



# Augmented Reality to Engage Preschool Children in Foreign Language Learning

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**Abstract.** The goal of this study is to see if Augmented Reality (AR) helps to motivate preschool kids and engage them in foreign language learning activities. The study conducts an experimental study to compare traditional approaches with an AR app for teaching a foreign language to preschool kids. Data were collected from experiments performed at three daycares on students at three age groups; 4, 5, and 6 years old. Surveys were also conducted to receive input from teachers and kids. The results show that there is significant engagement increase in learning a foreign language when AR apps utilized in the classroom.

**Keywords:** Augmented reality · Foreign language learning · Preschool · Early education · Engagement · English learning

## 1 Introduction

Learning a foreign language has become essential and increasing number of parents would like their kids to start learning a foreign language early. Kids have a better capability to learn a foreign language at early ages. However, engaging little kids with learning activities is challenging. To teach the foreign language effectively, it is important to motivate the learner, increase their interest and encourage them through engaging activities [1–4].

As futurist and writer Arthur C Clarke stated, “Any sufficiently advanced technology is indistinguishable from magic”. Augmented reality is the technology that is used to enhance/augment our view of the physical world by placing computer-generated (virtual) information or objects [5]. Augmented reality (AR) is like magic for children [6–8]. AR is an excellent tool for children that fascinates, surprises, grabs attention, entertains and makes them engaged. This establishes a perfect environment for foreign language learning.

Recent technological improvements in mobile devices and AR software development kits enabled entrepreneurs to realize their AR product ideas. These products, including the wildly popular and successful apps like ‘Pokemon Go’ made AR a well-known concept among people. As AR becomes a familiar concept, it becomes easier to introduce them to teachers and come to a consensus that AR apps for kids have huge potential to attract kids’ attention due to its engaging, surprising and fun features.

We have developed an educational set that utilizes AR to start teaching English to pre-school kids. The app aims to teach animal names and related action words. The main components of the educational set include 40 image cards (images of animals), 60 word cards (written text of animal names and action words such as walk, run, jump, etc.) and the AR app for Android and iOS devices. The set is developed through a grant from TUBITAK (The Scientific and Technological Research Council of Turkey) and teaches English for Turkish native speakers. AR app provides an interactive and engaging environment through games and fun interactions. We have conducted an experimental research study on kids between ages 4 and 6 at daycares and identified that kids learn a foreign language significantly better using the mobile AR apps when compared to conventional methods. Figure 1 below shows the content of the educational set and kids playing with it at a daycare center.



**Fig. 1.** On the left, contents of the ‘Magical Animals’ English learning set and on the right, kids playing with the educational set at a daycare center.

## 2 Related Work

The research on Augmented Reality gained momentum in recent years. Researchers have been exploring the utilization of the augmented reality technology in many fields such as tourism, advertisement, training, military, medicine, and education. Education is one of the fields that promise significant improvements and changes due to the utilization of the augmented reality [9, 10].

There have been studies to see the effect of augmented reality to teach a foreign language to students [1–4, 6–8, 11–13]. The studies about teaching a foreign language were mostly performed on students who are at elementary [3, 7, 12], secondary [1, 11] and college levels [14]. To the best of our knowledge, there was only one study [6] to test the effectiveness of AR on pre-school kids. However, this study only involved a very limited number of pre-school kids and it was based on observations [6].

In education, one of the most important factors to facilitate learning is motivation. This is true especially in foreign language learning [1, 6, 11–13]. The early education

of kids at pre-school ages can only be motivated through games and surprise factors. AR is very surprising to kids and it is like a magic as it brings virtual objects to existence. In fact, studies conducted on early age school children indicated that many children described the AR apps as magic [6–8]. AR app development for education is challenging because the design of the educational experience needs to be different and user-centric when AR is utilized [3, 11]. For a successful AR app that provides an effective learning environment, certain design patterns need to be followed [15, 16].

### 3 System Design and Architecture

To teach a foreign language (English) for kids whose native language is Turkish, we developed an AR app that we call ‘Magical Animals’. The app teaches 40 animal names along with 20 action words such as run, walk, dance, sit, jump, etc. The AR app was developed utilizing the Unity3D development environment and Vuforia AR libraries. The AR app utilizes image, text and voice recognition to provide an engaging environment for kids. The app works both on iOS and Android devices both on phone and tablets. The Unity3d development environment was chosen because once the app is developed in the Unity3D environment using C# programming language, the app can be exported to multiple platforms including iOS and Android which helps us save development time and cost. This also helps us to preserve the same unified design over multiple platforms.



**Fig. 2.** Kids are interacting with an animal 3D model via the ‘Magical Animals’ App

The interaction between the AR app and the user is done as follows: After the installed AR app started, the user can show an animal’s image card or an animal’s name text card to the camera of the mobile device (phone or tablet) to pop up animal’s 3D model over the image or the text. As the user sees the 3D model, he or she can move the card to experience the animal from different angles on the mobile device’s screen. The user can also show a card to the camera that has an action word written on it (for example a card with the ‘dance’ or ‘walk’ word on it) and the displayed 3D model of the animal starts animating (for example starts dancing or walking). Figure 2 shows that kids are interacting with the AR app.

## 4 Methodology

The study has been conducted in three daycares in Turkey on pre-school kids at ages 4, 5 and 6. Total of 87 kids participated to the study; 21 of these kids were in the four years old group, 25 of these kids were in the five years old group and 42 kids were in the six years old group.

We utilized the experimental research study with pre-test and post-test applied to experiment and control groups to assess the effectiveness of utilizing the AR app for teaching English to pre-school kids. While the control group learned English with conventional flash cards, the experimental group learned English with the AR app. We distributed kids at each age group into experimental and control groups randomly.

First, we met with the teachers at daycares to share the details of our research study. We introduced them the AR concepts as well as the AR app that would be used during the study. We described the lesson plans and the activities in details. We also let them know that we would be conducting surveys to teachers and pre-tests and post-tests to kids. During our initial meetings, we also asked the following questions and received the answers listed below:

- How many of the students have used a tablet before? About 80% of the students already used tablets.
- What methods and tools did they use to teach English to kids? Some of the tools they used are flash cards, computers, presentation slides, books, and videos.
- How do they assess kids' level of English? In one of the daycares, they do not assess how much the kids learned English. However, in the other daycares, they ask questions to get a feel about how much they learned.
- Did the kids learn animal names in English before? One of the daycares claimed that kids learned about 15 animal names already, and the other two claimed they learned about 5 animal names.
- How is the attitude of teachers and parents to use tablets and technological tools for teaching? The attitude is positive since these tools attract kids' attention.

Before starting the teaching sessions, experimental and control groups took the pre-test to assess their English level at the beginning of the study. At the end of teaching sessions by using the AR app and by using the conventional flashcards, we applied the same test used in the pre-test as the post-test to both experimental and control groups to assess how much each group improved their English. During the teaching sessions, both control and experimental groups both spend 3 h to learn the English animal names. We prepared the lesson plans for the teaching sessions so that the same teaching style is followed at all three daycares.

For 4, 5, and 6 years old experiment and control groups, 15, 20, and 25 animal names were taught respectively. With the experimental group, the teacher first introduced the AR app to the kids and showed how to play with it. Then, in small groups, kids started to play with the AR app that was installed on an Android tablet. When an animal picture is shown to the camera of the Android tablet, the App pops up the 3D model of the animal, and then the audio is played pronouncing the name of the animal in English. With the control group, the teacher first showed pictures of each animal and

repeated its name three times. Then, the teacher let each student say the animal names three times. Later, teacher and kids started to play a game where the teacher says an animal name and kids find the picture of the animal.

### 5 Results

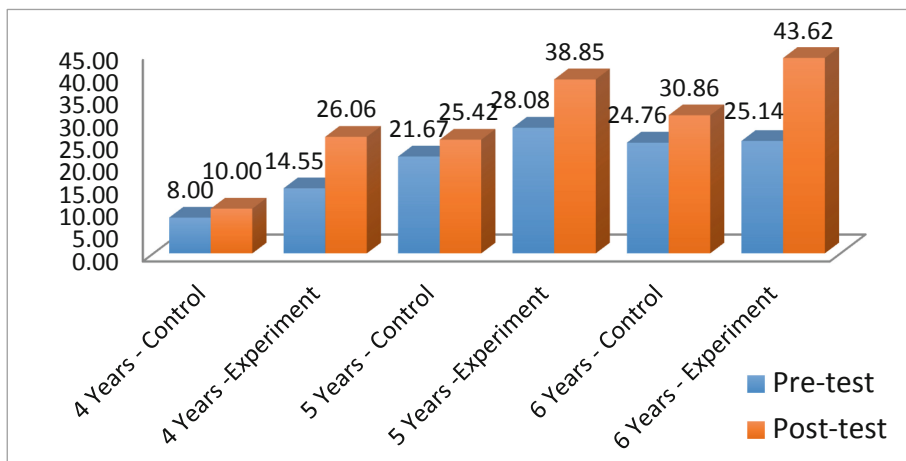
During the pre-test and post-test, pictures of the animals were shown to the kids and their English names were asked. Table 1 shows the percentage of correct answers.

**Table 1.** Percentage of correct answers

		Control		Experiment	
		Pre-test	Post-test	Pre-test	Post-test
4 years olds	Daycare A	6.67%	13.33%	0.00%	33.33%
	Daycare B	2.86%	3.81%	4.76%	12.38%
	Daycare C	26.67%	30.00%	42.22%	55.56%
	All Daycares	8.00%	10.00%	14.55%	26.06%
5 years olds	Daycare A	2.50%	7.50%	0.00%	27.50%
	Daycare B	26.43%	30.00%	29.38%	35.63%
	Daycare C	23.33%	26.67%	43.33%	55.00%
	All Daycares	21.67%	25.42%	28.08%	38.85%
6 years olds	Daycare A	3.50%	14.00%	5.00%	36.50%
	Daycare B	28.00%	29.14%	28.00%	34.29%
	Daycare C	49.33%	55.33%	48.67%	64.00%
	All Daycares	24.76%	30.86%	25.14%	43.62%

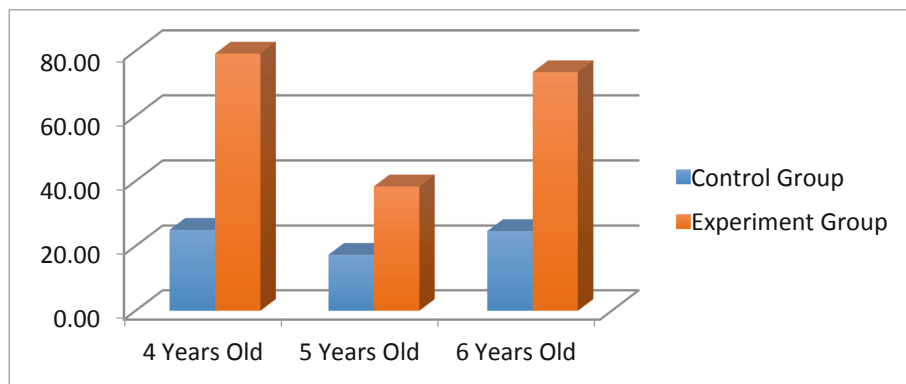
Having the results in percentages helps us more conveniently compare changes between pre-test and post-test and between control and experiment groups as well. We computed the percentage as follows: For example, 6 years old control group were asked 25 animal names during their pre-test and post-test. We have 21 students in the control group and 21 students in the experiment group. If the group had identified all animal names correctly during a test, they would have given 525 ( $21 \times 25$ ) correct answers. The sum of the correct answers given by all students in the experimental group during the pre-test and post-test were 132 and 229 respectively. These number of correct answers corresponds to 25.14% ( $132/525$ ) and 43.62% ( $229/525$ ) as listed in Table 1 above.

Figure 3 below shows how much increase was achieved between pre-test and post-test for age levels 4, 5, and 6. As it can be noticed, the increase is always higher in the experimental group.



**Fig. 3.** Learning gains between pre-test and post-test for all age levels

Figure 4 below shows how many percent control and experiment groups increased the number of their correct answers for age levels 4, 5, and 6. For example, the control group of 6 years olds increased their total number correct answers by 24.62% while the experimental group of 6 years olds increased their total number of correct answers by 73.48%. Figure 4 shows that the experimental group increased their vocabulary significantly better than the control group at all age levels.



**Fig. 4.** Percentage of improvements in the correct answers given compared for control and experiment groups at 4, 5 and 6 years old levels.

## 6 Teacher Comments and Observations

During the research study, we also gathered data via surveys to learn how to improve the AR app to make it more user-friendly and effective, how much did the kids enjoyed utilizing AR app for learning English, how much their level of attention and focus was improved, how much teachers felt comfortable using the AR app for teaching, how much did the AR app contributed to the learning process. In the surveys, teachers answered more than 40 questions by using the Likert scale. Besides, they had the opportunity to provide explanations for their answers.

Teachers expressed that kids' attention span was prolonged while studying with the AR app and they were more focused on the learning process. Since kids found it fun to play with the app, it would be possible for them to spend more time with the app. It was also observed that kids wanted to play with the AR app over and over again. Teachers also suggested that classroom management was easier when AR app was used because kids were very much engaged with the learning process. The animations of the animals' 3D models captured kids' attention and improved communication between the kids since they often tried to mimic the animations and showed it to their friends. However, sometimes AR app caused sharing problems since most of the kids wanted to interact more with the app instead of letting his/her friends take the turn to play. Teachers also commented that since the AR app provides both visual and audio feedback to the kids, the retention level of the learned words would be higher. Teachers praised the AR app for using real pictures of animals instead of cartoon animal characters because the kids would have difficulty identifying the animals from their pictures if they initially learned their name from cartoon characters. Teachers also expressed that when they teach using conventional books or flash cards, they pronounce the English words with an accent however with the AR app, they can play the audio recorded by native English speakers. This enables kids to learn the correct pronunciation of the words. It is also noted that having the 3D model pop up from the text of the word also gives the kids an opportunity to match the written name with its meaning even before they start learning how to write and read.

## 7 Conclusion

The results of this experimental study and surveys were consistent with the results of the current literature because all the studies concluded with positive outcomes about utilizing AR in education and in foreign language learning. We have seen that kids learn English more effectively and achieve much better scores in the post-tests using the AR app when compared to the post-test scores of kids studied English using the conventional methods (flashcards). While the kids learning through the conventional methods increased their vocabulary 25%, 17%, and 24% for 4, 5, and 6 age levels respectively, kids utilizing the AR app increased their vocabulary 78%, 38%, and 73%.

Based on the feedback received from the teachers through surveys and based on our observations, experiment group showed improved attention span, increased engagement with the subject, and higher motivation to learn. Moreover, the teachers reported that it was easier to manage the classroom. It was observed that utilizing audio of native

speakers for the pronunciation of words resulted in increased correctness of the kids' pronunciation of the new vocabulary.

The dramatic increase in learning outcomes encourages us to continue exploring the potential of AR for teaching a foreign language to early age learners. We explain how we plan to continue this research in the future directions section below.

## 8 Future Directions

We have seen a great potential in AR for engaging kids for foreign language learning. We plan to continue with the following research studies:

- Perform a similar experimental study to teach Spanish to kids that have English as the native language. That would allow us to compare the effectiveness of AR in different cultures and languages,
- Perform an experimental study to teach different subjects such as foods, clothes, numbers, etc. to compare if the subject was a differentiator factor for the engagement,
- Perform an experimental study utilizing the audio recordings of words and voice recognition functionality of the AR app to compare the correctness of pronunciations learned through the AR app and the conventional methods,
- Enhance the current AR application to utilize gamification techniques and variable rewards to test the effectiveness of gamification and rewards,
- Enhance the current AR application to add voice-bots that would guide kids in the learning process and perform the experimental study to test the effectiveness of voice-bots.

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