At each stage, the learner becomes familiar with the commonly used verbs as well as with pronunciation and dictation, which are designed to practice listening and better memorizing words. Also, in some stages, verbs are introduced in the form of a sentence or a phrase that is written or recorded. For example, in a café location, learners become familiar with the picture, pronunciation, and dictation of each word. Some of conversations are also played so that learners become familiar with how to pronounce words in a conversational way and practice listening skills. This game tries to get acquainted the learner with some cultures and attractions of Iran, one of which is the mosque.
3.2 Involved language skills

Table 1 shows the twelve stages of Parsishoo in terms of the language skills involved. The teachers of the Persian Language Training Center of Imam Khomeini International University supported and supervised the selection of the subject and the goal setting of the skills in each
Vocabulary: Strong performance of vocabulary learning will help develop language skills, including listening, speaking, reading, and writing [21]. Some of vocabularies that are rarely used in the language center educational references or has never been mentioned are used in some stages of the game.

Speaking: It changes, develops, and organizes thoughts. It is also one of the most difficult skills that foreigners face because they speak their mother tongue in everyday conversation and it is difficult for them to speak a language other than their mother tongue. In general, the process of transferring knowledge and how to express opinions, thoughts and desires in a suitable pattern that other people understand, is called speaking [25].

Writing: Because writing skills are one of the methods of assessing language learners in academia, it is very important. If learners have difficulty with this skill, their success is at risk. Due to the active and productive nature of writing, this skill is also very challenging for language learners [15, 22].

Reading: The language learners must first be able to read their specialized texts in order to understand them. According to some experts, reading consists of two stages [23]: identifying letters and words and then discovering the meaning of the word and sentence.

Listening: Many vital uses of language, such as words, grammar, pronunciation, and pitch, are reviewed when listening. When listening to other people, the brain breaks down the information it receives and stores it in short-term memory. This skill not only improves comprehension of concepts, but also greatly enhances the skill of speaking [31].

Cultural learning: In some stages, the learner becomes acquainted with a building or a cultural habit. Familiarity with cultural habits allows the learner to better communicate with the environment [23].

Time: For each step, the learner must search for a place and after finding it, perform the desired activity. The average time (in minutes) from the search of a stage to the end of that stage is measured by the game.

Table 1 Learning skills involved in Parsishoo stages

| Stage | Vocabulary | Reading | Speaking | Listening | Writing | Culture | Time (min) |
|-------|------------|---------|----------|-----------|---------|---------|------------|
| 1     | ✓          | ✓       | ✓        | ✓         | ✓       | ✓       | 2          |
| 2     | —          | ✓       | —        | ✓         | —       | —       | 4          |
| 3     | ✓          | ✓       | ✓        | ✓         | —       | ✓       | 5          |
| 4     | ✓          | ✓       | ✓        | —         | —       | ✓       | 3          |
| 5     | ✓          | ✓       | —        | ✓         | ✓       | —       | 4          |
| 6     | —          | ✓       | ✓        | ✓         | —       | ✓       | 3          |
| 7     | ✓          | ✓       | —        | —         | ✓       | ✓       | 4          |
| 8     | ✓          | ✓       | ✓        | ✓         | ✓       | —       | 5          |
| 9     | —          | ✓       | ✓        | ✓         | —       | ✓       | 4          |
| 10    | ✓          | ✓       | ✓        | —         | ✓       | —       | 4          |
| 11    | ✓          | ✓       | ✓        | ✓         | —       | ✓       | 3          |
| 12    | —          | ✓       | ✓        | ✓         | —       | —       | 4          |
| Sum   |            |         |          |           |         |         | 45         |
3.3 UX design

User eXperience (UX) design is often associated with User Interface (UI), and involves the construction of elements like navigation, ergonomics, usability and user flow in a given interface [9]. The user flow mapping out each and every step the user takes, from entry point right through a set of steps towards the close action. This research focuses on stimulating language learners to be present and moving in the environment and talking with other people. Therefore, the game plan was prepared with the participation of language teachers in 12 stages. Each stage engage users to interact with environment. Figure 4 shows the user flow in Parsishoo. After entering the game, the user’s profile page is displayed and then the user can enter the game stages based on the default game path or based on the user’s GPS location.

3.4 Gamification elements

Parsishoo has been designed as an educational aid tool to accompany the Persian language training courses. In this section, we will deal with the gamification elements used in this game. The gamification elements used in educational environments are classified using five dimen-
sions [27]. In the following, while expressing these dimensions, we will also deal with the methods used in Parsishoo:

- **Performance**: This dimension must always be present so the user may have feedback on their actions. In this dimension, Parsishoo used “Solver” badges as Acknowledgement; a “step” as Progression; a “score” as Point and a “dashboard” as Stats.
- **Ecological**: It is acts as properties of the environment that can be implemented in a subtle way to engage the users to follow the desired behavior. We used a “path selection” as Imposed Choice.
- **Social**: This dimension is related to the interactions between people presented in the environment. We used “conversation missions” as Social Pressure.
- **Personal**: It presents elements that are intrinsic to educational environments and the learner. We used “quizzes or challenges” as Puzzle; a “renewal” as Renovation; “visual and sound stimulation” as Sensation.
- **Fictional**: This dimension is related to the user and the environment, tying their experience with the context. The lack of fictional elements directly influence the quality of the user experience. We used “text, voice, or sensorial resources” as Storytelling.

### 4 Evaluation

To evaluate the impact of a designed game on language learning, we usually need to use language learners’ assessments (a user evaluation). A minimum of 15 language learners is required for assessment [29]. Because of COVID-19 and all of its restrictions, in addition we tried to use another method to evaluate the results that could be more effective, practical, and reliable. First, we did a user study, which benefited from a small number of language learners. The small number of users means that the evaluation is not accurate enough. The second study is based on heuristic evaluation, which allows for more sampling.

#### 4.1 User evaluation

In the user evaluation, a small number of language learners were asked to use the program in the campus of Imam Khomeini International University and then evaluate the program based on the comments and questions raised in the questionnaire. For this purpose, a limited number of 11 non-Iranian language learners were used, whose knowledge of Persian language was at an intermediate level. At first, they were fully explained how to play the game, and then each of them played the game separately according to the steps provided in the game. During each user’s test, two methods were used to monitor the accuracy of the test. The software recorded the user’s time and steps, and a language teacher also monitored how the user interacted with people in the environment.

After finishing the game, they evaluated the program with a questionnaire and expressed their opinions about the game. Although the small number of users causes the results to not have the appropriate statistical validity, however the feasibility and usability of the game in the real environment and with the target users has been measured.

Eleven volunteers; 6 males and 5 females, 9 Arab speaking, one English speaking and one Hindi speaking students from 19 to 25 years of age (mean = 22.3), participated in the experiments. All of the participants used touch screen mobile devices on a daily basis.
type of smartphone that was used was not significantly different from the personal device the participants had and all of them were familiar with the Android device\textsuperscript{2} used in the study.

4.2 Heuristic evaluation

Experts in the field can be used in heuristic evaluation instead of using the end user; In this way, the program is provided to the experts and then they evaluate the program based on the comments and questions raised in the questionnaire. Heuristic evaluation is a type of functional or user interface evaluation in which experts in the target field evaluate a specification, prototype or a product based on a brief list of evaluation criteria such as usability, user experience or areas of concerns [29]. Heuristic evaluation method is a common method in user-centered design to identify practical problems. However, in some cases, what people refer to as heuristic evaluation can better be categorized as a specialized study, because discoveries are intertwined with additional principles and personal beliefs and knowledge [19].

In heuristic evaluation of this research, 5 experts in human-computer interaction\textsuperscript{3}, 6 experts in the field of Persian language education\textsuperscript{4} have been used. A 53-minute video of the complete stages of the game was commissioned by one of the language learners and provided to the experts. Experts were also asked to perform at least 4 stages of the game of their choice. Expert game stages were also recorded by the game software. On average, more than 6 stages of the game were performed by experts.

4.3 Evaluated criteria

After selecting the tools and methods of evaluation and reviewing the various criteria of evaluation, we extract the desired evaluation criteria. The criteria used in this study were extracted and summarized according to similar researches and then used in designing a questionnaire for experts and language learners. These criteria are [4, 5, 8, 10, 17, 24, 28]:

1. Learners’ satisfaction.
2. Interaction with the environment.
3. Effect on learning rate.
4. Effect on desire for learning.
5. Variety of learning methods.
6. Understanding of educational content.

To evaluate the game, first a descriptions of the game and how to play were given to the evaluators and they evaluated the program according to the expressions in the questionnaire. The Likert scale was used for scoring (5 strongly agree, 4 agree, 3 neither agree nor disagree, 2 disagree and 1 strongly disagree).

\textsuperscript{2} The study was conducted on a multi-touch smartphone running Android 4.4. The phone had a 5.0-inch screen size, 295 pixels per inch density, and 720p 1280p resolution.
\textsuperscript{3} HCI experts had a Ph.D. in software engineering and have taught HCI related courses over the past 3 years.
\textsuperscript{4} Persian language experts have been professors at the Persian Language Training Center for non-Iranians language learners and have been working continuously for at least 3 years.
4.4 Evaluation results

Figure 5 shows the results of user evaluations. In terms of satisfaction criteria, all three language learners agreed with these statements, and only one learner believed that using the program was a little difficult for him and believed that the program should be designed more simply and eloquently. Language learners believed that the use of this program caused them to pay more attention to their surroundings and to interact with different people to find the next place. At the same time, language learners believed that in-game instructions for communicating with people and the environment could be more clearly articulated.

Based on the response of users, the effect on learning rate is 85.02%. In this regard, learners believed that because different educational elements such as sound, image and text have been used in this game, learning concepts has become easier and more efficient. The learners were very eager to use this game to learn Persian in other places as well. They also believed that learning Persian with this method is very attractive.

The variety of learning methods with 93.2% has the highest score among other criteria. According to the comments provided by learners, the reason is the use of different educational content in different places, more mobility and attention to the environment which does not cause fatigue. The criterion of better understanding of educational content with a score of 92% is the second criterion with a high score. Language learners believed that the relationship between the content used in the game and the environment had a profound effect on the understanding of the concepts they were learning.

Figure 6 shows the results of the heuristic evaluation. Regarding the criterion of language learning satisfaction, the game was able to attract 85.8% of experts' satisfaction. Some experts believe that this method will be successful in increasing student satisfaction due to the use of other gamification elements such as points.

Most experts believed that this game creates a good interaction between language learners and the environment and people (88.8%). However, an expert believed that the use of this method, because it is based on the use of mobile phones, is weak in communication between language learners and people in the environment.

One of the experts believed that because speaking in Persian is practiced less in language classes, so this issue is one of the strengths of this game. The effect on enthusiasm was able to
attract about 81% of the positive opinion of experts, which is the lowest rate compared to other
criteria. Some experts believed that using an educational scenario focusing on little number of
skills would be successful, and some believed that traditional methods and using augmented
reality could not be clearly compared.

Comments about the criterion of variety of the method were quite positive, so that its score
is about 93.7%, which indicates that the use of this method due to the combination of items
such as sound, image and text can be very effective and practical. Some experts have also
suggested that teaching outside the classroom and using gamify elements contribute to variety
of learning methods. Augmented reality makes better understanding of the concepts, which is
also evident in the opinions of experts (86.2%).

Figure 7 compares the views of language learners and professionals. Although the number
of language learners participated in the assessment was little, there is not much difference
between the opinions of language learners and experts.

![Figure 6: The heuristic evaluation](image)

![Figure 7: Comparing the opinions of learners and experts](image)
5 Conclusions

According to Persian language teachers, the most important challenge for learners is to interact with the real environment because of cultural differences and the fact that the host community is not prepared to interact better with learners [23]. Applying the learned concepts in language courses to interact with people increases their enthusiasm and understanding. This research tried to find an answer to this challenge by using augmented reality in a game.

This study confirms the achievement of previous researches in the field of foreign language teaching using augmented reality for Persian language as follows. Augmented reality increases motivation, satisfaction and enjoyment. This benefit is closely related with students’ interest and motivation to engage with a new technology. Learners interact with other people in light of learning materials, instead of being passive receivers of knowledge, work together, communicate and negotiate to solve problems. Such scenarios are important as they allow learners to practice the target language in a realistic way, thus promoting genuine communication.

According to language learners and experts, the use of augmented reality based programs increases the understanding of educational concepts and thus make better the process of learning and memorizing those concepts and more efficient. Some experts believe that the use of gamify elements such as points creates more motivation and desire to learn. The use of different places in the program causes more mobility and discovery of the surrounding environment, and as a result, this causes freshness. This research could be completed in the following ways:

1. Using more appropriate images, sound and text to increase the efficiency of the program.
2. Designing the game based on different scenarios and in different places.
3. Focusing on one or two language learning skills in the game scenario.
4. Using more language learners to evaluate users.
5. Evaluating the program on different nationalities and genders of language learners.

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Declarations

Competing interests The authors declare that they have no competing interests.

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