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ORIGINAL RESEARCH ARTICLE

Virtual reality as a tool for fundamental and vocational education

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ABSTRACT

This article is a contribution to the research on the implementation of virtual reality as a tool for teaching and learning processes, especially in the field of fundamental and professional education. For this purpose, virtual reality is analyzed as an alternative to ensure the quality of the educational process, which is particularly urgent given the current situation of physical distancing due to the pandemic. This research investigates already published works whose contributions can be considered adaptive, which have been developed and applied in fundamental and professional education environments, and which have successfully demonstrated effective results in the educational process. As a conclusion, the potential of virtual reality as an educational tool is clear for all to see, although it is not always the most appropriate, so its use must be carefully evaluated and defined.

Keywords: distance education; fundamental education; higher education; pedagogical innovation; virtual reality; information technology

1. Introduction

The concept of virtual reality, at first glance, may seem incoherent, so it is necessary to pay attention to the definition of the terms that compose it. The meaning of the word reality, according to Michaelis and Michaelis[1], derives from the Latin realitas, 'things', as opposed to fiction; it is what exists, what is true. In contrast, the meaning of virtual, also from the Latin virtualis, is that which is not real, practicable, feasible or possible. This same author brings the definition of virtual reality within the field of computer science as the natural form of interaction between a person and a computer through the user's immersion in a virtual environment[1]. From these definitions, it is more coherent to link both terms if we take into account the purpose of making something virtual real. According to Tori et al[2], the meaning of virtual is best understood when it is considered as something that can potentially be achieved, materialized. This helps to reconcile the two terms.

It is important to consider the three pillars that underpin virtual reality: realism, involvement, and

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interactivity. These pillars will help in this work as they lead to the main goal of virtual reality: immersion.

The virtual reality experience involves inserting the participant in a scenario very close to the real one. According to Sherman and Craig[3], such insertion can be attractive, since the user can interact with the virtual object. Thus, cradled by Jaron Lanier, the term virtual reality is related to the concepts of the real and the virtual, which are of central importance and create a new concept for this technology[4].

According to Tori et al[4], virtual reality relates to an "advanced user interface", whose characteristics involve visualization and movement in three-dimensional environments and interaction with elements in that environment in real time. For these authors, the experience of user interaction with the real world can be accepted through the stimuli of the human senses: sight, hearing, touch, taste and smell. According to Cardoso et al[5], virtual reality is a computational system that allows the creation of artificial environments by the user. In this type of environment, it is possible to interact, navigate and immerse oneself in a three-dimensional space using multisensory channels. Other definitions can be found in Liu et al.[6] and Ancioto et al[7].

On the other hand, the concept of ubiquitous or pervasive computing is used to des- cribrate the presence of technological resources in people's daily lives, in order to make the interaction between humans and computers imperceptible, i.e., to integrate technology with people's natural actions and behaviors[8]. It is from this concept and through virtual reality that we can have a more natural and powerful human-computer interface. Virtual reality or augmented reality, which also refers to our object of study, is a type of technology with high dependence on real-time processing. Computational developments in these aspects, both hardware and software, have a high impact[9]. The evolution of software seeks to enable the capacity of multi-sensory elements, optimizing the results of this technology, while the evolution of hardware is oriented to overcome the limitation of its application only in supercomputers, allowing the use of mobile platforms, microcomputers or web applications, and it is possible to add sound, gestural, reactive and tactile applications[4].

Therefore, this research approaches virtual reality to seek to answer the question of how it can contribute to the teaching and learning process, in the context of basic and professional education, in different areas, performance levels and circumstances, where traditional and remote education can be used in a different way. Additionally, its adaptation to today's world is investigated.

2. Theoretical or conceptual framework

2.1. Virtual reality: Concepts and meanings

The beginning of the evolutionary history of virtual reality is marked in the nineties; however, it has an origin with experiences in cinematographic sectors in 1950, when the "sensorama" appeared as a pioneer experience in the development of virtual reality. From its development by Morton Heilig, it was possible to provide the user with the sensation of aromas and simulated motorcycle winds in New York through a three-dimensional tour[10]. Then, in 1968, at Harvard University, Ivan Sutherland built a "head-mounted display (HMD)", considered the icon of virtual reality immersion through the construction of a helmet that allows the display of images with a built-in tracking system and the ability to analyze the position of the user's head[11].

Between 1977 and 1982, researchers Daniel J. Sandin, Thomas A. DeFanti and Richard Sayre at the University of Illinois developed the first gloves that were connected to computers. Measurements were obtained by photocells that changed according to the amount of light and then according to the fold of the fingers. It was only until 1987 that the company VPL Resecar Inc. marketed the product as "Data Glove"; later, the same company started selling a display helmet, which it called "Eye Phone"[12].

2.2. Virtual reality: A brief history

Between the years 1989 to 2000 it is possible to find significant milestones for the evolution of virtual reality, among them the Rend386 software, through which it is possible to render 3D objects in real time using the VR386 engine[13]. Also in this period there was a software that marked the advancement of augmented reality with ARToolKit. The great relevance of this was the facilitation of the development of augmented reality applications. This is free software under the GNU General Public License. For users who want customizations or advanced support, commercial licenses are administered by ARToolworks Inc. in Seattle (USA)[14]. Other important developments further consolidated the history of virtual reality.

The work of Sherman and Craig[3] allows us to understand and identify the different ways in which virtual reality can be approached. These authors apply virtual reality to solve various problems, thus making it clear that virtual reality is not only a matter of entertainment, but can also be applied to solve problems in different fields.

2.3. Education and information and communication technologies in Brazil

In times of pandemic, students all over Brazil, from both public and private schools, belonging to all levels of education, had to adapt to this new global reality. Now more than ever, the Internet stands out as one of the main resources in the educational process. According to the Brazilian Institute of Geography and Statistics (IBGE)[15], in 2018, 79.1% of Brazilian households had internet. Among households with internet access, the cell phone was considered the main means of access with 99.2%, followed by the use of microcomputers, which reached 48.1% with Ordinance no. 343 of March 17, 2020, the Ministry of Education determined the replacement of face-to- face classes by classes in digital media for the duration of the new situation due to the COVID-19 pandemic[16]. In this context, it is crucial to identify the means that can contribute to the success of this new paradigm.

Among the resources commonly used in distance education are private messages, photos and discussion lists, video classes, chat, virtual library, among others. While these resources are able to support the learning process, one of the challenges is the cultural impact of this modality in the lives of students, since the experiences of face-to-face teaching of students cannot be fully replaced with distance education, through the aforementioned resources[15].

The pandemic has forced to adapt the process of knowledge transmission through education, adopting measures of social distance and closure of face-to-face classes. Remote education is strongly characterized by the use of both technology and practice. It is the responsibility of the educational institution, tutors and students to dedicate efforts to achieve success in this modality. Remote education can take place in two ways: through the use of synchronous tools or asynchronous tools by teachers, in order to guarantee the quality of the educational process.

Synchronous tools in remote education require the teacher and the student to be connected, since it is a scenario of mutual interaction. However, interaction is not a guarantee of quality, although it is interesting that teachers request the collaboration of students. One of the benefits of this model is the ability of the teacher to perceive the level of engagement of the students, which can be an advantage when evaluating them. Examples of this type of tools are web conferences, chats, webinars, among others[17].

On the other hand, asynchronous tools are characterized because they do not require such simultaneous connection of teachers and students, i.e., students are allowed to have contact with the contents at a time and place according to their needs. This asynchronous model provides greater autonomy for the student; however, for the same reason, it requires greater commitment. Asynchronous tools include webmails, blogs, forums, among others[18].

As for the online classroom, it is important to emphasize its differences with a repository of digital content; the classroom needs to be an active space, with activities inside and outside the platform. For the structuring of these activities, it is necessary to employ useful principles for the adaptation of a given technology with precision[19].

It is also worth considering that one of the bases for the development of distance education is governed by Ordinance No. 343 of March 17, 2020[16], issued exceptionally during the current COVID-19 pandemic. This norm opened the possibility of replacing face-to-face subjects in regular courses with digital educational activities and resources of information and communication technologies.

With the objective of associating virtual reality and digital technologies in education, this work seeks, through exploratory analytical research, to show how virtual reality can serve as an alternative to apply in schools, by educators and communities in different traditional models (using computer labs) or through the use of internet and digital technologies, which allow synchronous or asynchronous actions to support various educational contexts.

For this reason, this research performs the processing of data obtained from virtual reality applications in different situations. Following this, the potentialities of virtual reality and its practices in the educational context are analyzed in its different stages: basic core, technical and professional education. Finally, a discussion is opened on the application of virtual reality in real life educational activities in the classroom, both in face-to-face and simulated environments, which can contribute to the learning process of students.

3. Methodology

According to the above, relevant information in scientific databases related to virtual reality was explored and analyzed. In addition, the application of virtual reality as a tool to support teaching and learning was investigated, taking into account different application scenarios.

Published research whose contributions can be considered as adaptive was taken into account. Considering that the pandemic, since March 2020, has forced to make innovative changes in teaching and learning processes using new technologies such as virtual reality, its complexities are addressed when adapting and modifying the commonly used classroom model.

The structure used considers the presentation of concepts and work reviews according to the content covered, its chronology, results and discussions. Initially, we seek to inform about the evolution of virtual reality and the processes that connect the idea of using it as something that potentially contributes to education, in comparison with traditional methods: blackboard, books, films, among others.

The current pandemic scenario and its adaptation needs are then addressed. In relation to this, the works on the application of virtual reality allow us to evaluate the current problems and the application to our reality. In consideration of this, the biases of this application of virtual reality, and even certain difficulties that may make the application unfeasible, are also discussed.

4. Results

The following are the characteristics and applications found in other studies that demonstrate the contribution of virtual reality in basic and professional education.

4.1. Virtual laboratory of experience in electronics (LVEE)

The Virtual Laboratory of Electronics Experiences (LVEE) is a project that creates a virtual environment based on real-world models to allow experimentation of virtual activities related to electrical circuits (**Figure 1**).

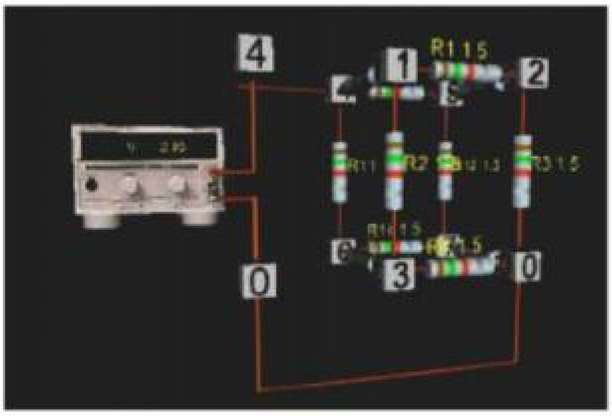

Figure 1. 3D circuit in cuboresistor format[20].

One of the objectives of this project is to make knowledge available to students through practical activities that facilitate learning and reduce implementation costs, among other benefits. It was developed using VRML (virtual reality modeling language), Java, PSPICE module and Web/CGI Server. In general, the authors reported that the virtual reality systems did not work well for educational purposes, and were limited to some demonstrations. One of the main problems encountered is that of prohibitive costs for the educational institution[20].

4.2. Virtual reality in education, health and safety

The work developed by Nemer et al.[21] uses virtual reality in health and safety education through the gamification of a game called "Working in Confined Spaces" (**Figure 2**). In this game, the student assumes the role of a worker who enters a confined space and is responsible for making a series of decisions in order to score and meet the proposed objectives, including performing an inspection of a water pump. Tests were conducted to validate the efficiency of the game among the participants. With the results, the authors identified that, of the 28 participants, 68.4% reported that the game helped them prepare for the practical activity and 79.20% felt as if they were working. In addition, the students' experience was considered pleasurable, meaningful and effective, and had contributed to student engagement in the learning process.

Figure 2. Menu of the "Working in confined spaces" game[21].

Immersive and interactive simulator for computer science: Disk scale

In computer science, the immersive and interactive simulator proposed by Ancioto et al.[7] was developed to allow the student to explore a three-dimensional environment, with the main objective of learning disk scaling algorithms, including the advantages and disadvantages of each one. In addition, the simulator demonstrates the physical elements of internal architecture of magnetic disks, as well as solid disks. In this regard, it explores the three-dimensional elements of the context (**Figure 3**).

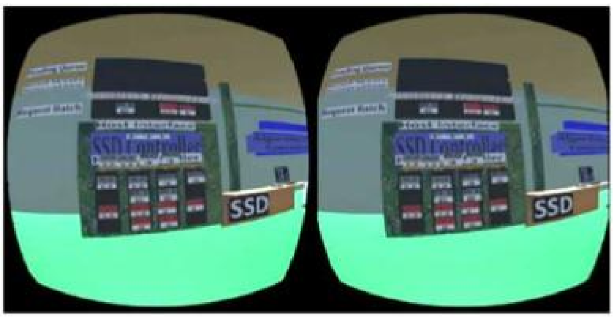

Figure 3. Visualization of the 3D simulator (left and right eye).

This simulator seeks to develop students' empirical skills in learning the FCFS algorithm on magnetic disks, and the PIQ and NOOP algorithms for solid disks, while allowing the teacher to make associations with the internal architecture of the disks. In this same work, usability, learning and motivation tests were carried out, which made it possible to identify the points that aroused the greatest interest in the students or that they did not like, as well as to analyze whether there was a significant statistical difference in learning between the teaching methods evaluated.

Although the use of virtual reality is seen as an important driver in the educational process, in the knowledge tests applied to the students of the computer networks course integrated to the baccalaureate, the use of the interactive and immersive simulator did not obtain significant differences with respect to the use of the simulator in a 2D environment (non-immersive) or the traditional method (blackboard) in the learning process and knowledge construction of FCFS, NOOP and PIQ disk programming algorithms. Although, according to the evaluation of their appearance (**Figure 4**), there were more motivations regarding the use of simulator in the HMD (immersive) environment compared to the non-immersive environment.

Figure 4. Simulation of NOOP algorithm.

Main memory management simulator: SigemVR

The simulator proposed by Freitas[22] is an immersive and interactive didactic tool complementary to operating system (OS) disciplines. This tool allowed simulating the main RAM management techniques used by different OS. Simple contiguous allocation, dynamic partitioning and paging techniques were addressed. The simulator, called Siembra (Main Memory Management Simulator with Support for VR Technology), presents the student with a three-dimensional, immersive and multisensory experience through graphical, textual and auditory representations (**Figure 5**). After the software product was designed, it was validated to verify that it met the needs of the end user. To this end, the SigemVR simulator was subjected to usability and educational tests in the form of questionnaires, with students from the higher education course in system analysis and development, and from the integrated middle-level IT technical course.

Figure 5. SigemVR virtual environment: hardware, RAM and CPU.

In his educational assessment test, Freitas[22] concluded that the average performance of students who used the SigemVR simulator on a desktop and in a virtual reality environment was significantly different from that of students who took the test in the traditional method (blackboard). However, when the comparison is made taking into account running the desktop simulator and the virtual reality environment, the difference between the mean scores on the OS knowledge test is no longer significantly different. The multiple comparison test, Tukey's test, applied to compare pairwise averages, is used. According to this, two averages are statistically different at the 5% significance level.

Hardware component simulator: TI

The simulator proposed by Scamati[23] used the benefits of VR technology to provide an experience of immersing, interacting and navigating as if inside the computer. In this case, the simulator allows the teacher to transport the sensation of presence to the computer, where the student can observe the motherboard, the records, and the abstract communication between the computational elements through their processes. In their study, the educational gain using VR was evaluated.

Gynecology medical simulator (Siteg)

In medicine, Santos[24] proposed a "Virtual reality-based medical simulation for gynecology teaching and training" tool. The purpose of this simulator is to provide a three-dimensional and interactive environment for the study and training for the examination of gynecology. This work concluded that there was a significant reduction in medical procedure errors; however, most of the benefits provided by the VR simulator are not direct and are difficult to measure.

Simulator for teaching mathematics to children

Roussou[25] used virtual reality to teach mathematics to children by addressing fractional problems. In his tests it was not possible to find evidence of success in learning mathematical concepts for solving fractional problems or in conceptual change at a deep level. In other words, although the interactive environment helps in problem solving, it may not provide a framework for conceptual learning.

Table 1 illustrates the main features of the immersive and interactive simulators explored, which were used in different educational environments and stand out for their contribution in different areas and educational levels.

Table 1. Matrix of data on the use of virtual reality

Author	Environment	Area of action	Educational level	Main advantages
Meiguins et al.[20]	LVEE (Virtual Laboratory of Electronics Experiences)	Electronics	Superior	Immersion and interactivity
Roussou[25]	Virtual Playground	Mathematics	Media	Immersion and interactivity
Santos[24]	Medical simulator in gynecology (SITEG)	Medicine	Superior	Immersion and interactivity
Scamati[23]	Hardware components simulator: computing	Computing	Upper and middle, integrated with the technician	Immersion and interactivity
Ancioto et al.[7]	Magnetic disk algorithm simulator	Computing	Upper and middle, integrated to technical	Immersion and interactivity

Analyzing this table, immersion and interactivity should be highlighted as important factors for simulation in any scenario and application area. With this view of simulators, we highlight the areas of electronics, medicine, mathematics and computer science, which were chosen for their use of virtual reality, and for the topics they deal with, which can highlight visions at different educational levels. In particular, we highlight simulators that are useful in basic and professional education.

In addition, we highlight a chronological organization of simulators, indicating that, over time, simulators are also applied to computer science. Next, we will discuss how simulators can be used in the computer science perspective and how they can be applied in basic and professional education, with special attention to the characteristics of Brazilian education.

5. Discussion

5.1. Virtual reality applied to the Brazilian educational context

A close look at the need to use differentiated strategies in the teaching and learning process appears when we observe the basic structure of Brazilian national education. The law of guidelines and basis catalogs comprehensive education as a social and fundamental right, which entails the vision of building the profile of the citizen and also the valuation for work. The broad educational processes point to the need to provide opportunities for integration between elements such as culture, society, family and school, highlighting the important role of teaching skills and competencies, which reflect both the preparation for work and its social practice[26].

In this sense, the perspective of a simulated environment can open a new horizon on the diversification of the evaluation instrument in different types of courses. There are possibilities of observing dynamic objectives and teaching plans that can dialogue with integrated actions among teachers[27], in order to carry out the feasible structuring of an evaluation instrument that can take place within a simulated environment characterized by virtual reality.

Although there have already been implementations of virtual reality, its use has not been consolidated in a broad sense, regardless of the sector in which it is used. In this sense, the main objective of the implementation of virtual reality is to provide understanding, either by understanding an entertaining story, learning an abstract concept or practicing a real (concrete) skill. The experience of participating in an action through the use of (interactive) sensors that simulate and capture the human sensory capacity, or through resources that increase motivation through immersive experiences, allows for increased understanding in the learning process.

5.2. Virtual reality, school space and the use of information and digital communication technologies

Virtual reality can add interactive aspects to traditional teaching and learning processes. Thus, the trend of using new technologies in school and creating a hybrid model can bring a potential partnership between the way we learn and the use of technologies, so that the student becomes a critical thinker for problem solving in the school context. This hybridization of the teaching model includes, in addition to innovative physical spaces, also the use of digital spaces[28].

On the other hand, despite the potential benefits of the use of virtual reality in the educational process, this experience alone does not guarantee an improvement in terms of motivation and learning. The extended use of sensory immersion may not bring a good experience for the student. For example, spending a long period of time in an immersive environment may make the learner uncomfortable, and the learner's attention may waver with the richness provided by the virtual environment, thus reducing his or her attention and potentially diverting him or her from the learning objective. Also, the visual resolution may hinder reading[7].

5.3. The contribution of simulators in teaching and learning environments

Education and motivation are related both politically and socially, even more so when dealing with issues focused on the mental health of the student and the educator. Therefore, the focus of this paper is specifically oriented towards motivation as a primary factor to ensure a good education. The objective of the educational process is to guarantee changes based on the acquisition of information and knowledge. It is important to consider that the ideal is to fulfill the objective of the educational process based on motivation. Joao Pessoa and Martini[29] propose the importance of the relationship between motivation and the teaching-learning process, as opposed to the generally propagated opinion that educational problems are due directly to the student. Through empirical and theoretical research, it was possible to verify the need for reflections on motivational aspects to ensure learning.

Thus, the motivational factor should also be taken into account when implementing changes such as those proposed with a view to their effects on learning. According to Lourenço and Paiva[30], although the teacher tends to seek stimulating and feasible solutions, changes in course curricula, subject matter and annual adjustments specific to each institution can make the implementation of novel strategies more complex. Therefore, the teacher is forced to build plans parallel to the interests of the class in an interdisciplinary manner. In this sense, the proposal of virtual reality applied to education can be presented as an ideal tool, especially in the current circumstances, when the difficulties increase at a distance. However, there is a need to contemplate the student with a view to their learning process. In addition, educational models have been continuously renewed by technological changes, as well as by the diverse needs to incorporate methodologies based on the actual local context. An example of this is the use of gamification in education. According to Fardo[31], gamification aims to motivate and help people to solve problems taking into account the mechanics of strategies and thoughts in the context of games.

Therefore, virtual reality as a tool is capable for assisting and transforming an educational model by bringing improvements in the teaching and learning process, especially with regard to the issue of student and teacher motivation. Moreover, once gamification is added, it can be considered as another alternative for the solution of specific educational demands.

5.4. The contribution of virtual reality environments in basic and higher education

The complexity of this moment is directly linked to the adaptation process of education professionals. In this regard, it cannot be ignored that technological tools are an alternative to achieve the main objective in the classroom: learning. However, they are not always the most appropriate tools. Therefore, a thorough and open analysis is needed, not only by the teacher, but also by the sectors involved in pedagogical issues, in order to find the ideal model that guarantees learning in each specific context. Without forgetting that the measures of social distance during this pandemic have made it necessary to appeal to new teaching alternatives, it should be clarified that the use of virtual reality does not in any way exclude more traditional methodologies. On the contrary, it is possible to adapt it to different teaching modalities and methodologies. In this sense, virtual reality brings us closer to better scenarios and new learning possibilities.

According to Pereira and Peruzza[32], the implementation of computers in teaching has gone through four generations, the last of which appeared with the use of virtual reality. The first generation is related to behavioral theory, in which traditional instructional planning approaches were implemented. The second generation focuses on how information is transmitted to learners. The third generation understands the interaction between the student and the instruction as a determining factor in the learning process. Finally, the fourth generation assumes that knowledge is constructed by the students themselves. In this sense, virtual reality emerges as a resource that allows interaction between the user and the computer in a more intuitive, dynamic and immersive way, which, combined with the potential of distance education, is able to offer conditions and possibilities for people to take a step forward in their learning process, in search of independence of thought and action.

One of the challenges encountered in the traditional school is the difficulty in associating the abstract concepts studied in the classroom with the appropriate models[32]. The use of virtual reality makes it possible for students to explore the environment through three-dimensional resources by using and manipulating virtual objects, processes and analysis of the object of study itself. Pereira and Peruzza[32] also indicate that the main reason for using virtual reality in the learning process is its pedagogical potential, since it makes interaction more intuitive, allowing students to use teaching tools in a more natural way.

Virtual reality has been widely explored to improve the educational process in several areas that consolidate teaching and learning in concrete content; for example, in the aerospace industry, for aircraft piloting, or in medicine, in health and safety education[21]. However, its use in an abstract context is not yet consolidated, as in the case of the area of computing, and the teaching of learned algorithms in the discipline of operating systems[7,22].

Despite the advances and positive adaptations in the use of VR, there are also issues that have been debated in the most diverse educational environments. Perhaps the most evident problem in relation to the involvement of students in the virtual modality is the unequal situation to participate in basic education by students who do not have technological or computational devices.

5.5. Perspective of the use of virtual reality in

the educational environment

The simulators addressed open new perspectives for the use of virtual reality as a support tool. For example, in the course of computer networks, integrated with the high school of the Federal Institute of Science and Technology of Education of São Paulo, as well as in the disciplines of teleprocessing and hardware maintenance, virtual reality could bring a different dynamic. The principles of analog and digital communication with the use of hardware devices can be clearly illustrated in an immersive virtual reality environment, where the student sits inside the computer.

On the other hand, in terms of safety in the classroom, the teacher must always be attentive to the proper handling of hardware resources, because, due to the immaturity of the student, risky situations may arise, especially when there is obsolescent equipment that requires manual dexterity; even the equipment can be burned with static electricity when handled inappropriately. In this case, the creation of an immersive basic electronics laboratory for complex experiments could provide training and awareness of safety aspects, integrating transmission principles, manipulation of hardware resources, and physical and chemical properties experienced in a simulated, immersive and controlled environment.

In this sense, integrated work could be carried out considering the competencies and skills necessary for the student to develop ethical hacker thinking, considering the importance of the proper use of programming languages, as well as the structuring of computational logic and mathematics for problem solving.

Likewise, professional education can include gamification as an active method- logy so that students can have a more immersive environment, which prepares them for the working world and at the same time is associated with decisions that can respect ethical and social issues in the education of citizens. Likewise, the development of scenarios and environments that enable actions and reactions based on corporate decisions that assume consequences in the maintenance of the information life cycle can strengthen training and awareness in cybersecurity aspects.

Virtual reality is especially useful when working with events and sequences very close to the daily professional development of a network technician. A practical case is situations in which the student needs to associate hard skills (technical programming and cybersecurity knowledge to solve problems in computational environments) with soft skills (empathy, emotional intelligence and citizenship education), when finding, for example, a lost flash drive. Situations like this, through the inclusion of virtual reality, can drive the convergence of important aspects that we highlight as essential for Brazilian education: citizen training and preparation for work, which today has a very important dynamic in the aspects of information care.

Another area where virtual reality could be significant is digital inclusion for the elderly. Students in this age group reflect yearnings and fears before situations of application of information technologies in everyday situations. In this regard, it is worth highlighting actions for the development of a basic computer course[33] and the use of smartphones by seniors, and even strengthening the idea of digital writing as a way to keep their records electronically for posterity[34]. Many older adults request the teaching and exchange of computational practices in situations in which they still have fears and difficulties to act, such as in front of an ATM, for which they often depend on others.

Therefore, from this work, a course is projected that implements strategies and techniques associated with virtual reality, which can provide a gradual immersion for the older student, so that the didactic objectives and classes materialize situations in controlled environments. In this way, self-control and active development of the student in situations associated with panic could be encouraged, but thanks to virtual reality, it would provide a great motivational contribution to learning and, therefore, to the independence of the elderly.

6. Conclusions

Virtual reality is a tool that can help transform educational models, bringing improvements in the teaching-learning process. However, it may not be the most appropriate tool in all cases. Therefore, a thorough analysis of the teacher and all the sectors involved in education is necessary in order to approach the best model that guarantees learning. In the exploration of other works, its implementation in school environments has been found due to the intensive use of digital information and communication technologies, as well as the need to build and contextualize simulated scenarios where students and teachers have a controlled immersion environment for training, awareness and evaluation of competencies and skills. These findings show viable contributions of virtual reality that can be contemplated and discussed both for basic education and mainly for professional education.

Conflict of interest

The authors declare no conflict of interest.

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