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AUGMENTED REALITY (AR) IN EDUCATION, MEDICINE AND INDUSTRY: A SYSTEMATIC REVIEW OF LITERATURE

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Abstract

Over the years, it has been observed how new technologies have grown as is the case with augmented reality. For this reason, it was pertinent to carry out a systematic review of the literature in order to establish and discuss the state of the art of the application of AR in education, medicine and industry. Therefore, 25 articles were analyzed in the homogeneous secondary databases IEEE, SciELO, Elsevier, ScienceDirect and EBSCO for the analysis of substantive variables (sample, thematic and countries) and methodological variables (designs and study periods) to continue exploring and understanding the trends of in-depth studies, considering a 7-year period of inquiry. As a result of this outline, the augmented reality state of the art was presented as a transcendental milestone and its amplitude within the constructs of this study, leaving open the need to investigate other contexts of approach to this topic of interest.

Keywords

Augmented Reality, education, medicine, industry, technology

1. Introduction

With the rapid advance of the applied sciences (technologies) of information, in its use, applicability and incorporation in different activities to be carried out in society, education, industry, medicine, economy, culture and lifestyles, various manifestations of this have been born in the course of the years to the point of already being part of the daily life of human beings (Heinze et al., 2017; Bernal et al., 2019). Thus, under this dynamism, new interrelationships appear between man and the computer and, in many cases, makes the virtual become reality, the real in virtuality and encourage the development and creation of new technological interfaces and innovations (Pérez, 2017).

Augmented reality is the term used to define a direct or indirect view of a combined real world physical environment as an element for the creation of a mixed reality in real time (Vidal et al., 2017). All this is reconciled thanks to a set of devices that add virtual information to existing physical information. This is the main difference with virtual reality, since it does not replace physical reality with an emulated one, the purpose is to add information of interest to the real world already established (Berrios, 2020). Augmented reality (AR) is interrelated with virtual reality (VR) technology, which is more widespread in society; some characteristics are evident, such as the inclusion of 2D and 3D graphical virtual models in the user field of vision; the difference is that the AR does not replace the real world, but maintains the real world that the user sees complementing with virtual information superimposed on the environment (Gómez et al., 2020).

In this sense, the AR is currently a technology that has been incorporated in most sectors of society including education, medicine and industry. Although its use began to be evidenced in the decade of the 90's (Merino et al., 2015), its approach has become novel at present by the expansion of the application constructs (Angarita, 2018). In this way, this technology is the object of research in various sectors, among which the educational one stands out for the application of the augmented reality for the improvement of the teaching process-learning, medicine for the approach of body replacements and rehabilitations and industry for standardization and ease of processes.

Recently AR glasses have been used in visual overlay of information such as text, images, videos, 3D virtual objects, and games, but several studies have shown that training based on systems that

use AR to promote the decrease of human-generated errors and optimize the time allotted for the complete task of ions, to solve problems faster with the same effort. In conclusion, it is necessary to identify the appropriate scenarios and design of appropriate learning experiences for different sectors. Specifically, apprentices should have products and portable device while performing real-time tasks. Based on the premises described above, a systematic review of the scientific literature was carried out in order to establish and discuss the state-of-the-art applications of augmented virtual reality glasses in 3 main axes: education, medicine and industry.

2. *Materials and methods*

Based on the nature of the research and in order to answer the objective and question of study, the present article was based on a methodology of systematic review of the literature (Quispe et al., 2021; Aguilera et al., 2021). To ensure rigor and compliance with certain quality criteria, a series of standardized phases were developed in the preparation of systematic review (Moreno et al., 2018; Palacios et al., 2021; Bermúdez, 2021), among which is the clarification of basic concepts, fixing the need for review, design of research questions, management of search equations and databases, definition of processes, establishment of inclusion and exclusion criteria, flowchart design and organization of results.

Another parameter of importance within the research is the protection of quality standards and the PRISMA declaration for systematic reviews clarified by (Urrútia & Bonffil, 2010); thus, the description of the eligibility criteria was collected, sources of information and search, the process of selection of studies, extraction of data and synthesis of results. The articles included were analyzed in terms of methodological quality according to an evaluation protocol prepared for this study, composed of 12 quality criteria related to the studies. This instrument was modified from (Stanlenhoef et al., 1997), which is concerned with key parameters for the identification of systematic errors and originality, related to case studies, field studies, observational, analytical and narrative.

The initial search was carried out by 4 reviewers independently by means of the title using several keywords and the combination between them. In the background, the search equations were formulated based on key Boolean terms in the study guide related to "Augmented reality glasses", "advanced technology", "industry and applied medicine", "didactic resources", “EnseñaAPP". In order to not limit the results, descriptors were included in the international construct, these terms were finally translated and structured in a way described in Figure 1. It should be noted that the keywords that promoted the inquiry were determined by means of traditional methods of reconciling repeated words "Repetition detector 2" available at: http://www.repetition-detector.com/? p=online which turned out to be a friendly tool for addressing Boolean terms for analysis.

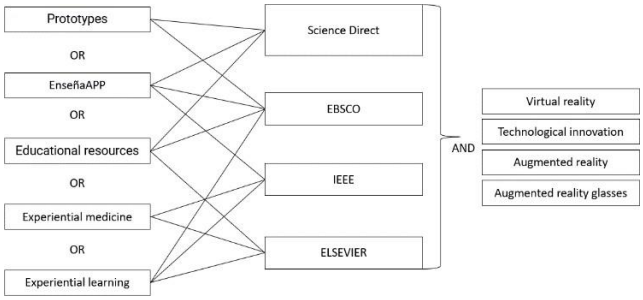

Fig. 1: Combination of Boolean terms and keywordsfor information search. Source: author’s own work, 2022.

Consequently, the search was established in primary and secondary sources of information in the homogeneous recoverable databases IEEE, Scielo, Elsevier, Science Direct y EBSCO. The choice of these databases responded to the indexes impact evidenced in JCR and SJR and the indexing of scientific articles in peer-reviewed journals that have clarified a rigorous process for these, present in these databases. In the case of the IEEE the search was realized with the SSCO Social Science Citation Index and SCIE Science Citation Index Expanded indices. It should be noted that the search in these databases relied on these Boolean terms or keywords to reliably consolidate the information (Figure 2).

2.1 Review process and establishment of study sample

The procedure for obtaining the sample was divided into three distinct phases from the introduction of the inclusion criteria. These criteria respond to: a) original articles and documentary review of indexed journals, b) publications within an investigative period from

2015 to 2022, c) open publications and available for consultation, d) experimental studies, e) empirical studies on the subject of study; exclusion criteria responded to: a) conference proceedings, b) restricted access to publications, c) applications n other study contexts, d) academic studies, e) duplicated articles, f) scientific productions outside the investigation period.

Fig. 2: Key expressions for the search. Source: author's own work, 2022

Thus, the first phase consisted in establishing the iteration of search equations in the databases elucidated in the figure above, the second phase consisted in the application of inclusion and exclusion criteria in filtering options in databases; and finally, all titles, summaries and keywords were revised to apply the inclusion criteria again. The PRISMA flowchart collected the process followed and refined from the scientific articles until a definitive sample of 25 scientific productions was established, this being evidenced in Figure 3.

2.2 Analysis variables

The variables were classified in two aspects according to the type of information contained in each scientific production of the categories to be discussed that represent the research. Thus, they are condensed into substantive and methodological variables (Villamizar et al., 2016; Semaja, 2018). In the development of the study, reference was made to all those data contributions that could influence the study as substantive variables, these are sample sizes, study topics, study area and countries of scientific production; and, as for the methodological variables describe the research process as the methodological designs addressed and the duration of the studies. To these variables were added three main axes of

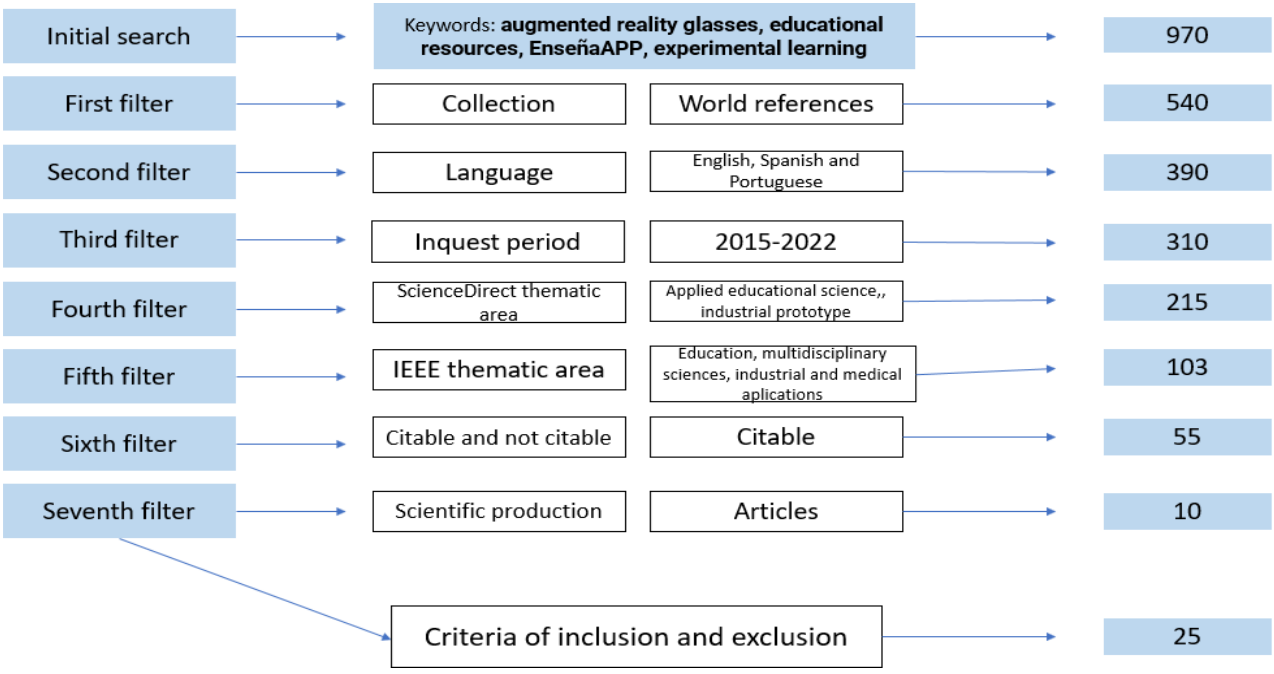

Fig. 3: PRISMA flowchart of the systematic review process. Source: author's own work, 2022

analysis such as the applications and approaches of augmented reality in education, industry and medicine.

2.3 Data analysis

The analysis was carried out in synthesis of the filtration described phases, in the first phase the initial sample was established and filtered and concretized by means of the inclusion and exclusion criteria until reaching the last phase. In each sample establishment consolidated after phase 3, a rigorous reading of the title, summary, methodology, findings and conclusions was made.

However, once the sample was clarified, for the extraction of information we used traditional methods of data analysis templates addressed by Microsoft Excel software for the realization of a synthesis matrix, in order to analyze the information in a concise way to determine aspects of interest and to capture them for the findings final approach.

3. Results

The results of the systematic review were developed in detail at this stage. The analyzed articles address the applications of augmented reality glasses understanding the state of the art in industrial, educational and medical disciplines. These articles aimed at rigorous discussion, methodological steps and synthesis of information over the years to facilitate understanding and application in these disciplines.

Consequently, a summary matrix of the documents considered in this research was presented (Table 1), which allowed to have a structured panorama of logical form that introduces in a sequential and reasonable way the information that had as purpose the relation, easy reading and comprehension by the reader, highlighting relevant aspects that support scientific research and promote the visualization of the findings required for the process of comparison and discussion of the subject.

Tab. 1: Summary matrix of the systematic review

N.°	Title	Author and year	County	Thematic area	Impact
1	EnseñAPP: Augmented reality educational application for the first cycle of primary education	Castellano & Santacruz, 2018	Spain	Education	Attraction of a dynamic learning, favoring the teaching-learning process
2	Rehabilitation through virtual reality therapy after a stroke: a literature review	Montalbán & Arrogante, 2020	Spain	Medicine	Efficiency in body movements in isolation
3	Augmented reality in medical training: Experiences and future perspectives	Sanchez & Fernández, 2022	Spain	Medicine	Technology can enhance hands-on learning and the acquisition of clinical skills.
4	Influence of augmented reality for management of orders in restaurants	Gamboa et al., 2018	Peru	Industry	Increased customer loyalty, efficiency in offices, management effectiveness
5	Augmented reality: digital resource between the real and the virtual	Alvites, 2015	Peru	Industry	Documentary description of technological development, fields of application and innovation software
6	Augmented reality in primary education: ystematic review.	Rodríguez, 2021	Spain	Education	Increased interest in improving the teaching learning process

7	Innovation in the university classroom through augmented reality. Analysis from the perspective of Spanish and Latin American students	Cabero et al., 2021	Spain	Education	Development of cognitive and competence skills
8	GLIMPSE: Google glass interface for sensory feedback on micro electric handpieces	Markovic et al., 2017	Serbia	Medical industry	Beneficial interface for prosthetic control
9	Designing an augmented reality app for teaching an online follower	Solís et al., 2020	Mexico	Educational industry	Mobile application online for online teaching and learning
10	Student feedback on augmented reality mobile app and content developed in science class	Karagozlu & Ozdamli, 2017	Cyprus	Education	Development of effective educational material for student learning.
11	Close-up view of the augmented reality eye using Pancharatnam-Berry phaselenses	Seokil etal., 2019	South Korea	Industry	Principle feasibility of a DHOE chromatic system
12	Application of ICT and augmented reality as an initiative for the enhancement of architectural heritage	Agüero,2021	CostaRica	Education	Clarification of a relationship between culture, tourism and technological advances in order to promote social interaction
13	Augmented reality applied to motor rehabilitation: Advances and challenges.	González et al., 2022	Spain	Medicine	Highlighting the benefits of this technology in improving the functionality and recovery of patients.
14	Virtual archaeology applications for heritage education: trend analysis and research	Rivero & Feliu, 2017	Spain	Education	Contribution to education heritage through virtual archaeological reconstruction
15	Learning the basics of augmented reality through the game Pokémon go and its possibilities as an educational measurement tool in Latin America	Gutiérrez et al., 2018	Colombia	Education	Understanding the cognitive functional basis for the learning process
16	Augmented reality to support the training of industrial engineers	Álvarez etal., 2017	Chile	Education	Approximation of theoretical foundations to reality through ICT
17	Virtual reality and its applications in mental disorders: a review	Brito & Vicente, 2018	Chile	Medicine	Methodological contribution to access to therapies for mental disorders such as anxiety, depression
18	Virtual reality as a complementary treatment in pain relief in burned children	Scapin et al., 2020	Brasil	Medicine	Technological effectiveness in reducing pain from second and third degree burns

19	Educational use of immersive virtual reality with natural user interaction focused on wind turbine inspection	Canton etal., 2017	Mexico	Industry	Technological convergencetowards a technologicaltool motivating immersion learning
20	Effect of a four-week virtual reality- based training versus conventional therapy on upper limb motor function after a stroke	Schuster et al., 2018	Switze rland	Medicine	Training design through virtual reality optimizing the potential of the upper extremities to 45%.
21	Multiview reconstruction of real-world dynamic objects and their integration into virtual and augmented reality application	Ebner et al., 2017	Germany	Industry	Enlargement of the three-dimensional mesh simple in the reconstruction of glasses and its application in different areas.
22	DARGS: AR dynamic guidance system for indoor environments	Gerstweil er et al.,2018	Austria	Industry	Dynamic path calculation algorithm for orientation and location guidance
23	Proven effectiveness of augmented reality in learning cardiopulmonary resuscitation	López et al., 2021	Spain	Medicine	Increased reality effectiveness in learning methods for cardiopulmonary resuscitation.
24	Augmented reality as a didactic technique in the teaching of calculus subjects in higher education. Study case	Berumen et al., 2021	Mexico	Education	Promotion of attention and interest in the subject through augmented reality improve the learning process by 78%
25	Digitization of engineering education: from technology-based learning to intelligent education	Mendoza,2019	Bolivia	Education	Proposals to improve the educational process through augmented reality that promotes motivation and improvement of the teaching-learning process
26	Application of augmented reality in the manufacturing industry: A practical approach	Rodríguez & Fernández, 2022	Spain	Industry	This technology can improve the efficiency of processes and facilitate the training of workers.
27	Application of augmented reality in laparoscopic surgery: Improving precision and safety	Matínez & García, 2022	Spain	Medicine	Improve the precision of surgical procedures and increase safety for patients.
28	Augmented reality for history education: a case study in Germany	Müller et al., 2022	Germany	Medicine	Enrich the teaching of history by providing students with an immersive experience.

The content analysis of the 25 articles that make up the sample has allowed us to establish the information concerning each of the analysis variables. Most of the publications were concentrated in 2018, 2021 and 2022, representing 72% of the sample.

The exhibition of the results has been grouped around the data collection and type of approach to the subject in such a way as to weave the information until the main idea is concretized and answer the question of research. What is the state of the art and impact of augmented reality glasses on educational applications, industrial and medical?

3.1 Substantive variables

In reference to the sample size of the studies, these empirical, original and documentary review investigations on the subject vary between study samples belonging to students of university higher education classroom, experimental and control group of medical patients and low voltage industrial applications. The topics where this type of approach is implemented or presented present 3 variations covering different fields of knowledge, highlighting education (pedagogy, methodological material and mathematical sciences) with a binomial scope, that is, the approach with alternatives to improve teaching and learning, the industry where it is sought to facilitate the intrinsic processes within a business construct and medicine where regeneration and rehabilitation are covered as milestones of application of this technology, Thus, within these branches are reconciled that can be clarified in figure 4.

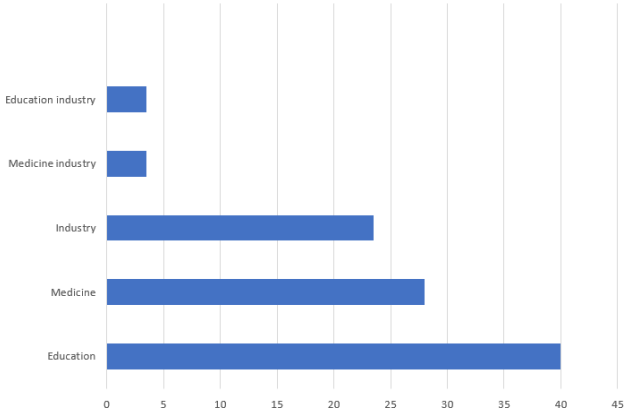

Fig. 4: Thematic items in %. Source: author's own work, 2022.

With regard to countries of scientific production, this being also a substantive variable, augmented reality is an object of interest in different parts of the world, highlighting Spain as the country with the most productions within the present systematic study representing 32% of the studies, followed by Mexico (12%), Peru and Chile (8%); and, finally, Bolivia, Serbia, Austria, Germany, Switzerland, Brazil, Cyprus, Costa Rica, South Korea, Colombia (4%), this can be seen in Figure 5.

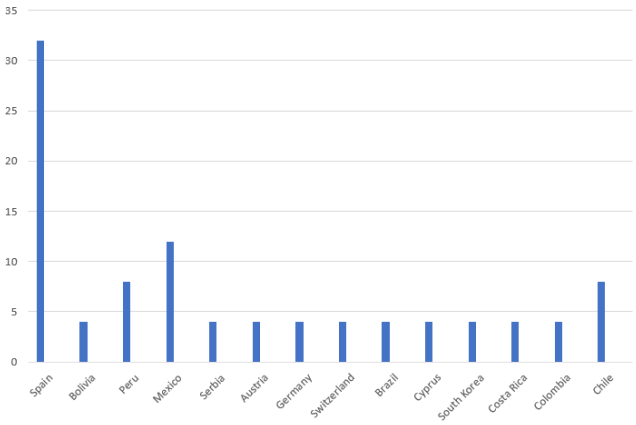

Fig. 5: Countries included in the systematic review. Source: author's own work, 2022

3.2 Methodological variables

Emphasizing the methodological designs and duration of the studies, within the research the original articles predominated (85%), which in turn, in their methodological approaches were applied experimental and nonexperimental designs with control and experiment groups, pre test and post test measurements and also other designs applied as analysis of sense units within educational institutions with study periods of minimum 5 weeks and maximum 60 weeks, however, the trend marked quarterly studies (3 months). Systematic reviews, documentary reviews of 1 year (52 weeks) information collection periods were also positioned within the analysis.

4. Discussions

The conceptualization of augmented reality (AR) within the construct of this systematic review has been analyzed from different perspectives.(Vidal et al., 2017) clarifies that it is "the combination of real environments, to which

information is incorporated in digital format in order to expand what the senses capture about a real situation". Meanwhile (Berrios, 2020), mentions that the AR has the potential to combine the real with the virtual, without the user losing contact with reality. On the contrary, it receives rich images and graphics of reality making an ideal complement to the structures of the environment. (Gómez et al., 2020), establishes that AR is an appropriate technology that groups those technologies that access the real-time superposition of forged content in a virtual way on elements of the real environment. For (Merino et al., 2015; Angarita, 2018), the AR condescends enrich the real world with applications of various types of virtual media, which are expressed through a computer, making a balance of coexistence in the same space real environments and virtual objects.

Having made this conceptual exception, in this research we address the AR as a rough diamond technology (novel) that, although it is true, its initial approach was in the 90s, currently under a broad application spectrum, this creates a blurred line between the real and the virtual, bringing as a consequence that the subconscious does not distinguish differences between these two environments by the approach of superposition, traversing an extensive consolidated of applications (figure 6). Consequently, AR has been used in aspects of visual overlay of information such as texts, images, videos, 3D objects, games, among others, but mainly it has been shown that training based on an AR system promotes the reduction of error generation and promotes the optimization of the time allocated for a job, task and studies to solve a problem with minimal effort, thus, this discussion is condensed into 3 main axes of application, synthesizing the state of the art in the educational, medical and industrial areas.

4.1 Application of AR augmented reality

Both in education and in medicine and industry they have required the support of tools that allow to mitigate in some way the problems that arise with patients, students and environment that requires an optimal sustainability of life (industry)and to seek new technological alternatives to help achieve this common goal. From this perspective, AR becomes one of the applications that has entered these areas with various developments and uses. One of the incursions into education with the aim of improving teaching-learning through students' interest is the increased book, this allows to provide mixed communication environments between the printed and digital content of the technological book, this broadens the communication, as well as the understanding of

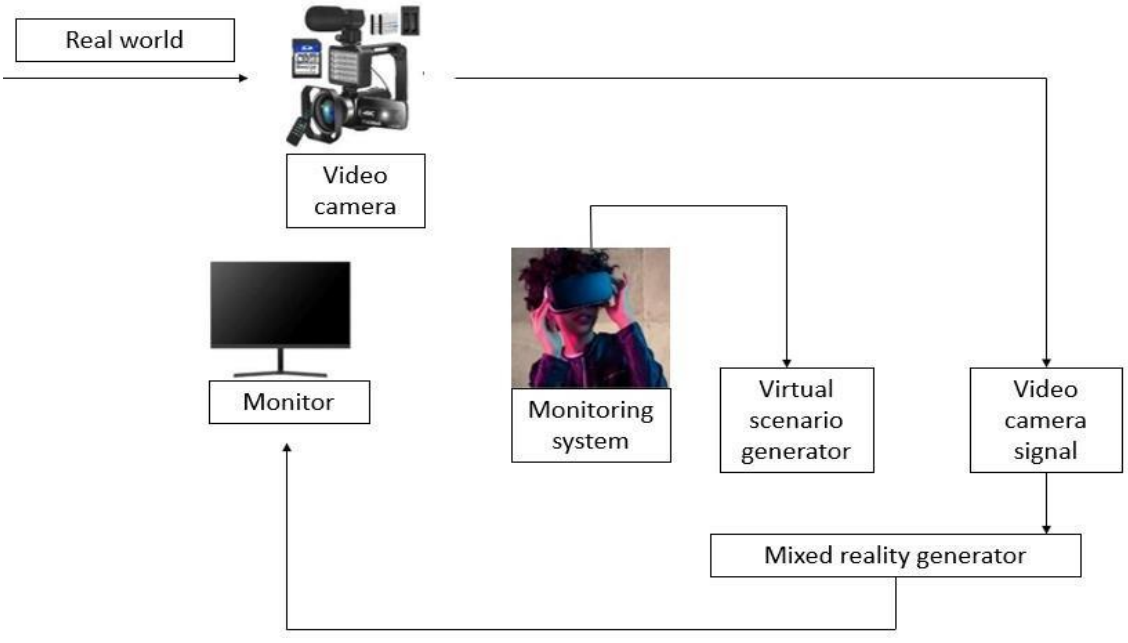

Fig. 6: Conceptual diagram of augmented reality. Source: author's own work, 2022

the material generated by the text becoming novel and interesting (Alvites, 2015; Castellano & Santacruz, 2018).

For their part (Álvarez et al., 2017; Rodríguez, 2021; Cabero et al., 2021) mention that through a technological approach based on a system of recognition of markers, symbols, activators, to which digital content has been anchored as audio, videos and recreations in 3D, interlacing reality and the virtual world, the virtual support material constitutes panoramas in which students interact, through reading with a virtual facilitator, objects, animations or characters in real time (Canton et al., 2017); it provides a high level of content of images which favors a greater orientation and ease of understanding of reading the narrative sequences by students (Cabero et al., 2021).

(Agüero, 2021; Gutiérrez et al., 2018), highlight that there is significant evidence in the application of AR in terms of motivation, dedication, coexistence and immediate contact with reality in areas of knowledge such as mathematics and experimental sciences, by offering the opportunity to experience and live contexts that would otherwise not be possible to reproduce and manipulate in real life. An elementary part of this implementation in the educational construct currently goes hand in hand with the conjuncture caused by SARS-CoV-2, where classroom learning is restricted due to the existing precariousness, this has brought with it consequences where the main one is school dropout and frustration, where the motivation to continue in cognitive development has been lost (Berumen et al., 2021; Rodríguez, 2021). The application of augmented reality has yielded results in the initiative and interest of the positive student union which indicates that it must give continuity with the approaches of case studies whose dimensions promote the overall educational implementation (Mendoza, 2019), in turn, AR in the educational context promotes a sociodemographic study to know the limitations of users in the acquisition of this type of educational approach.

(Gutiérrez et al., 2018), for their part have established implements through Google Glass, Android smartphone and web platforms to assess critical thinking skills in solving students problems in order to check the usability of the system and the effectiveness of learning, this concerns a focused and structured pedagogical methodology where the margin of error is verified and evidence by means of tests the critical level of students and the level of educational response through these applications (Karagozlu & Ozdamli, 2017).

Secondly, there is the medical construct, where in this systematic review was evidenced technological applications in books of cardiology and neurology 3D (Montalbán & Arrogante, 2020), where the physician or even medical student will be able to visualize the anatomy of these organs and the morphological changes that may be consequences of cardiac and cerebrovascular pathologies, allowing the reader to internalize the pathology in 3D, evidencing the pathophysiology and the way it should act under the therapeutic lines, as well as incisions, echocardiographic approaches, resonances and understanding of hemodynamics and neuronal movement (Álvarez, 2021; Viñas & Sobrido, 2016; López et al., 2021; Schuster et al., 2018; Scapin et al., 2020).

The articles analyzed refer to the use of AR in the medical fields of optometry (Markovic et al., 2017), this refers to the use of glasses with high-capacity automatic focus, what could potentially replace conventional glasses with the real and virtual world, optimizing vision, still under study the calibration of this method to improve vision and sharpness of objects and environments (Schuster et al., 2018). Another application within optometry is the development of smart technology in real time through computer vision algorithms and facial recognition to detect early loss of peripheral vision (Seokil et al., 2019).

In terms of mental health, it is evident in the systematic approach monitoring systems in patients with mental disorders such as schizophrenia, depression, anxiety, among others, by visualizing behavior patterns and formulating information through feedback, where similar situations occur through the AR of other studies where the patient through virtual inclusion feels engaged with the dynamics and there may be a sensorimotor shock where closure is achieved that inhibit the patient's release (Brito & Vicente, 2018; Viñas & Sobrido, 2016). In summary, in the area of mental health, the aim is to reduce stigmas related to managed mental disorders in order to improve sensory perception by patients.

Finally, at the industrial level, (Canton et al., 2017; Ebner et al., 2017) describe that in marketing and sales processes are contexts where augmented reality is applied. In marketing it has had inclusion due to the capture of attention by consumers, allowing access to striking virtual experiences in order to promote a product or

service (Alvites, 2015). In sales, it also provides the opportunity to check the results of a product without having to have to purchase it (Gamboa et al., 2018). One of the most relevant industrial applications is the technological approach at the level of smartphones which has allowed a practical experience for the user in different aspects.

Tourism, since this is a large industry is another thematic line where the AR is applied with great emphasis on the enjoyment of museums without the need to be in them properly (Solis et al., 2020; Agüero, 2021). This is achieved through guides and personal assistants who accompany during the tour of the various virtual rooms and provide the historical information necessary for the understanding of art and culture (Rivero & Feliu, 2017).

The contribution of the AR in the area of the engineering industry has been of great support to the initial approach of prototypes and their simulations before making reality the model, algorithmic runs and structuring in software have established the behavior of boilers, engines, compression chambers and others (Canton et al., 2017). Another relevant aspect within the engineering construct has been evidenced in electronic (low voltage) and electrical (high voltage) approaches, where material bonanzas have been verified since the virtual addition of characteristics, for example, three-phase transformers, tesla towers, microprocessors, safety circuits and signage (Seokil et al., 2019). Another aspect of relevance evidenced in this review is the automotive and industrial assembly without being present in the work area, but remotely operate robotic hands and arms that run the job while adding the processor algorithm and by means of augmented reality desire perform the industrial sketch (Alvites, 2015).

Another important aspect must be considered within the approach of augmented reality and is the breadth of knowledge, that is, the idea is possessed but not materialized by the broad application context, which represents a disadvantage since this construct can be applied from the anthropic intervention of ocular macula to significant attack of mental disorders, which means that this line of research is constantly developing, facing barriers of dissemination and concern on the part of users, organizations and societies. However, it can be added that currently technological entrepreneurship is of major what exists a wide range of software for the creation and animated recreation of augmented reality with a variety of contexts, in areas not yet explored, both for professionals and non-professionals, with extensive programming knowledge and with only basic foundations, giving the possibility to explore new research trends through the approach of augmented reality.

4.2 Cultural heritage

Regarding cultural and environmental heritage, Pérez (2018) points out that augmented reality offers significant opportunities for the documentation of cultural and environmental heritage. Through the use of mobile devices and specialized applications, it is possible to capture high-quality three-dimensional images and data, allowing the creation of accurate digital models that represent the heritage in detail. According to Rodríguez et al. (2019) highlight that documentation through augmented reality allows the conservation of valuable information on cultural and environmental heritage. The generated digital models can be stored and shared, ensuring the preservation of cultural memory and facilitating its accessibility for future generations.

On the other hand, Lopez et al. (2021) mention that augmented reality allows the virtual restoration of damaged or lost cultural heritage. Through digital reconstruction, it is possible to recreate architectural elements or historical artifacts, giving visitors the opportunity to experience and understand what they looked like in their original state. Similarly, Martínez (2022) highlights that augmented reality enriches the enjoyment of cultural and environmental heritage by offering immersive and personalized experiences. Visitors can explore virtual environments, access contextual information and engage in interactive activities, fostering a greater understanding and emotional connection to heritage.

5. Conclusion

Augmented reality, as a learning teaching strategy, is one of the tools that allows students to be motivated to face problem situations in a practical way, without causing any physical or psychological harm. It also gives them the possibility to include additional information in video, text, diagrams and other formats.

Augmented reality, as an emerging technology, can be used with markers or geolocation. It allows

theuser to recreate situations that could not actuallybe performed, as is the case with medical sciences, natural sciences or experiments. It gives the feeling of being in the past or in a certain place (say: a museum, a park, a country, among others). Augmented reality has penetrated all fields, not only formal but also informal, business, medical, teaching, industry, commerce, military system among others. A clear example of this is in the tourism sector, since it can provide general and specific information provided through geolocation. Within this one can be mentioned the museums, in which the use of markers has become more common, since it allows users to interact with the virtual object as if it were real, through the manipulation of the markers, allowing the virtual object to be inserted into the museums real space. Having augmented reality as a resource or didactic tool, advertising, training among others for various fields provides the possibility of exploring new ways of teaching and learning, of providing information, data and a wealth of exploration in unthinkable situations. Therefore, AR should not be overlooked or kept incipient in the world, but should be considered as a strategy with this "generation Z" who are the ones who have made this technology emerge and is constantly mutating, becoming more versatile and dynamic.

It is hoped that this research will serve as a precedent for future research of interest in the topic studied. However, it should be noted that this investigation was limited by having established exclusion and inclusion criteria, therefore, for future investigations, it is recommended to include documents recovered in other databases, as well as extend the period of inquiry of the studies consulted, and include other publications in languages other than English, Portuguese and Spanish, in order to find other studies excluded in the present study.

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