Augmented reality (AR) in education: an exploratory analysis

Abstract

The use of new technologies plays an essential role in our lives and more specifically in education because of the improvement they represent in the educational process. Within the use of technologies, there are a large number of promising tools with advanced technology that are already being applied in the educational field. One of the most popular is augmented reality (AR). However, despite their growing importance, there is still a need to carry out more studies on these new tools, and more specifically, on the perception that users have of them. Therefore, the objective of this study is to analyze the reviews of the main virtual reality mobile applications (apps) that can be used in the field of education. For this, web scraping techniques will be carried out for the massive extraction of the reviews. The main result achieved in the current research shows the general dissatisfaction of users towards the functionalities of these apps considering that they are in a preliminary stage. The conclusions of this study show that the use of AR apps has not proliferated significantly in the educational field yet, although an expansion is expected in the future.

Keywords: Innovation; Apps, Reviews, Web Scraping

1 Introduction

Today, the use of new information and communication technologies (ICTs) [1] in the educational field is becoming more and more frequent, since these tools provide an enrichment to the teaching-learning process. Digital resources have come to stay in classrooms in particular and in higher education in general. In fact, it has been demonstrated that the use of mobile applications (apps) in education has great benefits [2]. The great development of ICTs in teaching has given rise to the appearance and evolution of a new type of applications called Augmented Reality applications (AR apps). In recent years, the presence of AR apps has increased

latently. There are many definitions of the concept of AR. According to [3], AR apps are known as modern e-learning apps, it is a sophisticated technology that helps the user to experience a semi-real environment that combines virtual elements, providing mixed reality in real time. However, AR does not replace the real world with a virtual one, rather it means maintaining the real world that the user perceives and complementing it with virtual information superimposed on the real one. In this situation, the individual does not lose contact with the real world at any time, but can also interact with the superimposed virtual information. [4].

AR apps are therefore considered as an advanced technology that can be used in teaching to help students approach information and their visual perception [5]. Augmented reality is a promising technological tool that is already present in many classrooms and that allows improving the educational process. In fact, several authors have shown in the literature that the use of AR apps has important benefits in education [6]. AR apps can be useful in fields of education because the modeling 3D can be very useful for students. For example, in engineering and more especially in the field of aeronautical engineering [7], mechanical [8], civil [9], design and manufacturing [10] etc. In addition, the creation of the so-called industry 4.0 is currently becoming very popular. where augmented reality is being used exponentially [11].

However, the process of implementing AR apps in education is becoming difficult, mainly due to their high start-up cost due to the technological advances required and the necessary access networks [12].

Currently, there are a large number of scientific articles that address the subject of AR. However, when it comes to AR applied to the educational field, there is a gap in the literature despite the growing importance of this type of apps and the positive benefits that its use could have in education [5, 13]. In addition, the vast majority of scientific studies carried out on AR and education focus on analyzing the use that teachers are making of these new tools. However, there are no studies in the literature that analyze AR from the users' point of view to know their perception of them. Therefore, this research aims to present the main virtual reality apps in education and the perception that users of AR apps have.

2 Methodology

The sample for this study is made up of the main AR apps in the educational sector. These are 5 apps: CoSpaces Edu, Augment, Assemblr, Escaner 3D and UniteAr. This sample is scarce because there are no more considerable AR apps in the educational sector. The data for each of the apps is summarized in Table 1, where it can already be seen that the ratings that users give to each app are not high.

Table 1. Sample summary

Augmented reality	*CoSpaces Edu*	*Augment*	*Assemblr*	*Escaner 3D*	*UniteAr*
Assessment	3,9	3,8	3,4	2,4	1,9
Reviews	928	32.146	5.198	2.684	1.085
Downloads	100.000	1.000.000	1.000.000	500.000	100.000
Release date	01/06/2017	01/04/2011	01/08/2018	01/03/2018	01/04/2018

The collection of reviews was carried out in January 2022. Reviews of the apps on Google Play are extracted. We use Rvest, an open-source software package, R, to make it easy to download, then manipulate, HTML and XML. It allows performing web scraping, which automated the collection process. In this way, through web scraping techniques, 1979 reviews were automatically obtained.

The web scraping´s basic process that we followed was to analyses the web page structure, continue parsing HTML content, later getting the URL to get the page source and so select data to start processing them.

In this way we obtain 100% of the population available on the web. That is, we take into account for the analysis all the reviews written of the AR apps. This has been verified when viewing the automatic scraping that has been carried out and the tool has reached the end of the web page where it has not been updated again because there is no more information available. And it is that Google Play is an infinite scroll page, so we cannot scrape your web page as is, since this would only collect the data of the first visible segment. To do this, to scrape this type of page, it is necessary to simulate human behavior so that the following content is automatically loaded on the web page and you can scrape all the necessary elements. This is repeated until the end of the page is reached. Thanks to obtaining all the reviews, it is possible to show conclusions that are closer to reality.

A text mining analysis was applied, where qualitative data were addressed. The content of the reviews was analyzed using algorithms to identify the frequency of each word and the emotions that the users have expressed in the reviews thus seeing them opine.

3 Results and discussion

The analysis previously carried out shows us a radiography of the perception of users of AR apps used in education.

In the first place, we show that there is a consensus in the opinion of the users of the different AR apps. Figure 1 shows how there are high correlations between the reviews received by each app. The reviews come close to an average of 80%

similarity between them. This allows us to carry out a joint study of all the augmented reality apps, without having to differentiate their reviews. Therefore, from this moment on, all the apps are analyzed together.

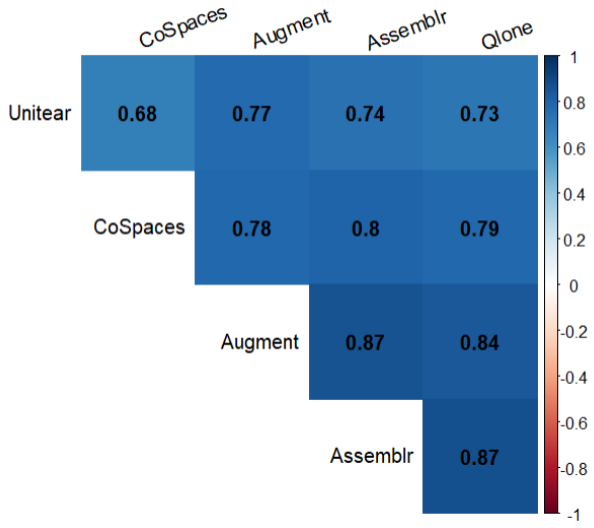

Fig. 1. Correlation of reviews.

Through the number of reviews that have been written each year, the evolution of the use of these apps can be drawn. This form of analysis is applied, since it is not possible to know the number of downloads each year, and it is also understood that the more downloads are made, the more reviews they receive. Therefore, we make the following estimate. Figure 2 shows us the evolution of the reviews that AR apps have received. It is appreciated that the evolution is irregular. At its inception, in 2011, its use was almost nil, but already in 2014 there was a large increase that would last only until 2015, since the next years (2016 and 2017) its use decreased considerably. However, again there is a strong rise, reaching almost 350 reviews during 2018 and 2019. But again, the use plummets in 2021 to close figures obtained from 2013. Almost ten years later its situation is similar, the use of AR apps is again low.

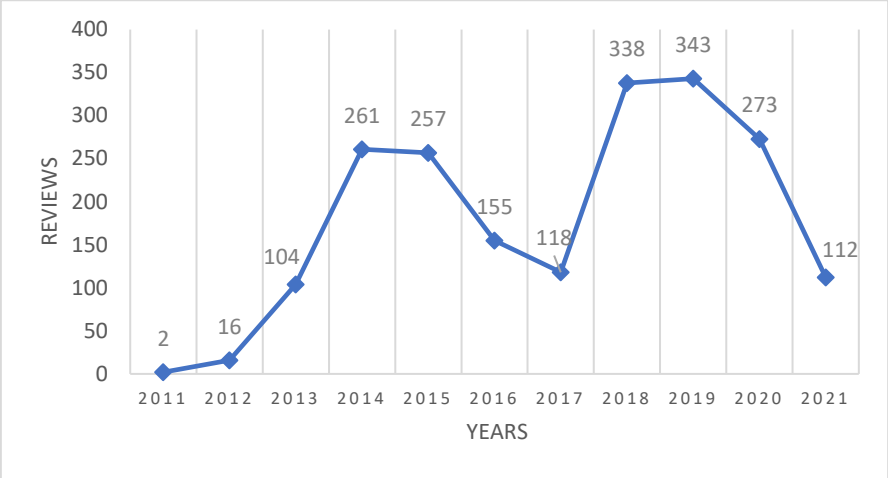

Fig. 2. Evolution of reviews.

To understand the perception of users, we identify what stands out the most both positively and negatively. That is why we divide the reviews into two sentiments: positive (4 and 5 stars rating) and negative (1 and 3 stars rating). For each feeling, the five most frequent words are obtained, which are collected in Figure 3 and Figure 4.

In the positive reviews, qualifying adjectives stand out, both to indicate the quality and simplicity of these apps. Instead, negative reviews indicate that users are concerned about gyroscope compatibility issues and app glitches, especially with the Samsung galaxy smartphone model. Although more positive than negative common aspects stand out, it turns out as previously indicated and as indicated below, the general perception of users for AR apps is negative.

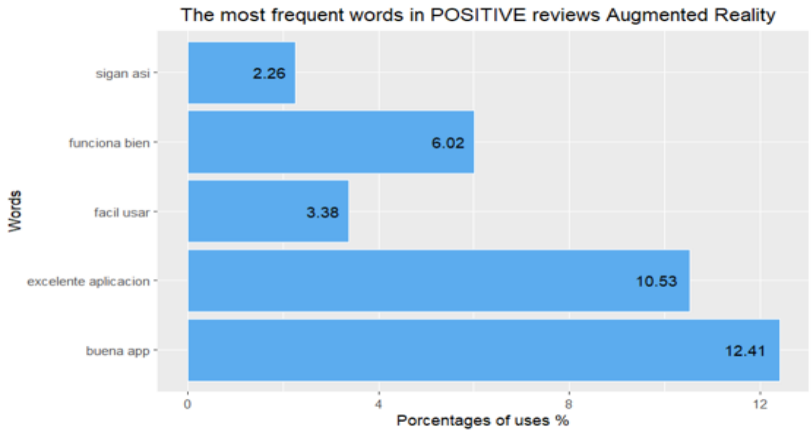

Fig. 3. Word frequency in positive reviews.

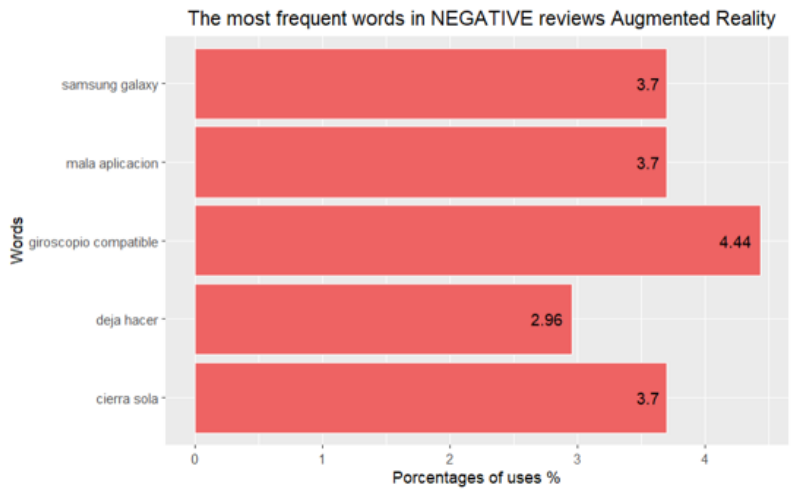

Fig. 4. Word frequency in positive reviews.

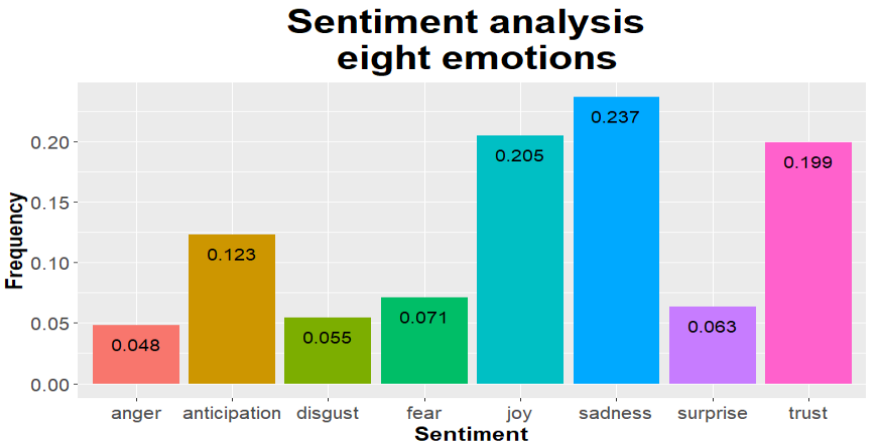

Fig. 5. Analysis of the eight emotions of reviews.

Finally, to better understand the perception of users, an analysis of the feelings that they have left impregnated in the words that make up the reviews is carried out. Figure 5 shows the proportion of eight feelings generated by AR apps. Users have mostly presented sadness after using these apps. However, despite the disappointment generated by the apps after the expectations placed on them, the experience of using this new support tool to learn seems very fun and generates trust for the potential it has when teaching in some classes. more dynamic and practical.

4 Conclusion

Regarding the conclusions of this study, it can be highlighted that in general the perception of users to the AR apps is negative. Specifically, the most popular AR application is CoSpace Edu, followed by Augment, Assemblr, Scanner 3D and finally Unite AR. Users point out that the applications does not allow you to correctly use all its features.

In addition, the conclusions of this study also show that AR apps began to be used exponentially after their launch in 2011. However, this use was cyclical and finally, it is from 2019 when the use of these applications is substantially reduces. This is due to the fact that initially the AR applications had high expectations on the part of the users but later, after their use, the users realized that these applications had little applicability and this fact caused their disuse.

As far as educational centers are concerned, and more specifically in higher education, this type of application has hardly had a place and, in fact, its use is relatively scarce. This may be due to the fact that universities are not yet prepared to implement these tools in their classes, since they do not have the necessary means to it. We must consider that in order to use these applications correctly, additional technological material is necessary, which universities do not generally have to date. It is expected that in the near future, these tools will begin to be used.

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