

Virtual and Augmented Reality, Application in Higher Education.

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Summary

Virtual reality is the representation of scenes or images of objects produced by a computer system, which gives the sensation of their real existence. In this sense, the main objective of this work is to analyze and investigate the way in which virtual and augmented reality have been constituted in an interactive scenario of learning in Ecuadorian higher education. To this end, the Technical University of Manabí and more specifically the Faculty of Humanistic and Social Sciences have been taken as a case study. From a quantitative, descriptive methodological approach and from a bibliographic-documentary approach, this study has investigated the knowledge about this technology and has assessed its usefulness in higher education. To this end, a survey was applied to 58 tenured professors of this academic unit. The analysis carried out has taken the teachers of this faculty as a perspective and the proposed time cut considered is the semester period between the months of October 2023 and February 2024. The results highlight the functioning of the virtual and augmented reality processes used in the Faculty of Humanistic Sciences, the difficulties in the use of these technologies, as well as their characteristics to improve the teaching and learning process. Factors related to usability and user experience were evaluated; including attractiveness, clarity, efficiency, manageability, stimulation and innovation. It is concluded with an analysis of this problem that there is a positive level in the valuation of the user experience and presents additional elements, potentially useful for educational institutions that evaluate the use of virtual and augmented reality as a support environment for their instructional processes.

Keywords: virtual reality; augmented reality; teaching and learning process; new technologies; higher education.

Introduction

Virtual and augmented reality provide additional tools to strengthen collaboration between computing and education, allowing tasks to be carried out faster and more securely. At the end of the twentieth century, the first prototypes of virtual and augmented reality systems appeared, very limited in terms of hardware. New advances in user interfaces, mobile devices, network connections, among others, have allowed these technologies to be more present. While initially these systems focused on improving people's lifestyles through everyday and entertainment applications, today these applications go further: tourism, navigation, education, geometric modeling, assistants for industry, military uses, among others.

Virtual and augmented reality in the field of higher education have become essential. The use made of them by both teachers and students has made it possible to advance in the teaching and learning process. The importance of this resource lies in the fact that it allows online training, using various strategies for learning, strategies that can be proposed by the teacher based on academic content in combination with the technological tools provided by academic platforms. In this way, they play a preponderant role at all educational levels. The main motivation of this research is the study of new advances in relation to virtual and augmented reality techniques that allow the development of new applications in the field of higher education.

The relevance of this research lies in the fact of its approach, considering these technologies as an interactive learning scenario, since they constitute an environment where all the factors that exist in the traditional classroom are found, but some of them, such as the students and the teacher, are separated both in time and in place. This educational environment expects the student to perform his or her learning task independently, and the materials of the specific courses must contain the concepts of teaching, as well as the opportunities for interaction available with virtual and augmented reality.

In Latin America, there are countries such as Guatemala, Nicaragua, and Paraguay where low percentages of teachers trained in these technologies are estimated, compared to Chile, Peru, Colombia, and Costa Rica, in which educational personnel are prepared at a high level with respect to the evolution of technological processes (Medina *et al.*, 2020).

The most advanced countries are those that tend to give rise to virtuality, since their experiences serve as an example to developing nations, it is important to mention that, in Mexico, for example, in the 21st century there are still limitations due to lack of teachers and technology, which prevents students from accessing a guaranteed and inclusive level of education (Toca & Carrillo, 2019).

In Uruguay, the use of technology related to virtual and augmented reality has been implemented for more than a decade, facilitating the adaptation of new educational literacy programs, through policies carried out by the state, which have allowed access to education and technological tools to many families in the country, expanding inclusion to a large majority of Uruguayan students of all ages and socioeconomic contexts. It is one of the emerging technological tools and its trend is increasing in relation to its application in the educational field. It is defined as technology that enables the user, through the use of a virtual reality headset, to immerse themselves in three-dimensional scenarios in the first person and in 360 degrees (Carabelli, 2020).

Over time, these new technologies have been gaining ground in different fields, especially in educational processes where virtual education models have been developed, strengthening collaborative learning between teachers and students to carry out activities in which it is possible to provide daily feedback and always rely on the tutor (Martínez and Jiménez, 2020).

Virtual reality can often be confused with augmented reality, but they are totally different terms, since augmented reality refers to the combination of elements of the real world and elements of the virtual world and is classified according to location (it recognizes virtual elements as a result of positioning systems) or images (virtual elements with techniques to detect images). The main difference between them lies in the fact that virtual reality generates a fully virtualized world without, like augmented reality, resorting to the introduction of virtual elements into real spaces (Aguirre, et al. 2020).

This type of technology aims to improve students' teaching-learning, showing them how to use technological tools that provide them with materials, allowing them to build new knowledge, skills, and abilities autonomously, using criticality, and building meaningful learning through new experiences generated in virtual interaction (Granados, 2019).

In Ecuador, it is considered that there is a society open to the technological system, where the use of virtual and augmented realities has begun to be promoted, providing motivations in the educational community, so that they are interested in the interaction that being part of this type of teaching entails, offering tools, ideas and creative digital models that attract the attention of the learner. that facilitates the incursion into this field, in addition, makes it more bearable to follow and close to the teacher of the activities they send daily with respect to the subjects they teach (Magallanes, et al. 2021).

The aforementioned studies served as the basis for establishing the present research. Virtual and augmented realities have been useful for both teachers and students to communicate properly in virtual learning environments. It is a strategy that allows improving academic processes, a good interaction between the members of the educational processes beyond a definitive physical space. This has led to the investigation of these resources as innovative interactive learning scenarios in Ecuadorian higher education.

Materials and methods

To analyze the implementation of virtual and augmented reality, as well as its use in the application in higher education, this research work based its methodological perspective on a quantitative, descriptive approach and from a bibliographic-documentary approach.

At this point, it is pertinent to determine that, according to Vizcaíno, et al. (2023), the quantitative method is one in which quantitative data on variables are collected and analyzed. At the same time, it tries to determine the strength of association or correlation between variables, the generalization and objectification of the results through a sample to make inferences to a population from which every sample comes. This approach was used in this work for the elaboration of the survey.

After the study of the association or correlation, it intends, in turn, to make causal inferences that explain why things happen or do not happen in a certain way. In addition, in this research he uses the descriptive method, whose purpose is to have a first knowledge of reality as can be seen from the direct observation made by the researcher and the knowledge he has acquired through the indirect information obtained (Vizcaíno, et al. 2023).

The proposed methodological triangulation is complemented by the bibliographic-documentary method that brings together the existing theory on the proposed object of study. It helps to analyze various documentary sources useful for the formation of the theoretical foundation and contributes to a greater understanding of the methodological issues of the research.

The technique for obtaining data is the survey, which was applied to 58 professors of the Faculty of Humanistic and Social Sciences of the UTM. It should be noted that in this work only the tenured professors of this academic unit have been considered.

Analysis and discussion of results

At the Technical University of Manabí (UTM) we began with virtual interaction, through platforms, this process had small technical difficulties and internet providers, but despite that they were able to overcome, resulting in the understanding of the activities and a good management of tools associated with Information and Communication Technologies (Angulo, et al. 2023). This section systematizes the data obtained from the survey carried out on 58 professors of the Faculty of Humanistic and Social Sciences of the Technical University of Manabí. Table 1 shows what is meant by virtual reality by teachers.

Table 1. Virtual and augmented reality as seen by teachers

Variables	Teachers	Percentage (%)
A virtual learning space located on the web	10	17
Virtual reality is an environment of scenes and objects generated using computer technology	8	14
The use of software, applications, and hardware that overlays digital content in real-life environments and objects.	28	48
A virtual space that is not used efficiently by students	12	21

As can be seen, 4 variables were incorporated, of which 17% of the teachers consulted indicated that virtual and augmented reality means virtual learning space located on the web; for 14%, on the other hand, it is an environment of scenes and objects generated by computer technology; while for 48% of teachers it is the use of software, applications and hardware that is superimposed on digital content in real-life environments and objects. Finally, 21% indicated that it is a virtual space that is not used efficiently by students.

As is often the case in any process, innovation has its resistances at the beginning due to its complexity, but frequent practice banishes any doubts about these procedures. The opinions of the teachers consulted are divided in this regard. Although there are standards that have not yet been defined in the use of these technologies, the use that has already begun to be made is significant. It may be that the conception that professors have is varied, but the use that is being given is an indication of how information and communication technologies play an important role in the teaching and learning process in higher education

Virtual reality is the creation of a fictitious or simulated environment or scenario with a totally real appearance and that allows us to move to any place or situation we want as if we believed ourselves to be inside it, with the illusion of being inside this environment. Augmented reality is a very important technological resource in higher education. This importance is determined by the specific characteristics offered by this technology, which is a complement to traditional resources. On the one hand, it is an interactive and easy-to-administer technology, and through its use we provide additional information (Montenegro & Fernández, 2022). He was consulted related to the operation of the virtual and augmented reality processes used in the Faculty of Humanistic Sciences, showing the results in table 2.

Table 2. Operation of the virtual and augmented reality processes used in the Faculty of Humanistic Sciences

Variables	Teachers	Percentage (%)
Very satisfying	20	34
Satisfactory	12	21
Unsatisfactory	22	38
Nothing satisfactory	4	7

In this second question of the survey, 34% of teachers rate the operation of virtual and augmented reality technologies used in the Faculty of Humanistic Sciences as very satisfactory, while 21% define it as satisfactory. For 38% of teachers it is unsatisfactory. Finally, only 7% of teachers classify it as unsatisfactory.

The operation of virtual and augmented reality may present some technical drawbacks, but its usefulness, much more so in this day and age, is not in doubt. The implementation of these technologies is relevant to the extent that it offers interactivity, communication, dynamism in the presentation of content, use of multimedia, text and elements that allow students with different learning styles to be served, all in the same place. To do this, the student must be motivated by the virtual learning environment, virtual classroom resources, and the permanent attention of teachers (Cabero, et al. 2019). This can be seen in Table 3.

Table 3. Difficulties in the use of virtual and augmented reality

Variables	Teachers	Percentage (%)
Lack of internet connectivity	10	17
The use of virtual and augmented reality is slow and confusing	8	14

The activities entrusted are not elaborated by the students	15	26
None of these technologies work perfectly	25	43

In this third question of the survey, teachers were asked about the difficulties they have had with the use of these technologies. For 17% it is the lack of internet connectivity; one 14% said that virtual and augmented reality is slow and confusing, while 26% said that the activities entrusted are not developed by the students. Finally, a significant 43% of teachers indicated that they have not had any difficulties, since these technologies work perfectly.

The drawbacks detected in the use of these resources reflect that the process initiated is arduous. Teachers have complications, many of them with the lack of internet connectivity in their homes. This can be solved gradually with the development of technological processes. What is worrying is that the activities are not sufficiently fed back in forums or chats provided to solve this type of problem raised.

When we refer to augmented reality, we are talking about a technology that is being applied in different areas of society, from dissemination, games and the industry itself to, of course, in the educational context. Augmented reality technology is a mixture of physical and digital information in real time through different technological supports, such as tablets or smartphones, to create a new reality. The mixture or combination of these two realities (digital and physical) can be implemented at different levels (Mystakidis, 2021).

Table 4. Features of Virtual and Augmented Reality Technologies to Improve the Teaching and Learning Process

Variables	Teachers	Percentage (%)
Share experiences and ask for student participation.	4	7
Mixed reality interaction as the space between virtual reality and the real world, where real and virtual objects are displayed simultaneously	24	41
Permanent interaction with students	4	7
Use all the resources of the virtual platform and not just a few	26	45

In the fourth question of the survey, teachers were asked about the characteristics that virtual and augmented reality should have to improve the teaching and learning process. 7% said that it is the fact of sharing experiences and asking for the participation of students. The same percentage said that the virtual classroom should allow interaction. For 41% of teachers, emphasis should be placed on the interaction of mixed reality as the space between virtual reality and the real world, where real and virtual objects are shown simultaneously. Finally, the remaining 45% indicated that all the resources of the virtual platform should be used and not just a few.

Technologies related to virtual and augmented reality are configured in educational innovation scenarios characterized by their flexibility, comprehensiveness, versatility, potentiality, and diversity, in which the teacher manages content, shares information, uses pedagogical resources, encourages students' skills and competencies through activities, promotes cooperative learning, and strengthens independent work. Virtual reality requires stereo vision and the qualitative differences between devices lie mainly in the quality of the panel they mount. As for augmented reality, there are two types of approaches: video display and transparent optical displays (Elfeky and Elbyaly, 2021).

Table 5. On training in the use of virtual and augmented reality technologies

Variables	Teachers	Percentage (%)
Always	3	5
Almost always	5	9
Occasionally	50	86

In the last question of the survey, teachers were asked if they have received training on the use of these technologies. In this regard, the vast majority, that is, 86%, indicated that occasionally, while 9% indicated that almost always. Finally, only 5% indicated the option always as an alternative answer.

Teachers need to be trained to be able to edit their courses and upload resources, among other aspects. It should also be considered that virtual and augmented reality presents an infinite number of resources available on the internet for self-taught learning. However, it is necessary for higher education institutions to train teachers at all times, because this type of resource is an effective tool that allows courses, topics, and content to be created and managed in a simple way (Vélez, 2020).

It is for this reason that through this research the procedures, usefulness, operation, difficulties and characteristics of virtual and augmented reality were determined so that they become an interactive learning scenario in Ecuadorian higher education; particularly in the Faculty of Humanistic and Social Sciences of the Technical University of Manabí.

Conceptual framework or development

Research into virtual and augmented reality technologies has been gaining ground to the point of consolidating themselves today as essential spaces for teaching and learning. In higher education, their use is not new, but it has become much more visible because they emerged as a resource. In this section, the theoretical foundation of this topic is analyzed.

Recent research indicates that this technology is gradually being incorporated into the field of higher education, to promote learning by discovery and experimentation, and thus meet the educational needs of students; whose teachers "do not need to learn to use them themselves. What teachers do need to know is how technology can and should be used by students to enhance their own learning. At this point, it would be pertinent to reflect on the integrative and inclusive use of ICTs as an educational response in general; and that of virtual and augmented reality, in particular in relation to teacher training (Granados, 2019).

Augmented reality is one of the technologies with the greatest impact on education in recent years. Different definitions have been made about this technology, but perhaps the most common is the one that characterizes it by combining real-world information with digital information through different technological devices. For Manresa (2010), most virtual reality applications are visual experiences where the participant is immersed and interacts in a virtual environment or scene.

This technology is characterized by combining real and virtual objects in a real environment, by aligning real and virtual objects with each other, and by executing them interactively in real time. This combination facilitates the approach and knowledge of the real object from different perspectives and through different supports (video, audio, images, url, text, 3D models, animations), managing to add information that is missing in the real world. In this way, the user improves the perception of reality through virtual elements. The use of this technology facilitates the synthesis and assimilation of academic content (Martínez, 2020).

These technologies have produced significant changes in education due to the implementation of new forms of knowledge transfer, since through these resources new paradigms are being created in the teaching and learning process. This means that virtual and augmented reality have become a powerful tool in educational technology, being able to develop the independence of knowledge in many cases and the virtual approach between teachers and students (González, 2019).

In this context, virtual and augmented reality favors the teaching-learning process, motivates the student and facilitates the understanding of content. What's more, this technology allows us to recreate different moments in history and bring the various disciplines closer together. This allows the information present to be expanded, influencing the attention and motivation of students in a decisive way (Bogost, 2010).

The advantages it offers for professional learning, because it allows simulated scenarios to be presented, thus avoiding possible dangers that may occur when carrying out certain practices such as those in laboratories. The importance of the inclusion of role-playing in the teaching of professional practices through augmented reality should also be highlighted (Ponce, et al. 2019).

Virtual and augmented reality systems have certain limitations, especially related to the quality of the immersive experience. The delay that can appear in virtual reality and augmented reality of low frames per second has a very negative effect on the experience, since humans are very sensitive to visual delays. A time delay between consecutive frames destroys the sensation of immersion and should be avoided to alleviate dizziness (Blas, et al. 2019).

These technologies are usually based on mobile hardware for the most part. In fact, this implies that the performance of systems in virtual reality and augmented reality is equivalent to that of desktop computers of approximately ten years ago. Therefore, it is necessary to develop optimization techniques, such as cloud computing or the use of levels of detail, to increase the frame rate per second as much as possible. On the other hand, interaction also presents a number of challenges.

A very typical mistake in certain systems is the presentation of excessive information to the user. This causes an effect called intentional blindness, defined as the lack of attention to a stimulus present in the visual field, not being associated with any disorder. The solution to these problems lies in reducing the number of details to be shown to the user to the minimum possible, forcing them to focus their attention on the most important aspects (Martínez, et al. 2021).

This virtual and augmented reality technology allows the creation of new immersive environments with virtual reality layers that position students in the simulation of situations and contexts that would only be possible in real situations. For example, each student can see the inner organs of the human body in three dimensions and understand, in a much clearer way, the process of eating. Also, contexts can be simulated, such as the purchase of a plane ticket and how it would be done virtually in a second language. This characteristic helps students to more easily acquire a series of skills that will facilitate the acquisition of the knowledge that is required of them (Cabero, et al. 2020).

On the other hand, in the field of education, virtual and augmented reality is one of the transformative technological advances with a great impact, as it allows the creation of interactive content that can be visualized to students and incorporate new educational information into printed documents. Similarly, its use in the educational context offers interesting possibilities, such as: adding relevant and significant information to the real world to make it more intelligible to students; promoting ubiquitous learning; the creation of safer simulated virtual contexts for students, favoring students to be designers and evaluators of educational materials with virtual and augmented reality technology and using training activities to promote learning (López, et al. 2019).

This technology is synonymous with innovation. They are currently characterized by being versatile, potential, comprehensive learning scenarios, with a diversity of content for the educational community. Through them it is possible to share a number of original and important information in order to strengthen knowledge, increase skills, promote learning and the autonomy of students. There are several benefits that stand out, among them are the material resources that are provided to the student, which do not need to be printed or photocopied, since they are delivered in digital format and are used in an organized manner (Han, et al. 2021).

The generation of knowledge in the contemporary academic modality is based on virtual and augmented reality. These have undergone changes since their appearance and have evolved gradually. This evolution represents amazing effects on learning and research. It is understood that the design of activities with the support of these technologies is a key factor for teachers in the planning of their courses, since it not only awakens motivation and interest in students, but also makes them autonomous in their learning by venturing and participating in tailor-made collaborative environments where reflection prevails. interaction and creativity (Vélez, 2020).

Educators have found a world of possibilities for the development of their teaching practice by integrating new technologies as another resource in the teaching-learning process, which has allowed them to promote and facilitate the participatory and creative attitude of students, the individualized teaching of interactive learning (Marco, et al. 2010).

For Amin (2010), among the benefits generated by the use of virtual and augmented reality in the learning of university students, are the following: it favors greater competitiveness, generates a culture in the use of new technologies to develop innovative teaching-learning models that adjust to the demands of society, provides technological tools to help and support the student and alternatives for monitoring and control the teacher, it promotes collaborative learning by having tools that allow the development of asynchronous activities complementary to face-to-face and distance teaching, through the appropriate virtual tools (Agurto & Guevara, 2023).

According to Chatfield, (2011), the way the teacher teaches changes, it is no longer necessary to use the blackboard and the spoken word as tools for communication, all the necessary information is available through virtual and augmented reality technology exposed in different ways; the teacher has the responsibility of managing the virtual classroom and its contents, carefully designing the learning objects that will be incorporated, as well as in the rebound and knowledge construction activities, clarifying doubts, inducing the performance of analysis, evaluation and knowledge creation activities by the student (Acevedo, 2019).

University education is no stranger to the various reforms that the present day demands. Hence, virtual and augmented reality in many higher education institutions went from mere accessories to essential resources for their optimal functioning. Many institutions

Educational institutions have made large investments in technology, and it is now common to see computer systems that support administrative processes. In several educational institutions, virtuality is used for the management of educational resources for computer support to education, with wide use worldwide, through which teachers create and manage academic content (Lovón & Cisneros, 2020).

The integration of these technologies in education can have various benefits for pedagogical work, which are: increased motivation, adaptation of learning rhythms, digital storage of resources and diversification of learning activities. Teachers often do not explore virtual learning environments to their full potential and only adopt a limited set of available tools, and some teachers share their courses with each other to strengthen virtual environments. In the same way, the teacher's attitude is important

and is a central element for the good use of new information and communication technologies in the classroom (Chávez, et al., 2021).

The implementation of virtual and augmented reality in higher education offers the opportunity to have a participatory atmosphere in which the student can interact, reflect and participate, satisfying needs, doubts and concerns, in addition, it allows the teacher to monitor the process that the student is obtaining during the teaching-learning process (Rodríguez & Grilli, 2019).

With these technologies it is feasible to use role-playing, where students use their creativity, stimulated by their imagination, reflecting on video games, celebrities, events, etc., it is important to orient these activities to the teaching exercise to which they are directed, in order to obtain the result that the teacher proposes. (González, 2019).

Virtual and augmented reality opens the door to new educational possibilities and to experiential and meaningful learning, since the student himself is in the middle of the action that is happening by being a participant in what is happening around him in the virtual world. In the coming years, the trend and production will increase, especially in this type of technology applied to education from the use of smartphones, since technology promotes the development of new ways of progress (Véliz & Gutiérrez, 2021).

Conclusions

Throughout this work, it has been possible to determine the main purpose of this study, which has been to analyze and investigate the way in which virtual and augmented reality and the way in which they have been constituted in an interactive scenario of learning in Ecuadorian higher education. This aspect can be identified above all in the results section, in which the Technical University of Manabí and more specifically the Faculty of Humanistic and Social Sciences have been taken as a case study.

The implementation of virtual and augmented reality of the Faculty of Humanistic and Social Sciences of the Technical University of Manabí constitute resources where teachers and students find a number of tools that allow permanent communication between users and that facilitate the interlearning of the academic year; in addition to the contents programmed for the subject. This shows spaces for teacher presentation, communication, opening hours, activities for the middle and end of the cycle, collaborative work, forums, chat, consultation, glossary, prezzi, wiki tasks, integrative work, projects, tests, evaluations, surveys and several. These spaces are useful because students quickly incorporate the virtual classroom as a fundamental tool for their learning, and with the guidance of the teacher they use it intensively to carry out their tasks. Virtual and augmented reality has significant potential for use in higher education and for fostering interaction between students and their teachers.

The initiative to put virtual and augmented reality technology into practice in higher education is the ideal scenario to offer a quality training and learning alternative, which is supported by having a team of professionals involved in the execution of good teaching practices in their didactic activities. their academic advisories, their tutorials and in their design of learning materials. Currently, implementing effective teaching practices with these technologies is a challenge that requires the adoption of a pedagogical model appropriate to online teaching and to the needs of students to enhance the use of technology in education. Therefore, it is necessary to increase efforts to promote effective online education, with results that favor student learning.

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