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Virtual environments as agents of strengthening creative thinking systematic review

Los entornos virtuales como agentes de fortalecimiento del pensamiento creativo una revisión sistemática

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Abstract

Creativity is fundamental in the resolution of complex problems. Thus, with the purpose of promoting creative thinking, diverse ICTs, through the use of virtual environments, have created new digital spaces in which users can interact, explore and create. In that regard, the objective was to analyze the evidence on the role of virtual environments in strengthening creative thinking in education. The methodology was approached from the PRISMA statement, for this purpose, publications were reviewed in the databases of Scopus, Google Scholar, Redalyc and Scielo. Additionally, the search queries incorporated the terms “education”, “virtual environments” and “strengthening of creative thinking” filtered within the period from 2018 to 2023. Regarding the results, out of the 175 reviewed publications, only 20 articles underwent thorough analysis. In conclusion, it can be stated that virtual environments in education strengthen creative thinking since they offer tools and opportunities to access global resources, foster collaborative learning and offer attractive and accessible resources. In addition, they foster the generation of new ideas and creative approaches that prepare students to face the challenges of the contemporary world in an innovative and effective manner.

Keywords: Education, virtual environments, creative thinking, information and communication technologies

Resumen

La creatividad desempeña un papel fundamental en la resolución de problemas complejos. De este modo, con el propósito de promover el pensamiento creativo, las diversas TIC, mediante el uso de entornos virtuales, han generado espacios digitales en los cuales los usuarios pueden interactuar, explorar y crear. Con este propósito, se planteó como objetivo analizar las evidencias sobre el papel de los entornos virtuales en el fortalecimiento del pensamiento creativo en la educación. La metodología se abordó desde la declaración PRISMA y para ello se revisaron publicaciones en las bases de datos de Scopus, Google Académico, Redalyc y Scielo. Asimismo, las fórmulas de búsqueda incluyeron los términos “educación”, “entornos virtuales” y “fortalecimiento del pensamiento creativo”, filtrados en el periodo comprendido entre 2018 y 2023. En cuanto a los resultados, de las 175 publicaciones revisadas, 20 artículos fueron analizados exhaustivamente. En conclusión, se indicó que los entornos virtuales en educación fortalecen el pensamiento creativo dado que ofrecen herramientas y oportunidades de acceder a recursos globales, fomentan el aprendizaje colaborativo y ofrecen recursos atractivos y accesibles. Además, propician la generación de nuevas ideas y enfoques creativos que preparan a los estudiantes para enfrentar los desafíos del mundo contemporáneo de manera innovadora y efectiva.

Palabras clave: Educación, entornos virtuales, pensamiento creativo, tecnologías de la información y la comunicación

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Introduction

Virtual environments are digital spaces that allow the development of teaching and learning processes mediated by technology. They can favor students' creative thinking, understood as the ability to generate original and useful ideas to solve problems. This context aims to conduct a systematic review of the scientific literature on virtual environments and their relationship with creative thinking, in order to identify the main characteristics, benefits and challenges of training spaces. For this purpose, several databases have been consulted and the most relevant and current articles on the subject have been selected. It is hoped that this review will provide a general and critical overview of virtual environments as agents for strengthening creative thinking.

Currently, educational technology is an essential component of pedagogical practices, increasingly education relies on devices to achieve its objectives (Medina et al., 2019). Due to the increasing use of ICT in the educational system, educational institutions are making an effort in managing the changes that must be introduced to respond to the technological demands of students and meet their needs, which ultimately leads to a change in the innovative thinking processes of students (Guzmán and Moreno, 2022).

Educational institutions are urged to use e-learning processes that foster students' critical thinking, thus implying a change in traditional pedagogical postures. The ability to adapt to change is what drives creativity and distinguishes educational institutions. Therefore, innovation is crucial to improve students' academic, professional and personal competencies (Castillejo, 2022; Alarcón, 2022).

Likewise, the incorporation of virtual environments implies the need for an infrastructure that includes: (a) access to global resources, which allow students to access a wide variety of online resources from academic databases to multimedia content and information repositories; (b) collaborative learning, offer tools for online collaboration such as discussion forums and collaborative projects; c) personalization of learning, which means that students choose their study paths, activities or projects that particularly interest them; d) multimedia resources, which stimulate creativity by presenting information in an attractive way that facilitates understanding and the generation of new ideas; and e) self-directed learning, which encourages student autonomy, allowing them to take control of their own learning process (Villacis et al. 2021).

Rodriguez et al. (2018), noted that it encompasses a broad and intricate scope: in order to improve and streamline all facets of teaching and learning, educational technology takes a systems-based approach, drawing on a wide variety of tools, techniques, theories, and methods from across disciplines. This allows for more efficient and effective planning, development and evaluation of human and mechanical resources. This study compares with the proposal of Zúñiga et al. (2020) for a new research agenda in educational technology in the next millennium.

Alcívar and Navarrete (2023) have emphasized that in the current period, digital technologies are involved in more than one essential process and that, for this reason, they need hermeneutic and ethical approaches. Capurro considers it important to provide conceptual frameworks describing information systems and criteria of use in order to develop a hermeneutics of the digital society

(cited in Barrios et al., 2021). in which the introduction of computers and the internet completely altered human life. The sectors of economy, transportation, medicine and tourism will see unprecedented effects (Rodriguez et al., 2018). As a result of this pressure, education has adopted the use of technological tools to achieve its goals, giving rise to what is now known as educational technology (Guerra, 2019).

Based on the above premises, the purpose of this article is to analyze the relevant evidence on the role of virtual environments in strengthening creative thinking in education. It was also proposed to examine qualitatively the different epistemological and methodological approaches taken by researchers in their studies.

Methodology

The study that was developed followed the PRISMA 2020 model for a systematic review of scientific articles in accordance with its purpose:

2.1. Information sources search phase

Various search engines were used to compile the information, including databases such as Scopus, Google Scholar, Redalyc and SciELO, which were chosen for their relevance and ease of access to the documents for authors, reviewers and readers. Subsequently, clear inclusion criteria were established for the selection of articles, these included: a) original or review articles, b) the terms: education, virtual environments and strengthening creative thinking; c) published between 2018 and 2023; and d) disseminated in Spanish or English. Exclusion criteria were also established. These were: a) theses of any type, blogs, letters to the editor and similar, b) articles that had a minimal relationship with the subject matter, c) articles published outside the established period; and d) written in a language other than Spanish or English.

Once the keywords relevant to the study were determined, search equations were constructed by combining terms with the Boolean operator: (virtual environments “AND” strengthening creative thinking) AND (education “AND” knowledge).

2.2 Research selection phase

The selection phase included the review of publications based on the criteria established in the formulas. *Table 1* presents summary data on the information collected both before and after the application of the filters in all the databases, considering the language or query used. In turn, *Figure 1* detailed the PRISMA flowchart and the delimitation of the filters that were set for the document exclusion process. We began by discarding blog posts and letters to the editor and theses of any kind, then those that had little relation to the research topic, followed by research published before 2013 and finally studies in languages other than Spanish or English. This resulted in a total of 20 papers that were carefully reviewed and thoroughly analyzed.

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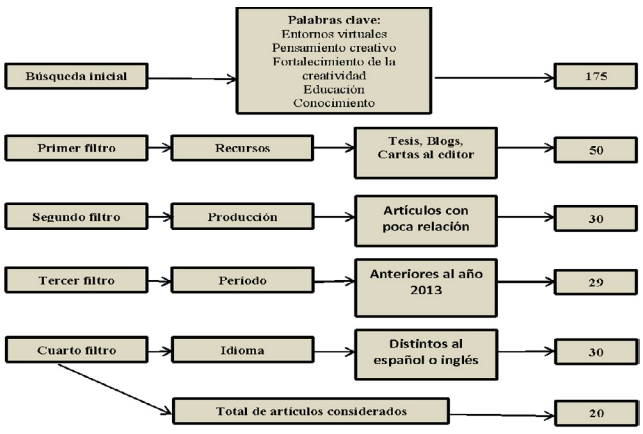
Table 1

Results obtained from each database according to the established search formula

Base de datos	Fórmula de búsqueda (en español y en inglés)	No. de resultados	N° de resultados después de aplicar los criterios de inclusión y exclusión
Scopus	Entornos virtuales “AND” fortalecimiento del pensamiento creativo; virtual environments “AND” strengthening creative thinking; Educación “AND” conocimiento. education “AND” knowledge	29	3
Google Académico	Entornos virtuales “AND” fortalecimiento del pensamiento creativo virtual environments “AND” strengthening creative thinking; Educación “AND” conocimiento. education “AND” knowledge	85	8
Redalyc	Entornos virtuales “AND” fortalecimiento del pensamiento creativo virtual environments “AND” strengthening creative thinking; Educación “AND” conocimiento. education “AND” knowledge	29	4
Scielo	Entornos virtuales “AND” fortalecimiento del pensamiento creativo virtual environments “AND” strengthening creative thinking; Educación “AND” conocimiento. education “AND” knowledge	32	5

Figure 1

PRISMA flow chart.



2.3 Information extraction phasen

After carrying out the process described in *Table 1*, the articles reviewed were presented in a synthetic manner in a matrix in which only those that were selected were included (*Table 2*).

This allowed us to obtain a broader perspective and a logical organization of the data, in order to facilitate reading and understanding by the target audience. In this way, the information was presented in a clear and concise manner.

Table 2

Matriz de Síntesis.

No.	Año	Autores	Título	País
1	2021	Frison y Russo	Constituyendo transicionalidad y devenir: virtualización del espacio educativo, interrogantes y estrategias desde un pensamiento creador	Argentina
2	2021	Aragundi y Game	Enseñanza creativa en entornos virtuales para el desarrollo de competencias emocionales	Ecuador
3	2018	Hernández et al.	Desarrollo de competencias de pensamiento creativo y práctico para iniciar un plan de negocio: diseño de evidencias de aprendizaje	México
4	2019	Medina et al.	El desarrollo de la creatividad en la formación universitaria	Ecuador
5	2019	Suárez et al.	Desarrollo de la Creatividad y el Talento desde las Primeras Edades. Componentes Curriculares de un Programa de Maestría en Educación	Ecuador
6	2022	Guzmán y Moreno	Evaluar el pensamiento creativo en estudiantes de arquitectura	México
7	2022	Castillejo	Inteligencia artificial y entornos personales de aprendizaje: atentos al uso adecuado de los recursos tecnológicos de los estudiantes universitarios	México
8	2022	Alarcón	Influencia de la enseñanza virtual en el pensamiento creativo	Perú
9	2022	Delgado	Estrategias didácticas para fortalecer el pensamiento creativo en el aula. Un estudio metaanalítico	Perú
10	2019	Guerra	Una revisión panorámica al entrenamiento de las habilidades blandas en estudiantes universitarios	Colombia
11	2020	Aguilar	Del aprendizaje en escenarios presenciales al aprendizaje virtual en tiempos de pandemia	Ecuador
12	2020	Marcillo	Agentes tutores para la enseñanza	Colombia
13	2018	Rodríguez et al.	Implementación de un entorno virtual como herramienta didáctica para fortalecer el proceso enseñanza aprendizaje	Cuba
14	2020	Casar et al.	Desarrollo de la creatividad en cursos a distancia a través de entornos virtuales de aprendizaje	Cuba
15	2020	Murillo	Estrategias educativas y tecnología digital en el proceso enseñanza aprendizaje	Perú
16	2020	González y Martínez	Dilemas éticos en el escenario de la inteligencia artificial	Cuba
17	2020	Lengua et al.	Tecnologías emergentes en el proceso de enseñanza aprendizaje: hacia el desarrollo del pensamiento crítico	Colombia
18	2020	Zúñiga et al.	El nuevo enfoque de participación docente ante los retos y desafíos tecnológicos de la cuarta revolución industrial 1	Perú
19	2021	Barrios et al.	Propósitos de la educación frente al desarrollo de la inteligencia artificial	Colombia
20	2023	Alcívar y Navarrete	Estrategia metodológica para el fortalecimiento de las competencias digitales docentes	Ecuador

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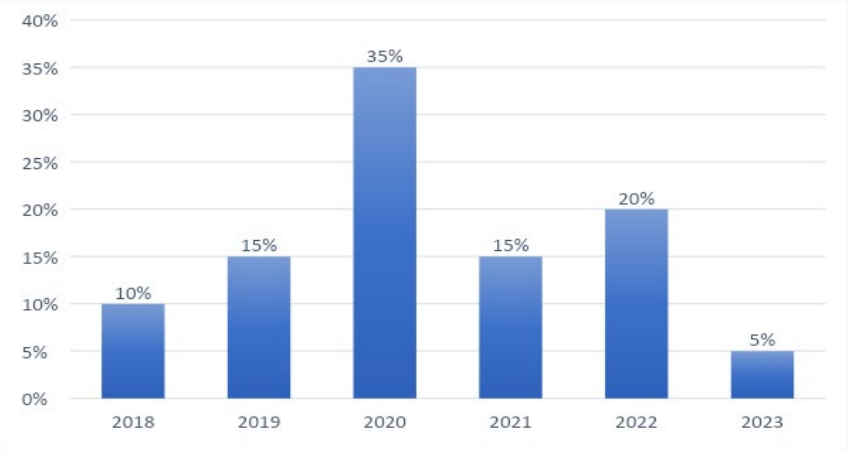
Consequently, the results of the analysis of digital competencies in the knowledge era were presented. New approaches from artificial intelligence. This acknowledges the distinctive contributions of the research considered within the present study.

2.4 Articles by year of publication

Making use of the data obtained from the systematic review and exposed in the synthesis matrix established in *Table 2*, the trend in research according to the year of publication was presented, this is shown in *Figure 2*.

Figure 2

Articles by Year of Publication.



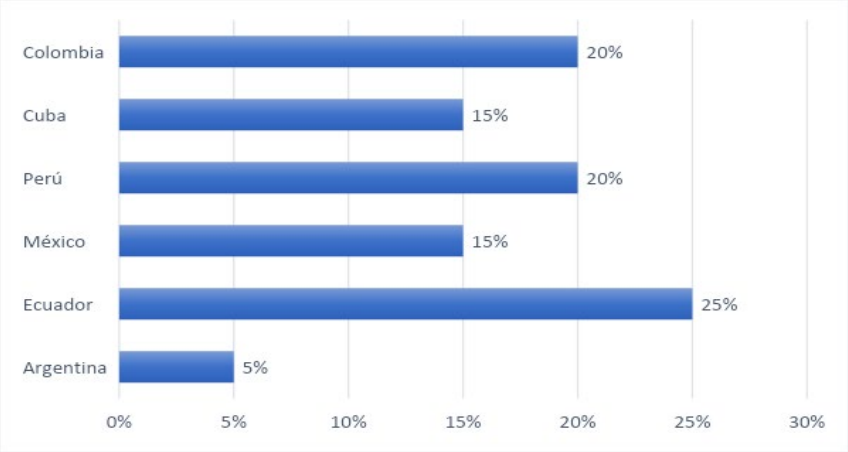
After examining the content of the 20 scientific publications selected to structure the systematic review, it was possible to concatenate the information corresponding to the variable of analysis in question. As evidenced in *Figure 2*, the majority of resources is positioned in 2020 represented by 35% (7) of the scientific resources; for its part, the year 2022 establishes 20% (4) of articles, for the years 2019 and 2022 it is established that there is a predominance of publication of 15% (3). Finally, for the years 2018 and 2023 there is a publication percentage of 10% (2) and 5% (1) respectively.

2.5 Publications by country of origin

Figure 3 shows the results of the studies reviewed, taking into account the country of origin of each one of them. The results are as follows:

Figure 3

Publications by country of origin.



By country of origin, it was found that there is a significant relevance for research on the topic and, in order of the number of publications that address it, Ecuador is the country with the highest number of selected publications, with 25% (5); countries such as Colombia and Peru 20% (4); 15% (3) in countries such as Cuba and Mexico; and finally, 5% (1) in Argentina.

Results

The results of the articles analyzed showed that virtual environments do indeed contribute to and can strengthen creative thinking. Creative thinking is a complex cognitive process that involves the generation of original and novel ideas, as well as the ability to innovatively combine previously known concepts and elements. The cognitive processes associated with creative thinking are fundamental to problem solving, creative decision making, and the creation of artistic and scientific works (Vázquez, 2021). Today's online classrooms encourage students to think creatively while learning, but this does not happen by chance; rather, teachers must invest time and effort in first developing their own digital competencies, so that they can then adapt and integrate into their activities, dynamics and didactic strategies focused on the learning process of their students.

This way of meeting the objectives with the mediation of devices forces teachers to expand their knowledge and links them to educational technology, improving both the teaching process and the use of these new technological tools (Marcillo, 2020). However, ICT is not only focused on technology, but also to the use of information and communication to achieve quality education (Guerra, 2019).

In this sense, an important number of the selected research emphasized the teacher's responsibility in adjusting their traditional classroom practices to learning situations mediated by virtual environments. Given that the changes have affected both the way in which they organize classes and the students' own learning experience. However, it is also important to highlight that online education poses challenges, among which are, the need to maintain high levels of motivation and

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self-discipline on the part of students, effective time management and the adaptation of teachers to new ways of teaching (Zuñiga et al, 2020). Likewise, not all students have equal access to technology and a high-speed internet connection, which can generate inequalities in access to online education. Therefore, the effective implementation of virtual environments in education requires considering these challenges and seeking solutions to address them (Lengua et al. 2020).

From the above, it could be seen that in the articles analyzed in depth it was confirmed that virtual education can be useful for students to develop skills to critically analyze information, make decisions autonomously, reach answers using other means, be more creative, innovative and productive. To this end, in the articles the teachers posed novel strategies to address challenges, posed questions with the aim of obtaining creative solutions. Therefore, it is crucial that teachers cultivate their skills by taking advantage of technological tools and encouraging the development of their creative capacity in their educational activities (Aguilar, 2020).

As has been explained, students can be more innovative and creative when they have access to a wide variety of digital tools for the creation and dissemination of knowledge, as analyzed by Rodríguez et al. (2018). These count among their strengths the management of virtualization and the use of technological resources in teaching and learning situations. Within the limits of this research, it was possible to understand the role played by the educator in the management of educational environments and their ability to incorporate strategies and resources of virtuality, not only in knowledge acquisition, but also in the expansion of their skills to explore their creative capacity (Casar et al., 2020).

For its part, creativity as the ability to identify defects in a given object, create and test novel hypotheses and present results, is a skill of divergent thinking. It is based on fluency, adaptability and originality in thinking, awareness of problem solving and redefining previously held concepts. From the activation of the learning process, Alarcón (2022) highlighted the importance of critical thinking that will allow students not only to be more critical, creative and autonomous in their approach to problem solving, but also to broaden their routes to think creatively. Delgado (2022) concluded that teaching-learning processes supported by ICT positively affect students' academic performance, leading to greater student autonomy and responsibility.

Guzman and Moreno (2022) concluded that ICTs are crucial for global higher education, particularly with regard to distance education and considering the resources provided by technology to assist students in their education. Castillejos (2022) argued that the use of ICT is crucial for online knowledge creation in education. The use of a personal technological device that manages educational processes is integrated into the dialogue between teacher and student. It also takes into account the technologically enhanced learning environment known as virtual classroom, in which students are encouraged to actively participate in creative problem solving during a class session to generate meaningful learning and access relevant information (Frison and Russo, 2021).

According to Aragundi and Game (2021), a new educational technology research agenda is proposed for the next millennium. First, it is proposed that studies be conducted to determine whether or not the purported benefits of technology exist and whether or not the claimed methods and programs are effective (Medina et al., 2019). Researchers believe that the most useful studies

will be those that attempt to demonstrate whether or not certain technology-based methodologies have the potential to achieve unique and consistent benefits in response to a specific category of educational problems (Guzman and Moreno, 2022). If there is a way to implement technology-based methods that are already widely used and are intended to increase their influence on student achievement, retention, and satisfaction, then they will need to be used. Advances made by understanding some of the most crucial educational objectives for technology (Castillejo, 2022).

Consequently recent experiences, due to the health crisis, demonstrated that distance education, according to Lengua et al. (2020) is the vanguard of education because it allows students to participate from anywhere, taking charge of their own learning and acquiring knowledge in novel and efficient ways thanks to the use of technological tools (Zúñiga et al., 2020). Online learning emphasizes open and continuous dialogue between instructors and students to foster bidirectional and multidirectional communication in which listeners become speakers and teachers become learners, respectively. This helps to guide and train students more autonomously throughout the learning process (Gonzalez and Martinez, 2020).

In universities around the world, ICTs are a fundamental tool for developing students' critical thinking and influencing the way they are taught to adapt to changing circumstances. Administratively, they help educational institutions streamline their operations by leveraging digital platforms; from the curricular point of view, they help students generate knowledge and provide them with access to relevant educational and creative resources (Alcívar and Navarrete, 2023).

Thus, in the opinion of Barrios et al. (2021), the key periods are those of exploration, integration and innovation. Exploration is carried out through the use of ICTs in the educational setting, reinforcing teachers' confidence in the use of technological aids in the classroom. The second phase of integration consists of establishing connections between the knowledge acquired and the experiences obtained during exploration, with the objective of implementing the appropriate use of ICT in education through the use of available resources (Lengua et al., 2020). Third, the innovative moments give rise to various learning strategies that are then used in each class meeting and, finally, the innovative experiences that result in pedagogical changes are evaluated. Finally, these moments have diverse effects; for example, in some cases they inspire creative ideas of new application (Vargas, 2020).

Within this line of thought, Aguilar (2020) expressed that ICTs at present group spaces, interactions, devices, languages, exchanges and even concepts, which are present in all areas of social life. These have revolutionized education by expanding access to information and learning, fostering collaboration, personalizing teaching and providing analysis tools (Marcillo, 2020). It is crucial that educational institutions use ICTs from the proper management by teachers so that all students have access to the same opportunities and can take advantage of the benefits of cutting-edge technological resources (Alarcón, 2022). The appropriate use of technology in education can improve teaching and learning, foster more democratic and inclusive classroom environments, and help students work together to solve problems using their creative problem-solving skills and scientific knowledge (Guzmán and Moreno, 2022).

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In this sense, it could be seen that currently Latin American universities recognize the importance of educational innovation with ICTs, so it is argued that the incorporation of ICTs in the classroom is crucial not only to foster creative thinking. From this point of view, several studies have shown that creative thinking can be fostered through online education (Suárez et al., 2019).

From another perspective, the study by Medina et al. (2019) recognized that the gradual incorporation of technology in the educational process leads to an improvement in critical and creative thinking. On the other hand, Castillejos (2022) argued that it is possible to improve students' creative thinking within the learning environment of massive open online courses. This allows affirming that in all the texts analyzed there is an important trend about the role of virtual environments in fostering greater individual and group creative performance, as well as the emotional aspects associated with the enjoyment and fun involved in this way of learning.

Likewise, it is recognized that the relationship between technological, sociocultural and pedagogical elements is crucial in the virtualization of education (Alcívar and Navarrete, 2023). Therefore, it is necessary to incorporate these factors in virtual education to foster creative thinking. In this regard, Barrios et al. (2021) emphasized that the use of multimedia tools to improve students' creative thinking skills at the university level. Likewise, a previous study highlights the use of a mobile application integrated with realistic mathematics education to foster the development of creative thinking skills in elementary school (Lengua et al., 2020).

As it has been established that students' digital literacy and ICT skills are important predictors of their creative thinking abilities (Casar et al., 2020), more and more research is being conducted to assess students' creative thinking in STEAM education (Rodriguez et al., 2018). According to Marcillo (2020), distance learning represents the next generation in education, with ICT serving as a crucial information and communication hub for today's students. Both Aguilar (2020) and Delgado (2022) stated that the use of alternative forms of innovation in online education leads to the development of more autonomous, critical and creative individuals.

For their part, Casar et al. (2020) in their work found that current graduates from various universities need to constantly update their skills and knowledge. Due to these drawbacks, online learning has emerged as a viable option to prepare future professionals. Today, educational virtualization (Alcívar and Navarrete, 2023) is experiencing a boom and positive transformation and is presented as a flexible, effective and viable option for providing quality education. Innovation is a key component of online education, and has a positive impact on the field as a whole (González and Martínez, 2020).

In this sense, it is recognized that despite the continuous development the pace of this virtual method is linked to changes in methodology, technology and society (Aguilar, 2020). The student is the protagonist of his learning because he understands that he is the personal constructor who creates his theories in light of the new technological paradigms, which also continue to contribute to intellectual capacity as part of a symbology that increases the levels of abstraction, autonomy and creativity (Medina et al., 2019).

Despite how extensive and diverse the literature review has become, aspects that were not considered or were addressed in a superficial manner continue to be observed. Among these are: the availability of data, the biases associated with the testing of some of the hypotheses formulated by the researchers, the diversity of virtual environments and the limitations that this may mean for making generalizations about the results, the rapid evolution of the technology of virtual environments that makes research lose validity in the short term. Finally, it should be pointed out that if a critical and comprehensive systematic review is to be prepared, the aforementioned factors should be taken into account, and these may give rise to new studies if the aforementioned factors are taken into account, which may be developed in another way, giving rise to new studies.

Conclusions

Based on the paragraphs provided, it could be inferred that virtual environments play a crucial role in strengthening creative thinking in education. The effective integration of Information and Communication Technologies (ICT) in pedagogical processes and virtual education has shown to have a positive impact on the development of students' critical and creative thinking. This effect was attributed to several factors such as the ability of ICTs to provide personalized learning and stimulate creative interaction among students.

Virtual environments facilitate broad access to diversified resources and allow the implementation of innovative methodologies that can motivate students to think more imaginatively and autonomously. Furthermore, the scientific literature reviewed supports the idea that online learning can enrich students' creative abilities, provided that educators make creative thinking a priority and continuously train in digital competencies. This suggests that not only the technology itself, but also how it is used and how teachers are trained to integrate it into teaching, are determining factors in the impact of virtual environments on creative thinking in education.

Therefore, to maximize the benefits of virtual education in the development of creative thinking, it is essential that educational institutions engage in a reflective and strategic implementation of technologies, supporting teachers in their training and continuously adapting pedagogical practices to the changing needs of the digital environment.

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