

# Language Learning Using AR and VR Technology: A Review

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## Abstract

Virtual Reality (VR) and Augmented Reality (AR) is technology used to create an environment that does not actually exist. Such technology nowadays receives much attention and has been widely applied to various industries. However, the applications of VR/AR in education, especially in the language learning fields, are rarely, comprehensively and academically reported and reviewed. In this paper, the authors first review the newest developments of VR/AR technology, list the scattered experiences of using VR and AR seen from different sources, and then propose the possible use of the technology for language learning. Finally, the paper will state the problems in integrating AR/VR with language learning scenarios.

## INTRODUCTION

### What is VR?

VR, short for Virtual Reality, is a combination of multiple technologies such as simulation, computer graphics, human-computer interfaces, sensor and multimedia. VR is actually a real-time, maginary created environment with which people can view, hear, smell or even physically sense.

As the marketplace value of the technology seems so promising, IT giants such as Facebook and Google have started to invest huge funds in developing and employing VR technology for their services. Mark Zuckerberg, CEO of Facebook, asserted that reality is limited and is not fully satisfying, therefore needing to be extended to the virtual world. Part of the social interaction which currently takes place in realistic Facebook will likely soon be happening between avatars sharing a virtual world (Sulleyman, 2017).

Google chrome has already enabled users to view and interact with websites which have VR contents. Google users can follow links between pages and view VR-supported sites. 2016 was called the year of VR. The technology continued to attract attention in 2017.

### What is AR?

AR is short for Augmented Reality. Different from VR, which is an environment totally virtual, Augmented Reality is a combination of virtual reality and existing environment. AR applications for smartphones typically include a global positioning system (GPS) to pinpoint the user's location and its compass to detect device orientation.

Pokémon Go, an extremely popular game around the world in 2016, was an AR application. The game uses the GPS ability to locate battle and exchange Pokémon, the virtual creatures.

As they did to VR, Facebook and Google also launched AR projects. Facebook introduced a new

cross-platform camera interface which makes the camera the first augmented reality platform. Google's Tango project lets Tango become an augmented reality computing platform. The platform uses computer vision to enable handsets to detect their position relative to the world around them without using a GPS or other external signal. If the products are mature enough, the device can detect its surrounding just like human beings do.

## **AR/VR FOR GENERAL EDUCATIONAL PURPOSES**

Using VR or AR, users can have realistic experiences with the 3D world and can even interact with it. For example, people can observe three-dimensional virtual objects in a 360 degree panorama using VR. With the help of AR, medical students can practice surgery in a controlled environment. AR is also widely used for navigation, sightseeing, system maintenance and product advertising.

Both VR and AR used to be mainly employed in digital games, but now have been used for various other purposes. Special devices to view VR content, such as the Oculus Rift Gear VR, which are called Head-Mounted Displays (HMD) are already available for ordinary people at reasonable prices. It can be predicted that AR and VR devices will become part of life in the same way that computers and televisions are now.

According to IDC (IDC, 2017), by 2020, there will be seven million AR and VR users around the world and will be at 20 times the market value in 2020 as it was in 2016.

There are two reasons that educational settings will soon witness a huge increase in AR/VR applications. Firstly, AR/ VR technology is in accord with educational theories of behaviorism and constructivism. Secondly, more and more VR/AR content is being created to be compatible with mobile phones - and mobile learning is becoming the main stream of e-learning (Wang, et.al. 2016). Jorge Martín-Gutiérrez. et.al. (2017) summarized the advantages of using virtual technologies: Virtual technologies increase students' motivation and engagement. Students immerse themselves in the virtual reality and feel as if protagonists; students are free to interact with virtual objects and other students; more and more VR/AR learning materials are now accessible via students' handsets such as smartphones which makes the learning environment ubiquitous.

Uimersiv is the largest platform in the world which provides VR educational content every month. After downloading the app for certain VR devices such as Gear VR, Oculus, Daydream...etc, users can learn about history, space or the human anatomy. Phenomena that can never be seen in reality are reproduced in VR and presented through VR devices. "Learn about Dinosaurs in VR", "A Journey into the Human Brain" , "Explore the International Space Station", "Explore Ancient Rome" are VR content for learners . Figure 1 shows dinosaurs in a virtual reality, a VR program that was launched by Uimersiv in July, 2017.



Figure 1. Dinosaurs VR experience

Nearpod is an interactive presentation and assessment tool developed by an education company in the United States. The tool also provides VR resources. The company developed a VR course called College Tours, in which students can virtually visit the campus of famous universities around the world. Every lesson in the course was created using high-quality panoramic images with verbal narration, text, and study materials added. Figure 2 is an image taken from the lesson of “Visiting the University of Tokyo”.



Figure 2. Nearpod VR: College Tours - Visiting University of Tokyo

Some other VR/AR learning contents may not be as well-known as Uimersiv and Nearpod, but still proves to be good practice for learning. Star Chart is a mobile app using AR for students to learn about constellations simply by aiming their phones towards the night sky. The app can provide students with virtual tours to many of the planets and the sun.

Thanks to VR/AR, when students touch a country map in a virtual globe placed in a class of world geography, the geographical information about the country will immediately display itself in a

multimedia format. Earth AR is an AR app that lets students see the globe from different angles. The app can detect students' motion and respond with zoomed images. This app makes geography more interactive and engaging for students.

A student majoring in architecture can design models in a virtual world with the help of VR/AR applications. Instructions on machine operations can also be conducted in distance by using AR or VR. The situation of the work scene is transmitted to instructors in the distance, and the instructors's guidance in texts or sound or images are delivered to the workers wearing AR or AR devices on the spot.

Many AR and VR applications have been used for art and history education. An app called Boulevard can serve as a perfect example. Using this app, people can visit six of the world's best art museums without actually going there. In the app, visitors are able to interact with famous artworks and learn about the art.

### AR/VR FOR FOREIGN LANGUAGE EDUCATION

**Speaking.** Learners can listen to conversations in the virtual world and interact with it. By moving bodies, learners can “go” to different places and “talk” to people at a place in the target languages. The following scene can be easily found in a typical VR language program: the learner “walks” out a hotel and wants to hail a taxi. Then a taxi comes and the driver asks him where he wants to go. A real-time conversation continues after the learner takes the taxi. When the taxi arrives at the airport, conversation will switch to a flight check-in.

These kinds of real-time speaking practices involving the participation of the learner obviously increase the learners' interest and let them use the target language more effectively.

Mondly is such a VR app available for smartphones. Learners can have a chat with an online robot in the target language in a realistically authentic event. Instant feedback about the learner's pronunciation, grammar and vocabulary is quickly given by the app.



Figure 3. Role play in virtual conversations (images from “Learn Languages VR” by Mondly)

**Vocabulary Study.** Flashcards and closed tests are traditional ways to learn vocabulary in foreign language classes. Using a smartphone installed with an AR application the learner can learn

vocabulary in a different, even an easy way. In an AR setting, when a learner places the smartphone camera on a particular object in a room, the name of the object and relative information will pop-up on the smartphone's screen. See figure 4 as an example.



Figure 4. Learning vocabulary in VR (image from “Learn English in VR – Language VR app)

Santos. Et.al.(2016) reports an experiment using AR to learn English vocabulary. They divided the learners into two groups. One group learned vocabulary with the AR app, while the other group learned the same vocabulary with traditional flashcards. The experiment shows that using AR can reduce cognitive load, improve attention, and increase satisfaction.



Figure 5. Display AR information on a tablet PC (image captured from Jurassic AR Book)

**Reading.** If those difficult sentences, paragraphs or even passages are presented in AR or VR for readers to see, to touch or to feel, then the text can surely become much easier and more impressive

for the readers to understand. In Figure 5, several difficult pages describing dinosaurs in the book were made into markers. In AR, markers are usually regular images or small objects which were created and trained in advance for cameras to recognize. When the camera of a smartphone or a tablet PC is placed over a marker, readers will see virtual 3D animated dinosaurs.

**Experiencing cultural differences.** AR/VR is very helpful in helping students experience cultural differences. By using AR or VR contents, without going abroad, students can vividly learn the history of foreign countries, visit a tourist spot thousands miles away, walk on a campus of a foreign university and even “stay” with a host family. Hastings & Brunotte (2017) reported that a smartphone-based VR program could reduce the anxiety associated with study abroad.

### **PROBLEMS AND LIMITATIONS FOR FOREIGN LANGUAGE LEARNING**

Applying AR /VR technology to foreign language education has just commenced. The technology will become popular in various educational scenarios in the near future. However, problems and limitations still exist.

Firstly, in order to create the VR/AR learning content, teachers will need to invest in hardware and software. For example, if a teacher wants to create a 360-degree video, then a spherical camera with 360-degree lens is needed. When a 2D video is converted to a 3D video, special software like Media Converter becomes necessary. Furthermore, even though an existing VR learning content is available for use, sometimes a user needs to wear a special HMD to view it – many VR contents cannot be well-perceived by the naked eye.

Secondly, the threshold to create AR and VR learning content is high and beyond the reach of many teachers without the necessary technical background. To shoot 360 degree VR videos needs certain video-taking skills; to write the interface codes, a knowledge of 3D-modeling, programming languages like C/C++/C# and software development kits (SDKs) is needed; for better design, experience in 3D production is preferable (Herrera, 2017). In addition, a huge amount of time needs to be guaranteed to produce and test VR/AR learning materials.

Thirdly, as AR/VR technology is still in its early stage, trends and standards have been changing. A learning VR or AR content created today may not be compatible with devices emerging tomorrow.

Fourthly but not finally, the pedagogical theories for VR/AR use in education are not well developed. Research papers till the present on AR/VR for learning, particularly for language learning, are still extremely few. In practice, teachers may feel frustrated when they are not able to find any pedagogical theories to follow nor any previously successful examples to which to refer.

### **CONCLUSION**

After introducing the definitions of VR and AR, this paper has reviewed the latest developments of the technology and its current applications in industry as well as in general education settings. In order to fill the gap of research on the use of VR/AR for language learning purposes, the paper

has discussed the possible applications of existing VR/AR products for foreign language speaking, vocabulary study, reading and cultural difference exploration. Although VR/AR for language learning is very promising for language teachers and learners, the hurdle to use the technology is still high due to the fact that VR/AR learning content creation is very technically demanding.

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