International Journal of English Language Studies
ISSN: 2707-7578
DOI: 10.32996/ijels
Journal Homepage: www.al-kindipublisher.com/index.php/ijels

IJELS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

The Effect of Using AR Technology on Language Learning

Victor Marrahi-Gomez[1] ✉ and Jose Belda-Medina[2]
[1]Ph.D. Assistant, Department of English linguistics, University of Alicante, Alicante, Spain
[2]Professor, Department of English linguistics, University of Alicante, Alicante, Spain
Corresponding Author: Victor Marrahi-Gomez, **E-mail**: marrahigomez.v@gmail.com

| ABSTRACT
The recent emergence and popularity of digital tools related to Augmented Reality (AR), such as Roar or Aumentaty, has facilitated the integration of this breakthrough technology in Language Learning, particularly in English as a Foreign Language (EFL). Thanks to the recent worldwide availability of new technological devices, such as tablets and smartphones, AR applications can be effectively used today in language learning with different learning purposes, such as grammar or enhancing the student's listening skills, among others. Thus, the main purpose of this study aims to examine the use of AR in Language Learning thoroughly and evaluate the possibility of including the tool in today's education by analyzing the possible advantages and limitations that researchers may have found in their studies.

| KEYWORDS
Augmented Reality; Language teaching; EFL; Immersion; Educational Technology; Advantages and Limitations

| ARTICLE INFORMATION
ACCEPTED: 01 February 2023 **PUBLISHED:** 12 February 2023 **DOI:** 10.32996/ijels.2023.5.1.5

1. Introduction

Given the latest technological advances in many areas, with the inclusion of AR functionality and the improvement of technological interfaces, the researchers claim that AR has a very wide potential and numerous benefits. Although there are certain disadvantages, this can provide a new context in education, enhancing its contextualization and effectiveness. In an educational context, AR has been used as a complement to a pre-established and standard curriculum based mostly on a traditional methodology. Text, 3D graphics, video, and audio can be overlaid in the student environment in real time.

The development of low-cost software and mobile applications has facilitated the use of this technology in more areas, such as language learning. An increase in the popularity of AR tools could be found due to diverse causes, such as free-downloadable applications such as Roar, Aumentaty, or Zapworks, among others. In addition, a set of mobile applications and games have become quite popular such as the Ikea App, in which you can use AR furniture to analyze if you want to make that purchase. In addition, Niantic released two AR-based games such as Ingress and Pokémon Go, which were a global phenomenon and presented this innovative tool.

However, despite their use in apps and games, there are not many examples that suggest the adoption of AR in language teaching. Although in the past years, some works have been published regarding this topic, the majority of them are focused on examining the possible impact that AR could have on student engagement and motivation. That is why this article aims to study the possible advantages and limitations of implementing AR in Language Learning as well as the possible effect of the implementation in it.

2. Literature Review

The first mentions of Augmented Reality were in the works made by Frank L. Baum in 1901 and, more specifically, in a new concept introduced by this novelist known as *character marker*. According to Altınpulluk (2017), although the said author is known for his novel Wizard of Oz, in writing appear certain elements that are called markers where reality was mixed with elements created through the use of said technology. Likewise, Woods et al. (2016) stated that the glasses used in this work to create fictitious elements and implement them in the real world are the basis that has been followed in the following years in the development of technology related to AR.

Tom Caudell (1992) coined the term "augmented reality" to refer to the technological elements used in an aircraft equipment factory where the operator received a greater amount of information through a projection of the assembly scheme on the wiring itself in which they were working. This decade began to delve more into the use of projections in devices of non-existent elements in a real context. However, it was not until 1992 that the first immersive system emerged, whose basic principle was based on the use of functional AR. This system was developed by Louis Rosenberg through his project "Virtual Fixtures", in which robotic arms were projected on the user's arms, creating a vision of AR.

Later, Ronald T. Azuma (1997) developed a project where he explored the different uses that RA could have in different areas, such as medicine, entertainment, or mechanics, among others. In "A survey of Augmented Reality", the author exposes, after including a definition and characteristics of AR, a vision that explores the different uses of AR in different contexts, for example, in the field of medicine, research, mechanics, and entertainment, among others.

2.1 AR Definition

According to Azuma (1997), Augmented Reality (AR) is a variation of Virtual Environments (VE), or Virtual Reality, as it is more commonly called. The author states that, unlike Virtual Reality, the user has the possibility to observe the real world with superimposed real-world objects. Instead, VR creates a completely virtual world without using elements or spaces of reality. Therefore, it could be said that AR complements the real world by mixing elements created through external tools with elements already existing in reality instead of completely replacing them by creating worlds and virtual elements, as VR does.

Azuma (1997) also established a set of common characteristics that were defined to describe AR.

1. AR consists of a combination between the virtual and the real world. This means that it allows the user to interact in the real world with elements of the virtual world, and in consequence, they can experience unique experiences not possible without this tool.
2. AR is interactive in real-time. A change or action by the user immediately impacts the scene created by the AR, resulting in a more realistic experience.
3. The RA has elements captured in three dimensions (3D). Information is always displayed in that perspective, giving the user a sense of belonging to the real world. Through the development of augmented reality, you can interact directly with the physical capabilities of the environment.

Marrahi-Gomez et al. (2022) pointed out that some technological elements are essential to be considered AR. Features such as overlays, triggers, or markers are needed in every AR application or game:

1. Triggers are the connection between the real world and the augmented one.
2. According to Rabbi et al. (2013), the concept known as tracking is the virtual alignment of objects with the real world. Depending on how accurate such tracking will produce a better feeling in users.
3. The overlay could be defined as the augmented element appearing on the device used. Depending on the application you use, such overlays might be different.

3. Objectives and methodology

This present study aims to analyze and review analyze the effect of implementing Augmented Reality technology on Language Learning. The study will also highlight the impact and the attitudes of the students toward its integration. The research objectives are:

1. To analyze the possible positive and negative aspects of the implementation of AR.
2. To overview the latest projects regarding the use of AR technology in Language Learning.
3. To discuss the future implementation of AR-based projects in the EFL classroom.
4. To observe the effects that AR may have on language acquisition.

To fulfill this purpose, a total of six research works were analyzed. Following the criteria:

1. Articles published between 2013 and 2023.

2. Articles that study English Language Teaching.
3. Research projects that were published in WOS and Scopus.
4. No excluding any educational level.

4. Results and Discussion

4.1 Overview of the latest projects

With the recent introduction of AR in language education, the literature focuses on the development of the use and implementation of AR. Some of the most recent studies focus not only on its development but also on the implementation of certain tools or their feasibility and usefulness in the classroom. Among the principal research works that have AR in language acquisition as a topic we highlight the following:

1. Hsu (2017) performed an experiment in which 38 third-graders from Taiwan students took part in a research program. The paper aimed to analyze the effect of two different AR games on language learners. The research paper concluded that both AR game systems produced an enhancement in their performance, although there were no significant differences regarding cognitive load.
2. Chen et al. (2019) aimed their quasi-experimental study to analyze the effects that AR flashcards could have in contrast with traditional flashcards on English learners from kindergarten. 98 children aged from 5 to 6 years took part in the experiment with both pre and post-tests and, in addition, with interviews with their teachers. The experiment lasted 4 weeks, and the results pointed out that students enjoyed taking part in all the processes and also using the AR. Chen also stated that a more detailed lesson could be applied in kindergarten to teach English.
3. Taskiran (2019) aimed the research to observe if EFL learners experienced enhanced motivation, interest, and enjoyment by using AR learning materials. A total of 83 learners from the University in Turkey took part in this experiment. The results demonstrated that the learners who took part had positive attitudes toward the implementation of AR in language learning. Not only were their results enhanced, but also their enjoyment of the activities, the motivation that the students felt during and after the experiment, and their interest in the topic. In addition, they believed that it was a beneficial experience that could enhance their experience while learning English.
4. Yeh et al. (2020) conducted an experiment that involved 52 English language students at the University of Taiwan. To observe if an AR environment could enhance their multimodal literacy for communication, they used an AR tourist app. The students had to use various ways to communicate with each other such as visual and auditory. The results showed that AR enhances the students' learning and motivation and that the adaptation to language learning would provide the students with some benefits that could affect a direct way to their behavior toward language acquisition and multimodal learning.
5. Cheng et al. (2020) carried out an experiment in Taiwan which involved 204 students belonging to the 9th grade to observe their English proficiency and their achievement with the use of AR. They also wanted to observe the motivation and the attitudes the students experienced during the experimentation. Two AR video-enhanced contextualized systems were designed to be able to fulfill their objectives. The study concluded that the AR environment was significant in improving their meaningful learning and their motivation. In addition, their adaptive attitudes toward learning were also improved in comparison with other methodologies.
6. Binhomran et al. (2021) aimed to discover the effect that AR may have on the motivation and vocabulary retention of 73 6th graders from Saudi Arabia. They were exposed to an AR storybook with some target words for a total of four weeks; at the end, they had to complete a test; also, interviews were carried out to observe their attitude toward the activity. The results of their study showed no significant differences between both methodologies in relation to vocabulary retention and learning, carrying some negative aspects such as the lack of technological knowledge. However, regarding motivation, the AR group showed and experienced more motivation than the traditional methodology group.

4.2 Advantages and limitations

According to Küçuk and Yilmaz (2014), the rapid advancement of technology has provided a great opportunity for new technologies in education. Augmented reality is one of those technologies that has benefited in different contexts. This is because AR allows the user to interact with both virtual and real objects in different fields of education. For example, different augmented items in textbooks in the classroom or create a textbook that is completely enhanced with the use of AR, and, according to Hawkinson's studies (2014), the initial reaction of students is *surprisingly positive*.

Authors like Wu (2013) and Belda-Medina (2022), among the main advantages of the implementation, either total or partial, of Augmented Reality we can observe, it is necessary to highlight the following:

1. **Motivating factor**. Being an everyday element with which students possess considerable familiarity, the motivation of students to use mobile devices for the acquisition of knowledge is growing compared to that produced by materials used

in traditional education. This motivation is a direct consequence of another significant advantage, according to studies by Belda-Medina (2022) which stated that there was a sensory interaction that was considered to be "related to how children learn in their natural mode, using several of their senses in a constructive process. In addition, Cheng et al. (2013) stated that when various senses of the students are activated, the brain speeds up the constructive process, which is considered a great advance in the learning process.

2. **Economic factor**. According to Liu (2010), mobile learning is superior to traditional learning in terms of flexibility, cost, portability, and ease of use since it is carried out with materials that students of all ages possess, whether mobile or an electronic tablet and is already used to their everyday use.
3. **Better emotional relationship outcomes**. As stated by Wu (2013), AR systems can help students develop skills and knowledge more effectively, building on students' emotions toward learning.
4. **Interactivity factor**. According to Barroso and Cabero (2016), one of the properties that characterize Augmented Reality systems is that there is an interactive implementation in real-time. This means that the student can modify activities based on AR.
5. **A better understanding of abstract concepts**. According to the studies of Belda-Medina (2022), one of the advantages of using AR in the educational field is that it has the possibility of facilitating the understanding of elements considered abstract.
6. **Retention factor**. Studies by Chiang et al. (2014) showed that one of the advantages of education with the implementation of AR in their curriculum is the greater retention of concepts.
7. **Autonomy factor**. The combination of the virtual world increases, according to Ibáñez et al. (2014); the incorporation of the virtual world into teaching increases the autonomy of students because they show natural skills and great motivation to use technological tools. RA creates the possibility for students to learn and share knowledge among themselves through interaction.

Despite the educational advantages of AR, there are certain challenges and disadvantages in terms of its use regarding pedagogical and educational problems. According to Wu (2013), Herpich et al. (2014), Belda-Medina (2022), and Marrahi-Gomez et al. (2022), they could be grouped into five general disadvantages that can be observed in their implementation in the educational field. These are:

1. **Distraction factor**. The use of AR in the classroom generates a lot of information that the student must assimilate; this fact, added to the different tools, such as mobile phones, that they must use, may generate a multitasking failure. It can also be caused by a lack of technological knowledge on the part of the student or by poor collaboration between them. Finally, it should be noted that the distraction may be caused by the technological tool itself. Due to a lack of concentration on the part of the student, the student may decide to use the time required for the activity in other recreational or communicative activities outside the initial objective of the use of AR in the classroom.
2. **Complexity factor**. There is some complexity in the use of AR, and the lack of previous technological knowledge could become an impediment. This disadvantage, however, is easy to solve since, over the years and the use of AR in the educational field could lead to an acquisition of methodology and, therefore, greater efficiency in its use.
3. **Control factor**. Wu et al. (2013) stated that it might be caused by a lack of experience and ignorance of instructions by students, which would hinder their learning. It is also claimed that, despite recognizing the advantages of RA, many teachers tend to prefer to have full control of their student's education. The AR allows collective learning against the more traditional methodology, which affects the individual. In addition, for students to interpret the notions is necessary the teacher's guide; students may experience certain difficulties recognizing the information and navigating between the virtual and reality. And finally, this control could pose a problem when working with children who lack the technological and disciplinary skills to be able to take care of self-learning. This could lead to a loss of attention on the part of the students, to an excessive time in the realization of the activities, and, ultimately, to undesirable educational effects.
4. **Skill factor**. The low training of the faculty could lead to technical problems that may arise through the use of AR in the classroom. Wu et al. (2013) and Herpich et al. (2014) add that teachers should believe that the implementation of AR can be beneficial in the educational process and understand what strategies they should follow.
5. **Content factor**. Wu et al. (2013) also indicate that there are certain disadvantages in terms of the content of the subject taught and, more specifically, in its flexibility. That is to say. The teaching staff does not have the possibility to accommodate the knowledge to be imparted to all students since it is used in a generalized way and, therefore, certain students may have a sense of exclusion that is tried to avoid in educational centers.

4.3 AR implementation in Language Learning

The great majority of studies showed that AR is important for language acquisition. Not only enhance student performance in the academic field, it means in areas such as reading comprehension, grammar, and vocabulary acquisition, but the findings also show that engagement in the classroom is superior to using other methodologies. According to Punar Özçelik (2022), certain studies

conclude that AR could increase engagement when they are faced with reading comprehension activities. Among the benefits that come with the implementation of AR in Language Learning, we can highlight that the satisfaction of the students and their attitudes towards the subject is significantly superior with the use of AR. In addition, students can find their anxiety reduced, which could help them to feel safer and more comfortable when learning a new language.

The integration of tools such as AR in language teaching, although in the early stages, is an emerging topic. However, it is often criticized for not being enclosed in any pre-existing theoretical framework, and it might not lead to language acquisition by the mere fact of using AR. However, as it could be seen, many different researchers have shown that in the educational field, the implementation of AR in Language Learning could be considered Situational language due to the fact that it needs a specific context and a quality of education, including aspects such as the space or the interaction with other students and with the teacher to be worth to use AR in the classroom.

5. Conclusion

This study is based on a review of the impact of AR on Language Acquisition in which some affordances and limitations have been considered. These results are based on a comparative method through which several works published in WOS and SCOPUS have been analyzed.

In relation to the research, we have found evidence to conclude that the vast number of studies carried out on AR-based projects in Language Acquisition reported an improvement, not only in the student performances but in their attitudes while using AR as an educational tool. It is worth mentioning that some limitations have been highlighted, but they are outnumbered by the advantages that researchers have found.

As previously seen, all six studies focus on language learning and the outcomes, positives or negatives, that can be observed during the experimentation. In addition, all the research papers concluded that the implementation of AR in language acquisition could not be significant in the learning process, as seen in the last research; however, the motivation outcomes and the attitudes toward the subject have better results using this tool instead of a traditional methodology.

Finally, the advantages and limitations of the implementation of AR in an Educational Context have been pointed out. The improvement of students regarding some different areas, for example, grammar or reading comprehension, among others, has been proven to be superior while using AR. In addition, motivation and attitudes have also improved in the student, allowing them to reduce the anxiety that acquiring a new language could produce. However, some of the researchers have also stated that the limitation found during the performance of the studies could have a negative impact on the students.

Despite the growing interest in the use of AR technology in language learning, there is limited research on the different areas of Education. Thus, this could bring some limitations to the current research due to the fact that, although the number of studies regarding this topic is growing, it has few research papers on this topic. In addition, further research could appear due to the last trend of using AR-based tools in language learning.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
ORCID iD: https://orcid.org/0000-0002-5387-8509
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] Altinpulluk, H. (2017). Current trends in augmented reality and forecasts about the future. In *Proceedings of ICERI 2017 Conference*, 3649-3655.
[2] Azuma, R. T. (1997). A survey of augmented reality. *Presence: teleoperators & virtual environments, 6(4)*, 355-385.
[3] Belda-Medina, J. (2021). ICTs and Project-Based Learning (PBL) in EFL: Pre-service teachers' attitudes and digital skills. *International Journal of Applied Linguistics and English Literature, 10(1)*, 63-70.
[4] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Integrating augmented reality in language learning: pre-service teachers' digital competence and attitudes through the TPACK framework. *Education and Information Technologies*, 1-24.
[5] Belda-Medina, J.. 2022a. "Using Augmented Reality (AR) as an authoring tool in EFL through Mobile Computer Supported Collaborative Learning". *The Journal of Teaching English with Technology, 22 (2)*, 115-135. IATEFL Poland. Computer Special Interest Group.
[6] Binhomran, K., & Altalhab, S. (2021). The Impact of Implementing Augmented Reality to Enhance the Vocabulary of Young EFL Learners. *JALT CALL Journal, 17(1)*, 23-44.
[7] Cabero-Almenara, J., & Barroso-Osuna, J. (2016). The educational possibilities of Augmented Reality.

[8] Caudell, T., & Mizell, D. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. *2(2)*, 659–669.
[9] Chen, P., Liu, X., Cheng, W., & Huang, R. (2017). A review of using Augmented Reality in Education from 2011 to 2016. In *Innovations in Smart Learning*. Springer Singapore, 13-18.
[10] Cheng, K. H., & Tsai, C. C. (2013). Affordances of augmented reality in science learning: Suggestions for future research. *Journal of science education and technology, 22(4)*, 449-462.
[11] Chiang, T. H., Yang, S. J., & Hwang, G. J. (2014). An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities. *Journal of Educational Technology & Society, 17(4)*, 352-365.
[12] Hawkinson, E. (2014). Augmented reality enhanced materials design for language learning. In *The Asian Conference on Technology in the Classroom*, Conference Proceedings, 2014, 155-161.
[13] Herpich, F., Jardim, R. R., Nunes, F. B., Voss, G. B., Fontoura, L. M., & Medina, R. D. (2014, May). Virtual lab: an immersive tool to assist in the teaching of software engineering. In *2014 XVI Symposium on Virtual and Augmented Reality*, 118-126.
[14] Hsu, T. C. (2017). Learning English with augmented reality: Do learning styles matter? *Computers & Education, 106*, 137-149.
[15] Ibáñez, M. B., Di Serio, Á., Villarán, D., & Kloos, C. D. (2014). Experimenting with electromagnetism using augmented reality: Impact on flow student experience and educational effectiveness. *Computers & Education, 71*, 1-13.
[16] Kerr, J., & Lawson, G. (2020). Augmented reality in design education: landscape architecture studies as AR experience. *International Journal of Art & Design Education, 39(1)*, 6-21.
[17] Küçük, S., Yilmaz, R., Baydas, Ö., & Göktas, Y. (2014). Augmented reality applications attitude scale in secondary schools: Validity and reliability study. *Egitim ve Bilim, 39(176)*.
[18] Marrahí-Gómez, V., & Belda-Medina, J. (2022). The Application of Augmented Reality (AR) to Language Learning and its Impact on Student Motivation. *International Journal of Linguistics Studies, 2(2)*, 07–14.
[19] Marrahi-Gomez, V., & Belda-Medina, J. (2023). The Integration of Augmented Reality (AR) in Education. *Advances in Social Sciences Research Journal, 9(12)*, 475–487. https://doi.org/10.14738/assrj.912.13689
[20] Punar Özçelik, N., Yangin Eksi, G., & Baturay, M. H. (2022). Augmented Reality (AR) in Language Learning: A Principled Review of 2017-2021. *Participatory Educational Research, 9(4)*, 131-152.
[21] Rabbi, I., & Ullah, S. (2013). A survey on augmented reality challenges and tracking. *Acta graphica: znanstveni časopis za tiskarstvo i grafičke komunikacije, 24(1-2),* 29-46.
[22] Taskiran, A. (2019). The effect of augmented reality games on English as foreign language motivation. *E-Learning and Digital Media, 16(2)*, 122-135.
[23] Wedyan, M., Falah, J., Elshaweesh, O., Alfalah, S. F., & Alazab, M. (2022). Augmented reality-based English language learning: importance and state of the art. Electronics, *11(17)*, 2692.
[24] Woods, T. L., Reed, S., Hsi, S., Woods, J. A., & Woods, M. R. (2016). Pilot study using the augmented reality sandbox to teach topographic maps and surficial processes in introductory geology labs. *Journal of Geoscience Education, 64(3),* 199-214.
[25] Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education, 62*, 41-49.
[26] Yeh, H. C., & Tseng, S. S. (2020). Enhancing multimodal literacy using augmented reality. *Language Learning & Technology, 24(1)*, 27-37.
[27] Zhang, R., & Zou, D. (2022). Types, purposes, and effectiveness of state-of-the-art technologies for second and foreign language learning. *Computer Assisted Language Learning, 35(4)*, 696-742.