



Research Article

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Virtual Environments in Higher Education: A Systematic Review

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Abstract

Virtual environments are technological tools that facilitate teaching and learning in various academic contexts. This study aims to systematize scientific evidence on the different digital tools and platforms used by university faculty in their teaching processes. A search was conducted in databases such as Scopus, SciELO, Eric, and Dialnet using the terms "digital tools and platforms" and Boolean operators in Spanish and English. The study analyzed 19 scientific articles published between 2011 and 2021 on higher education. The PRISMA flow chart was used to analyze the data. The results showed a variety of concepts related to tools and platforms, which can be confusing for readers. The study concludes that there is a need for more comprehensive research on the conceptualization and differentiation between tools and platforms.

Keywords: virtual environment, digital platform, virtual education, review

1. Introduction

Technological tools provide an innovative approach to education because they allow virtual exchange between students who are in different geographic locations, but who can interconnect and exchange opinions and knowledge, thus promoting inter-learning (Lenkaitis et al., 2020).

It is known that, in the last decade, technology has been increasing rapidly. The impact of this can be seen in the educational sector, especially in virtual reality. Augmented reality in the university

space improves the teaching process (Çankaya, 2019). Technological tools are considered a necessity to promote collaborative learning (Khan & Baldini, 2020; Suyo-Vega, Meneses-La-Riva, Fernández-Bedoya, Polonia, et al., 2022).

Education has been transformed with emerging technologies, as key factors for this transformation include teacher interest, institutional perspective and perceptions about the use of technologies. There is a dichotomy between fluid communication and work teams. Therefore, a change in pedagogical practices is required to innovate and empower educators (Ngoc et al., 2020).

Learning environments have been affected by Web 3.0 technologies, as detailed in the analysis of 81 scientific articles between 2005 and 2020 related to the following semantics: augmented reality, intelligent tutoring, 3D visual environments, 3D games and ontologies. Most of the research results show the usefulness of learning in the area of science (Acikgul Firat & Firat, 2021). The virtual environment is used for the improvement of teaching processes in higher education, while interpersonal skills can be developed, and student work can be monitored. This is thanks to its characteristics of collaboration, interactivity, flexibility, standardization, and scalability. Concluding that virtual environments are beneficial for university students' learning (Aguilar Vargas & Otuyemi Rondero, 2020; Suyo-Vega, Meneses-La-Riva, Fernández-Bedoya, Ocupa-Cabrera, et al., 2022).

In the development of tools and resources for the improvement of teaching, augmented reality (AR) is a resource used in the educational field because it makes it possible for students to simulate and interact with these resources. Due to these characteristics and the possibilities, it offers. It is concluded that in higher education the applicability of AR can be found in different areas of knowledge, such as mathematics, computer science, education, architecture, engineering and medicine (Cruz León & Flores Guzmán, 2018).

The purpose of incorporating the platforms in universities is to provide opportunities for students in order to promote better teaching (Salas-Rueda, 2019). As they are present in everyday life, technological tools are used in various activities, whether educational or not. Therefore, it can be said that the use of platforms becomes a support for the teacher and contributes to a better understanding of concepts and theories (Khan & Baldini, 2020), enabling the construction of knowledge and generating innovative teaching methods; contributing to a change in the role of the student, from a passive receiver to an active subject that receives information, analyzes it and applies it in different contexts (Rodríguez et al, 2021), to avoid falling into digital illiteracy (Icaza-Álvarez et al., 2019). However, shortcomings found in the research reveal that teachers do not distinguish between the various tools that are hosted on the different platforms or face difficulties in the use of technologies compared to other professionals. (Vaillant et al., 2020; Yanza-chavez et al., 2020).

2. Methodology

This research is characterized as a systematic review that describes the processes to identify the various tools and platforms, methodologies, population served, results and conclusions. To carry out an adequate review that can be reused, the search equation has been exhaustively designed to allow other researchers to replicate it, as shown in Table 1.

To start with this research, it was necessary to raise the northern question, consider the use of Eric's Thesaurus and the application of Boolean operators, as well as the inclusion criteria such as: the time period from 2011 to 2021, peer-reviewed articles and PDF with open access, in Spanish and English. Monographs, essays, letters to the editor, systematic reviews and literature reviews, meta-analyses, duplicate articles, or those that were not fully downloaded from the various databases: Scopus, Dialnet, Eric and SciELO, were excluded, as detailed in Table 2 and visualized in the Prisma diagram, Figure 1. It should be noted that there are several databases to which there is no access, such as the Web of Science.

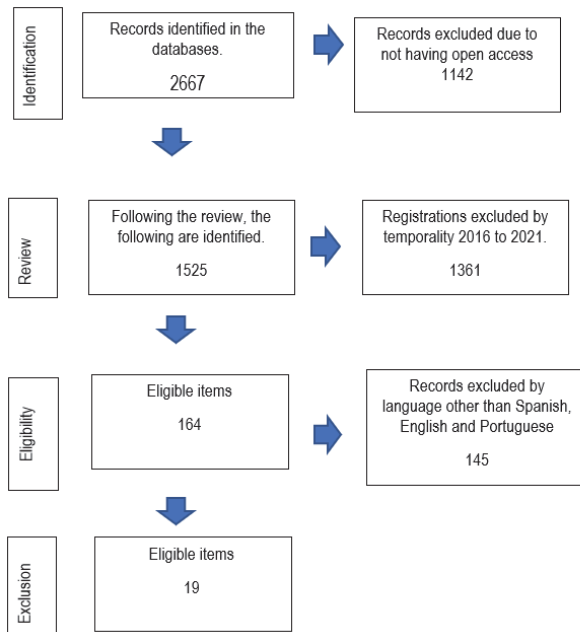
Table 1: Search equation

Keyword	Synonym for the word
Technological resources	Virtual resources; Virtual environment; Technological tools; Digital resources; Virtual environment; Digital resources
university	Higher education; Professional education; Undergraduate
Use of Boolean operators	Virtual resources OR Virtual environment OR Technological tools OR Digital resources Higher education OR Professional education OR Undergraduate

Finally, the search equation in Spanish is (Recursos virtuales OR Entorno virtual OR Technological tools OR Digital resources) AND (Higher education OR Professional education OR Undergraduate).

Table 2 : Database

SciELO Database	1º.	2º.	3º.	4º.
SciELO	108	105	101	11
Dialnet	2436	1362	13	4
Eric	123	58	50	4
General	2667	1525	164	19



Graph 1: Prism Diagram

3. Results

To answer the northern question, it was necessary to thoroughly analyze the various scientific articles, identifying the database to provide reliability. Authors and countries to visualize the thematic panorama. In each case, the tools used in the research were verified. Finally, the objectives and approach to find the gaps or research to be deepened. These results are shown in Table 3.

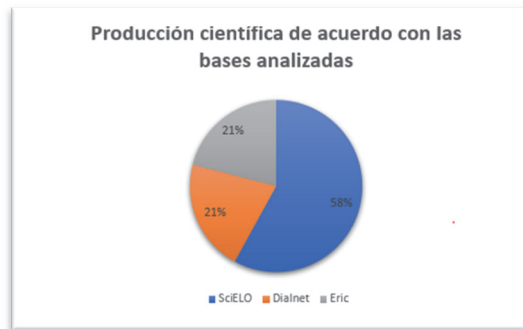
Table 3: Database - tools, objectives, and approach

Database de datos	Author	Country	Tools	Objective	Approach
1	SciELO (Monroy et al., 2018)	México	Plataforma Edmodo Plataforma Moodle Plataforma Schoology	To know the impact of the use of virtual classrooms.	quantitative
2	SciELO (Guerrero Segovia et al., 2017)	México	Readings, expert videos, digital portfolios, discussion forums and surveys.	To analyze the relationship between the use of technologies and the perception process.	Mixed
3	SciELO (Casnati et al., 2020)	Uruguay	Plataforma Zoom, Webex o Big Blue Bottom de EVA	Support the teaching team in the development of teaching materials.	Does not indicate
4	SciELO (Mendez Gijon & Morales Barrera, 2020)	México	Technical resources	Analyze the curriculum map	Constructive partner
5	SciELO (Pástor et al., 2018)	Ecuador Venezuela Argentina España	EVAS Moodle Glosarios Foros SCORM Wiki Chat	Make e-learning design proposal	Mixed
6	SciELO (Rodríguez Chávez, 2021)	México	Intelligent tutors (ITS)	Analyze the use of intelligent tutoring systems.	Quantitative exploratory
7	SciELO (Vargas-Murillo, 2020)	Ecuador	Draw.io CmapTools Microsoft Visio Lucidchart MindMeister XMind Google Drawing Piktochart RealWord Paint GIMP Google forms Survey Monkey Microsoft Forms Xodo Sejda Adobe Reader DC Google Slides Fibonacci EducaPlay ATLAS ti Moon Reader	Describe the educational strategies	Qualitative
8	SciELO (Schwartzman et al., 2021)	Argentina	Playlist en Youtube Murales colaborativos Moodle Zoom Drive Padlet	Addressing university faculty training for remotization	Qualitative
9	SciELO (Briseño Senosiain, 2021)	México	Digitized databases	Take advantage of new technologies to build the story	Qualitative
10	SciELO (Cifuentes Muñoz et al., 2021)	Chile	Teamwork	Assessing learning outcomes	
11	SciELO (Alfonso Azcuy, 2021)	Cuba	Text mining	Describe the module to review recommendations.	
12	Dialnet (Manrique Maldonado et al., 2021)	México	Zoom Meet E-mail Facebook WhatsApp Classroom Moodle Teams Drive You Tube Web Site Khan Academy	Evaluate the impact on the learning process	Quantitative
13	Dialnet (Cagua Huelo et al., 2021)	Ecuador	Zoom MessengER WhatsAp Meet Microsoft	Promoting digital competencies in digital teachers	Quantitative
14	Dialnet (Cruz et al., 2021)	Colombia	Quantitative evaluation and academic practice.	Describe the use of digital fabrication (FD) in the development of disciplinary competencies.	Work by competencies
15	Dialnet (Cañete Estigarribia et al., 2021)	Paraguay	Plataforma educativa del MEC Mensajería instantánea (whatsapp) Procesadores de texto como Microsoft Office Word Visor de archivo Adobe Acrobat Reader Powerpoint	Analyze the development of distance education	Does not indicate

Database de datos	Author	Country	Tools	Objective	Approach
16	Eric (Salinas Vacca, 2014)	Colombia	Skype Programa virtual Cuestionarios y foros de discusión	Analyze discussion forums. Graphing pedagogical and conceptual implications for the development of virtual courses.	Exploratory, Descriptive and interpretative
16	Eric (Cuevas-Salazar et al., 2016)	México	Digital competencias	Identify and compare the level of competence in the use of ICTs.	Quantitative
17	Eric (García-López et al., 2017)	México	MOOC	To evaluate the achievement of competencies for the production, search, and dissemination of educational resources through an online course.	Quantitative
18	Eric (Salazar-Márquez, 2017)		Online education Social networks	Determinar desde una perspectiva ontológica, epistemológica, metodológica, instrumental y desde la perspectiva del profesor los retos técnicos y comunicativos que enfrentan los inmigrantes digitales al realizar estudios en línea.	Qualitative
19	Eric (da Costa et al., 2018)	Brasil	Corporate image, distance learning. Platforms, surveys	Contribute to a better understanding of how the image of higher education institutions is perceived by distance learning students.	Quantitative

3.1 Herramientas digitales utilizadas

The most used tools are Zoom, Meet, Drive, WhatsApp, Scology. It can be observed that somehow it has been assumed that platforms have been considered as tools and vice versa. The authors of some of the articles do not specify the differences between tools and platforms, which underlies an apparent theoretical confusion; however, it can be found that Zoom, Meet, Moodle, Teams are the most used platforms. Likewise, some applications are used to improve learning strategies, as well as the interconnection between teacher and student.



Graph 2: Databases

Graph 2 shows statistically the distribution of scientific articles in the databases investigated. The highest production in SciELO (58%) stands out, followed by Eric (21%) and Dialnet (21%).

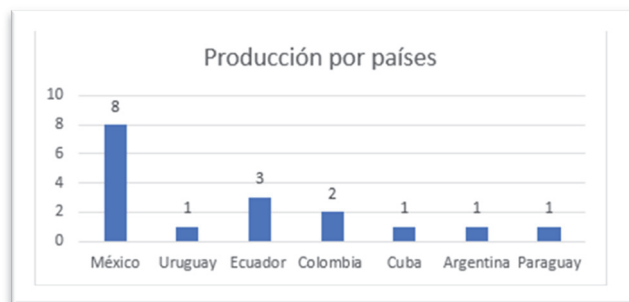


Figure 3: Scientific production by country

Figure 3 shows that the highest production is found in Mexico (8), followed by Ecuador and Colombia (2), then Argentina, Paraguay, Chile, Cuba and Uruguay with only one production. Shared research has also been found between Ecuador, Venezuela and Argentina. Therefore, the commitment of teachers to publish in high impact journals, which favors academic growth, can be seen.

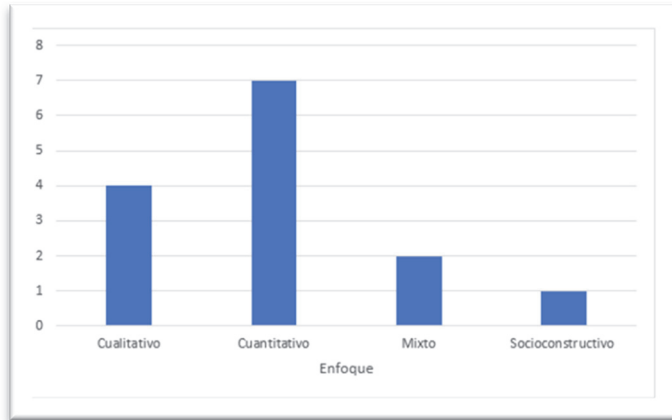


Figure 4: Research focus

Figure 4 shows that most of the research related to virtual environments has been developed under the quantitative approach (7), followed by qualitative (4), mixed (2) and socio-constructive (1). The results suggest the urgency of conducting research with a qualitative or mixed approach to broaden and deepen knowledge about digital tools and platforms.

In the investigations analyzed, it was found that the samples belonged to diverse careers from engineering to technical studies. In addition, it was found that the dimensions or categories were diverse, there is no homogeneity, as shown in Table 4.

Table 4: Database of careers, dimensions, sample, and conclusion

Nº	Careers	Dimensions	Sample	Conclusion
1	Engineering and Social and Administrative Sciences	Does not indicate	428	Educational institutions should train their teachers to use virtual platforms..
2	Does not indicate	Participation in open educational practices Participants' knowledge of computer technologies.	20400	Learning environments are related to the use of open access technologies and tools.
3	Management Technician Management Technician Bachelor of Science in Natural Resources Management Bachelor's Degree in Nursing Cultural Property Technician	Pedagogical and didactic dimension Communicative dimension University construction dimension	between 18 and 34 teachers	Students have difficulty interacting with the Zoom or Webex platforms, coupled with the difficulty of connecting to the network. Faculty are overloaded with work and are always plugged in responding to student needs.
4	Bachelor's Degree in Computer Science	Analysis of the digital competencies model for teachers Teachers' attitudes towards ICT	8 teachers	The use of ICT does not imply educational innovation; inclusion must be accompanied by transformational means for teaching..
5	Chimborazo Polytechnic School of Chimborazo Bolivarian University of Venezuela Foundation for the Technological Updating of Latin America National University of Sarmiento	Pattern mining Pattern specification Pattern catalog Template creation Pattern evaluation	5 teachers 75 students	Creation of techno-pedagogical patterns that combine technology, theories and learning styles.
6	Science	Expert domain module. Student module. Tutorial module Environment module.	Does not indicate	The purpose of ITS is not to replace the teacher, but to reinforce teaching in and out of the classroom.
7	Does not indicate	Pre-instructional teaching strategies Co-instructional teaching strategies Post-instructional teaching strategies	Does not indicate	Educational strategies can be improved using ICTs.

Nº	Careers	Dimensions	Sample	Conclusion
8	Medicine Nursing Pharmacy Biochemistry Surgical Instrumentation Biomedical Engineering	Does not indicate	659 students	The general idea is that teachers can not only solve problems during the pandemic, but go beyond it: take their learning to education scenarios.
9	History students	Quantity of information Information analysis capacity, Line stories vs. hypertextuality, Digital born sources and crowdsourcing.	Does not indicate	Students must take risks in order to face a future that is highly technologized; new ways of making history must be sought.
10	Medical students	Simple artillery, Aerial bomb, Atomic bomb, Atomic missile Nuclear missile	134 students	The use of alternative strategies such as clan warfare promotes student learning.
11	University of Computer Science	Educational resources Design patterns	100 users	The use of patterns through text mining allowed the validation of a module to obtain design patterns.
12	School of Communication and Marketing of the Universidad Autónoma de Guerrero	Does not indicate	Population: 609 students Sample: 236 students	
13	Education	Computerization and information literacy Communication and elaboration with the teaching-learning process, Creation of digital contents.	35 teachers	It is shown that after the trainings, teachers achieve a certain mastery of digital competencies.
14	Industrial design undergraduates from Universidad Javeriana	El conocer (saber) Las actitudes (saber ser) La práctica (saber hacer)	30 students	The FD resource is a pedagogical strategy for PBL.
15	Education	Does not indicate	1949 people	There is a need to design continuous training programs that help in the acquisition of digital competencies.
16	English	Does not indicate	50 students	Discussion forums function as a great learning facilitation tool.
16	ICT	Does not indicate	949 students and 49 teachers.	Mexican and Spanish students have the same level of digital skills.
17	Education Mathematics	Competences to produce educational resources. Competences for the search/selection of educational resources. Competences for the dissemination of educational resources, Competences for the mobilization of educational resources.	134 teachers	In the context of distance education, the learner must be able to express his or her ideas in a way that can be understood by others. The ability to work with digital tools and connect fragmented knowledge is one of the most important competencies when working with MOOCs.
18	Does not indicate	The beginning of the educational career and the first experiences working online. Communication with your students considering: tools and interaction, differences between digital natives and immigrants, motivation factor and the use of social networks. Technical aspects when carrying out educational activities.	Does not indicate	does not indicate
19	Higher education	Cognitive image Affective image Global image	85 students	Technological advances are generating a significant increase in the offer of distance learning (DL) courses through the Internet, increasing the importance of this type of education for the university structure.

4. Discussion

Technological tools are used by teachers to develop students' interest and motivation, as well as to reinforce knowledge inside and outside the classroom. Teachers make use of these strategies to design innovative learning models that keep students' attention, a position that agrees with Lenkaitis et al.(2020) who valued the importance of the use of the various applications, as well as intelligent tutors.

The perception left using the tools is that teachers should not only apply them at a given moment, but throughout the teaching-learning process. In this same line of use of platforms, the following research carried out by Khan & Baldini (2020), who consider the applications as effective tools in the learning process.

In response to the objective, it should be noted that the tools identified do not match the previous knowledge related to the concept of digital tools. Although in the research various technological means and resources are recognized, these do not correspond to the concept of tool, but to a conglomerate of categories that after the pandemic were confused with each other, each of them losing their own significant identity.

In research on the use of tools, it is believed that only exact sciences majors make use of them. However, there are many humanities majors who apply them to improve their learning (Acikgul Firat & Firat, 2021; Cruz León & Flores Guzmán, 2018).

The location of students from the use of various tools and platforms is no longer an impediment to achieve that the student seeks diverse learning, on the contrary, it can be taken as a great possibility for improvement; it is understood that the use of synchronization is important. However,

it is necessary for countries to demonstrate their research to be taken as a reference, such is the case of Mexico, where it is observed that the production scientific production related to tools is higher than that of other countries in the Latin American region. (Khan & Baldini, 2020; Lenkaitis et al., 2020).

From the analysis of the findings, constant training in higher education institutions is proposed, so that the attitude of the teaching staff towards the use of platforms and/or tools would not have major rejections: on the contrary, there would be a frank process of adaptation on the other hand, it is necessary to understand that there should be greater investment in these processes of performance and teaching quality. Likewise, the biunivocal relationship between the various faculties or schools in relation to the use of technological tools and platforms makes it clear that they are not only of one profession or another, but that there is openness in their use.

One of the limitations of the research is found in the methodological design, because although the IMRD format is respected. In the methodology, there is no coherence in the wording of the ideas, since it is not always possible to locate the instrument, since it is not recognized in the research itself, as is the case with the recognition of the population, the sample and the recognition of the dimensions of the variable.

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