SSRG International Journal of Electronics and Communication Engineering
ISSN: 2348-8549/ https://doi.org/10.14445/23488549/IJECE-V12I3P112

Volume 12 Issue 3, 125-133, March 2025

Original Article

Chronological Analysis of the Metaverses of Peruvian Universities and their Impact on Education

Alberth Pérez-Mamani[1], Nebeck Dávila-Díaz[1], Oscar Arana-Huanca[1], Julio Méndez-Nina[2], Alicia Alva-Mantari[1*], Sebastián Ramos-Cosi[1]

[1]*Image Processing Research Laboratory (INTI-Lab), University of Sciences and Humanities, Lima, Peru.*
[2]*Faculty of Health Sciences, University of Sciences and Humanities, Lima, Peru.*

[*]*Corresponding Author : aalva@uch.edu.pe*

Received: 08 January 2025 Revised: 09 February 2025 Accepted: 011 March 2025 Published: 29 March 2025

Abstract *- The metaverse in higher education offers great potential but faces significant challenges. According to the United Nations Cultural, Scientific and Educational Organization (UNESCO), less than 10% of educational institutions globally have adopted immersive technologies. In Peru, although 62% of the population is familiar with the metaverse, its application in the educational field is still limited. This study aimed to chronologically analyze the metaverses of Peruvian universities and their impact on education. Through a descriptive and comparative review, information from databases such as Scopus and Latindex and university repositories was used. Characteristics were then established to identify similarities and differences between metaverses. The results pointed to the existence of seven university metaverses developed between 2008 and 2023. The first, the Second USMP, introduced innovative academic simulations, while in 2022, UPC Cultural, ContiVerso, Meta Waka and Ingeniería VR emerged, integrating tools to foster creativity and personalize educational processes. In 2023, the UDEP Metaverse and the UCHverse were identified, the latter being the most complete for possessing all the established characteristics that include total immersion, recreation of university environments, and multiplatform access. It is concluded that Peruvian metaverses have the potential to transform higher education. However, they face barriers to accessibility and infrastructure, and it is recommended to strengthen technological training and expand public access to maximize their impact.*

Keywords *- Metaverse, Universities, Education, Chronologically, Technologies.*

1. Introduction

The United Nations (UN) stresses that education is a fundamental pillar for individual and social development [1]. With the growing influence of new emerging technologies, it is essential to incorporate innovative tools that strengthen the educational process [2]. In this context, the metaverse emerges as one of the most advanced and effective solutions [3]. However, according to the United Nations Cultural, Scientific and Educational Organization (UNESCO), less than 10% of schools and universities in the world have implemented concrete policies to integrate artificial intelligence into their education systems, reflecting a significant gap that needs to be addressed to ensure more inclusive education. Effective and adapted to contemporary challenges [4]. The Public Polling Institute of the Opinion Sector (Ipsos) indicates that only 1 in 2 people show interest in getting involved with extended reality despite the benefits that this technology offers in various daily activities [5]. In countries like Poland and France, familiarity with the metaverse is even more limited, reaching just 27% and 28%, respectively [5, 6]. This lack of awareness and adoption reflects a significant barrier to the implementation and development of immersive technologies globally. Overcoming this gap involves promoting technological education and creating strategies that increase the positive perception and adoption of these tools in different sectors of society [7]. In Peru, 62% of the population states that they are familiar with the metaverse, mainly due to the dissemination of information and its exposure in the media [5, 8]. However, access to this technology is not yet widespread, and its use in the educational field remains limited [9]. Despite this, it has been observed that some Peruvian universities have recently begun to venture into the metaverse, exploring its potential as an educational tool [10]. This adoption poses significant opportunities to innovate in higher education, enabling the implementation of interactive and collaborative environments that can enrich learning, improve student engagement, and adapt to current technological demands. The metaverse is a three-dimensional virtual environment that fuses reality with interactive digital spaces, where users can carry out everyday activities such as playing, working, studying and exploring new places in an augmented or digital reality context [11]. Artificial Intelligence (AI) plays a crucial role in this ecosystem, enabling the creation and

customization of avatars that represent users in these environments [12]. In addition, AI facilitates constant adaptations to optimize and enhance the immersive metaverse experience [13]. These characteristics make the metaverse have wide applications in entertainment, education, remote work and commerce, consolidating itself as a versatile tool with a high potential to transform different areas of society [14].

Metaverses are categorized into centralized and decentralized. Centralized metaverses are managed by an entity that controls their development and operations, while in decentralized metaverses, users have greater autonomy over the environment and available functionalities [15]. Its benefits include immersive interaction, which provides realistic user experiences and global access, facilitating individual connection and eliminating geographical barriers [16]. They also promote economic opportunities through the exchange and commercialization of virtual goods. Significantly, metaverses foster educational innovation by offering interactive environments that optimize learning and enhance active student engagement [17].

To understand the concept and scope of the metaverse, it is essential to know its origin. The term was introduced in 1992 by Neal Stephenson in his literary work [18], but its first practical basis emerged in 2003 with the creation of the Second Life platform, where users could access a virtual space to interact and carry out various activities [19]. Subsequently, in 2012, Palmer Luckey launched the first Oculus glasses, laying the foundations for developing an accessible virtual reality [20]. In 2014, Mark Zuckerberg, founder of Facebook, acquired this product, which prompted the development of this technology [21]. Finally, in 2021, Facebook announced its transition to Meta, presenting an expansive vision of the metaverse [22]. This milestone generated global interest in the topic, accelerating the research and continuous development of technologies related to immersive virtual environments.

All of the above invites us to reflect on the impact metaverses can have on university education and how they have evolved in the academic field. In this context, it is relevant to analyze the development of these virtual environments implemented by Peruvian universities. Therefore, the objective of this study is to chronologically analyze the metaverses of Peruvian universities and their impact on education. This analysis will allow us to understand how these platforms contribute to pedagogical innovation and what opportunities they offer to optimize teaching and learning in an increasingly interactive and immersive technological environment.

2. Literature Review

In [23], a study was carried out whose objective was to analyze the tools of the metaverse and their impact on educational contexts. The methodology consisted of a review of existing literature, including scientific articles and other studies, to compare the positive and negative impacts of these platforms. The results indicated that Second Life and Open Sim have been the platforms with the greatest impact. Among the benefits identified, developing personal skills, such as self-confidence and social interaction, promoting playful learning and developing asynchronous activities stand out. However, negative effects such as cognitive exhaustion and technological dependence were identified. The authors conclude that, for an effective implementation of the metaverse in education, it is essential that teachers receive adequate guidance and stay updated on the use of these technologies.

The study presented in [24] aimed to analyze the use of the Second Life platform as an educational tool for university professors in immersive learning environments. The methodology consisted of a qualitative phenomenological study, applying observation techniques and interviews. The results highlighted three main categories: immersive, constructivist and collaborative learning, evidencing that this tool allows significant learning to be achieved. The research concludes that universities and teachers are responsible for recognizing metaverses as effective resources for teaching and learning. Therefore, it is essential that teachers receive adequate training and that educational institutions implement the necessary technological infrastructure to take advantage of the advantages of these virtual environments in university teaching.

The research in [25] aimed to analyze the process of acquiring professional skills at university through teaching in the metaverse. The methodology consisted of a categorization of terms and interviews with the participants. The results showed that the metaverse offers interactive opportunities that enrich the educational experience, but its implementation in university environments requires prior training for both teachers and students in digital technologies. In addition, the need to adapt teaching methodologies to virtual learning is highlighted, which has become more relevant in recent years. The research concludes that it is essential to develop a practical guide with effective instructions to facilitate the navigation and optimization of this virtual environment, thus allowing it to make the most of its benefits in the educational field.

In [26], a study was carried out to analyze the metaverse as a strategy to strengthen digital education. The methodology used was qualitative, using a matrix of conceptualization of terms and interviews with experts in the field. The results showed that the metaverse and its tools offer a positive experience for students, allowing them to enhance their learning by integrating theoretical knowledge with practical activities in virtual scenarios. It is concluded that, although adopting the metaverse is in an initial phase, it is

essential to prepare teachers and students to adapt to this new educational environment, thus ensuring an effective transition to innovative methodologies that optimize the teaching and learning process.

3. Methodology

3.1. Assessment of the Environment

A descriptive and comparative chronological identification of the metaverses developed by Peruvian universities was carried out with the aim of analyzing their progress, transcendence and current status. To this end, an exhaustive search was carried out in open-access databases, such as Scopus and Latindex, complemented by the review of university repositories [27]. This process made it possible to collect accurate information about the implementation and characteristics of each metaverse. Subsequently, the impact that these platforms have had on higher education was described, highlighting their influence on technological innovation, teaching methods and interactive learning.

3.2. Identification of Characteristics

The main characteristics of the metaverses implemented by Peruvian universities were analyzed in order to highlight their similarities and functional differences. This analysis made it possible to determine which of these platforms are best equipped in terms of specific functionalities, such as collaborative interaction, technological compatibility and simulation capacity. Identifying the most advanced platforms is key to assessing their potential in improving educational processes and carrying out academic activities. In addition, this approach makes it easier to recognize areas that require optimization to strengthen their impact on higher education and vocational training [11].

Table 1. Main characteristics of metaverses

Feature	Description
Free access	Entry into the virtual environment without the need for payments or subscriptions.
Active and accessible	Operational status of the environment in which it can be entered.
Compatible with headphones	Use with virtual reality devices to enhance the immersive experience.
Cross-platform capability	Operation on different platforms and computers.
Total immersion	An experience that completely immerses the user in the virtual environment.
Recreating real university environments	Accurate virtual representation of university physical facilities.
Freedom of movement	Ability to move in all directions within the environment.
Concurrent online users	Real-time interaction with multiple connected users.
Object Control	Manipulation and interaction with virtual objects within the environment.
Reproduction of scenarios and experiences from the professional field	Simulation of specific professional and educational activities.
Instant transition	Immediate movement between virtual locations in the environment.
Adaptation of avatars	Customization of the appearance of the user's virtual character.
Communication tool	Channels such as voice chat or text are available in the environment.
Prepared by students	Development is carried out exclusively by students.
Realistic surfaces	Using detailed textures to create visually authentic virtual environments.

Table 1 presents the main characteristics of the metaverses evaluated and used as analysis criteria. Free access (no payment required) and active and accessible status (operability of the environment) are included. In addition, headphone support for immersive experiences, cross-platform capability for different devices, and full immersion, which offers an immersive experience, are considered. Other features evaluated include the recreation of real university environments, freedom of movement, simultaneous online user participation, and interactive object control. Finally, the reproduction of professional experiences, instant transition, adaptation of avatars, communication tools, development elaborated by students, and realistic surfaces are analyzed.

4. Results

Several Peruvian universities were identified that have developed their environments in the metaverse, demonstrating significant advances in implementing immersive technologies for education. These metaverses reflect the interest of institutions in innovating in teaching and learning processes through interactive virtual environments. Each platform has particular characteristics in terms of functionality, accessibility and available resources, which shows an effort to adapt technology to current educational needs. Below are the metaverses identified and developed by universities in the Peruvian context.

4.1. Metaverse Timeline

4.1.1. Second USMP

The development of metaverses in Peruvian universities began in 2008 with the creation of the Second USMP, an innovative project promoted by the University of San Martín de Porres (USMP). Using the Second Life platform, this metaverse made it possible to explore new educational and social interaction methodologies, such as holding university fairs and prominent events.

Various faculties took advantage of its resources, such as the Faculty of Tourism, where students interacted with visitors, and Dentistry, which used simulations of human anatomy for virtual practices. However, the project ended in 2018 due to institutional decisions, leaving only the virtual representation of Machu Picchu accessible on the platform [28].

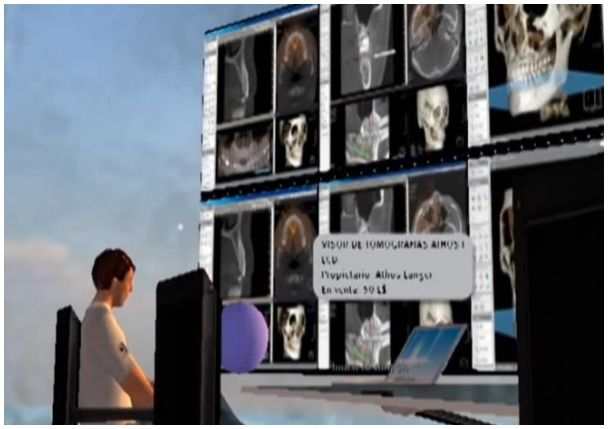

Fig. 1 Simulation for dental workshop

Figure 1 presents a virtual simulation developed in the Second USMP for a dentistry workshop. The image shows an interactive interface that shows detailed CT scans of human skulls, focusing on bone structures related to the dentition.

This digital resource allows students to visually explore and manipulate anatomical elements, facilitating hands-on learning in a virtual environment.

4.1.2. UPC Cultural

After the closure of the Second USMP, the interest in implementing immersive technologies in the academic environment continued. In 2022, the Peruvian University of Applied Sciences (UPC) developed the UPC Cultural metaverse using the OnCyber platform to promote and disseminate art. This virtual environment consists of an interactive gallery where students in graphic design, photography, and related disciplines can exhibit their works. Through competitions organized in this space, students have the opportunity to be recognized, which encourages their participation, boosts their creativity and strengthens their relationship with emerging technologies.

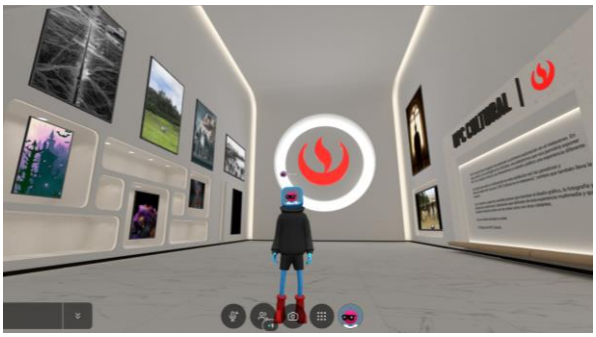

Fig. 2 Art gallery at UPC cultural

Figure 2 shows the interior of the UPC Cultural Metaverse, a virtual gallery designed to showcase artwork created by students at the university. In the image, you can see pieces of graphic design and photography arranged in an interactive environment. In addition, an avatar that represents users is observed, as well as accessible functions within the virtual space, highlighting the technological integration for promoting and disseminating student talent.

4.1.3. ContiVerso

In 2022, Universidad Continental developed ContiVerso, a metaverse that virtually replicates its headquarters in Huancayo. This environment was designed so students could carry out activities similar to those on the physical campus, such as attending classes, participating in laboratories, working in a team, and interacting with classmates and teachers.

Recently, Artificial Intelligence was integrated, which allows teachers to respond more efficiently to student queries and personalize teaching processes, thus strengthening the educational experience within the virtual environment [29].

Fig. 3 Educational session on the contiverse

Figure 3 presents a virtual classroom within the ContiVerse, where students actively participate in an educational session using personalized avatars. The environment faithfully recreates a real classroom, including furnishings and layout, providing a realistic experience for users. This similarity facilitates interaction with teachers and classmates, allowing dynamic and effective participation in activities within the virtual environment.

4.1.4. Meta Waka

In 2022, the University of Engineering and Technology (UTEC) developed Meta Waka, a metaverse implemented on the Decentraland platform. This virtual environment recreates the university campus, offering an interactive and accessible representation for users. One of its outstanding functionalities is the projection of audiovisual content, such as informative videos, which facilitate knowledge about the institution and the educational resources available. Meta Waka not only promotes institutional dissemination but also provides users with an immersive experience that strengthens interaction with the university's representative services and spaces.

Fig. 4 Virtual tour at meta waka

Figure 4 shows a corridor within the Meta Waka metaverse, where the walls are decorated with paintings and recognitions representative of the university. These elements provide users with a more detailed view of institutional and academic achievements. In addition, the user's avatar is seen taking an interactive tour, highlighting the immersive and personalized experience offered by this virtual environment to explore university spaces.

4.1.5. VR Engineering

In 2022, the National University of San Agustín (UNSA) developed the VR Engineering metaverse, a student-created environment that offers interactive experiences in specific areas of engineering. This space allows students to interact with machinery and participate in simulations of substance treatment, facilitating access to complex practices that are difficult to perform in physical environments. However, access to this metaverse is limited to a small group of students, which restricts obtaining more detailed information about its functionalities and educational scope.

Figure 5 shows a hands-on workshop in the VR Engineering metaverse designed for civil engineering students. In this virtual environment, participants can manipulate machinery and interact with various inputs used in practical activities. This simulation offers a realistic and accessible experience, allowing students to acquire technical skills by executing complex tasks in a controlled and fully interactive environment.

Fig. 5 Hands-on VR engineering workshop

4.1.6. UDEP Metaverse

In 2023, the University of Piura (UDEP) developed the UDEP Metaverse using the Spatial.io platform, where the emblematic Government Building of its headquarters in Piura is virtually recreated. This environment offers access to an auditorium, a meeting room and a customer service area. In the latter, users can interact to obtain information about the university and its services, thus facilitating an immersive and efficient experience for institutional and academic dissemination [30].

Fig. 6 UDEP metaverse façade

Figure 6 presents the façade of the UDEP Metaverse, a virtual recreation of the Government Building of the Piura campus of the University of Piura. In the image, an avatar is seen taking an interactive tour within the virtual environment, highlighting the architectural fidelity of the building and the possibility of exploring institutional spaces, which facilitates an immersive and realistic experience for users.

4.1.7. UCHverse

The UCHverse is a metaverse developed in 2023 by students at the University of Sciences and Humanities (UCH) using the VRChat platform. This virtual environment recreates the university campus in detail, from its façade to the main laboratories. Students can access experimental simulations and explore the academic tools available for various careers. In addition, interactive didactic representations were incorporated to capture the visitor's attention and enrich the virtual experience, making it an attractive and innovative educational tool for the university community and future applicants [31].

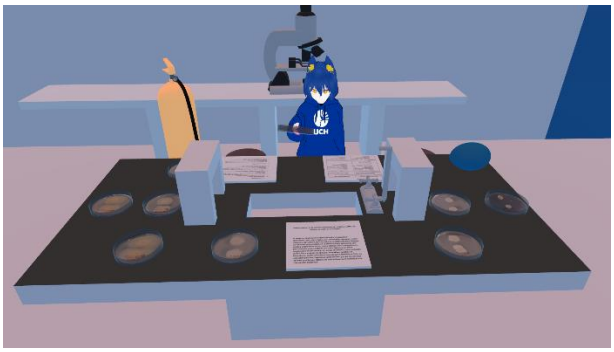

Fig. 7 Microbiology lab at the UCHverse

Figure 7 presents an avatar within the UCHverse, specifically in the microbiology lab. In this virtual environment, a real experiment can be simulated using materials arranged on the work table, such as petri dishes and a microscope. In addition, manuals are observed that guide the experimental activity, providing an interactive and enriching educational experience for students in a digital environment.

4.2. Feature Analysis

Table 2 presents a detailed analysis of the characteristics of university metaverses in Peru. Free access and active and accessible status are present in UPC Cultural, Meta Waka, Metaverse UDEP and UCHverso. Headset support, cross-platform capability, and full immersion are found in UPC Cultural, VR Engineering, UDEP Metaverse, and UCHverse. Recreation of real university environments is observed in Segunda USMP, ContiVerso, UDEP Metaverse, and UCHverso, and freedom of movement is enabled in all metaverses analyzed. Online concurrent user participation is possible in Segunda USMP, UPC Cultural, ContiVerso, Meta Waka, UDEP Metaverse, and UCHverso.

At the same time, object control is found only in Segunda USMP, VR Engineering, and UCHverso. In addition, scenario playback and professional experiences are featured in Second USMP, ContiVerse, Meta Waka, VR Engineering, and UCHverse, and instant transition is available in Second USMP, ContiVerse, Meta Waka, and UCHverse. Avatar adaptation and communication tools are prominent features in most metaverses, while student-crafted development is exclusive to VR Engineering and UCHverse. Finally, the realistic surfaces are found in Segunda USMP, ContiVerso, Ingeniería VR, Metaverso UDEP and UCHverso, consolidating the latter as the metaverse with the highest number of functionalities evaluated.

Table 2. Analysis of the characteristics of university metaverses

Characteristics	**Metaverse**						
	Second USMP	Cultural UPC	Contiverse	Meta Waka	Engineering VR	UDEP Metaverse	UCHverse
Free access	-	x	-	x	-	x	x
Active and accessible	-	x	-	x	-	x	x
Compatible with headphones	-	x	-	-	x	x	x
Cross-platform capability	-	x	-	-	x	x	x
Total immersion	-	x	-	-	x	x	x
Recreating real university environments	x	-	x	-	-	x	x
Freedom of movement	x	x	x	x	x	x	x
Concurrent online users	x	x	x	x	-	x	x
Object Control	x	-	-	-	x	-	x
Reproduction of scenarios and experiences from the professional field	x	-	x	x	x	-	x
Instant transition	x	-	x	x	-	-	x
Adaptation of avatars	x	x	x	x	-	x	x
Communication tool	x	x	x	x	x	x	x
Prepared by students	-	-	-	-	x	-	x
Realistic surfaces	x	-	x	-	x	x	x

5. Discussion

The chronological analysis of the metaverses developed by Peruvian universities made it possible to identify seven outstanding educational platforms, considering their years of creation and applications. The first metaverse identified was the Second USMP, launched in 2008 and developed using the Second Life platform, widely recognized for its impact on the construction of educational virtual environments, as noted [23]. This metaverse offered students the opportunity to conduct interactive practices and virtual simulations, fostering dynamic and immersive learning. However, the project was discontinued, and accessing this environment or its interactive tools is currently impossible. This case shows the need for sustainable strategies and continuous updates to guarantee the permanence and effectiveness of metaverses in the educational field.

Next, in 2022, four metaverses were identified that match the categories described in [24]: UPC Cultural, an immersive environment designed to foster creativity and showcase student work; ContiVerso, which stands out for its laboratories and virtual classrooms, allowing collaborative work and active participation; Meta Waka, a high-impact virtual campus designed in a constructivist way to promote educational interaction; and VR Engineering, focused on immersive learning through hands-on workshops and career-specific simulations. The latter is distinguished by reducing costs and overcoming barriers to access to complex practices. However, these activities are limited to students of certain engineering disciplines, restricting its general educational scope.

In 2023, two recent metaverses were identified that stand out for their contribution to the educational field. The UDEP Metaverse allows users to interact to obtain information about the university and its services, although it faces the challenge of having teachers trained in the use of this technology, as mentioned in [25], which limits its effective implementation. On the other hand, the UCHverse offers virtual labs where students can perform simulated experiments, promoting an immersive and enriching experience that encourages learning, as noted in [26]. Both cases reflect the potential of metaverses to transform higher education, although they underscore the need to overcome technological and training barriers to maximize their impact.

Analysis of the characteristics of metaverses revealed important similarities, such as free access and their active and accessible availability, which are essential elements to ensure that the public can use them without economic restrictions or additional barriers. These advantages are present in the UPC Cultural, Meta Waka, Metaverse UDEP and UCHverso metaverses, differentiating them from other metaverses studied that do not offer free access. This limitation in restricted metaverses makes it difficult for students at these institutions to fully benefit from the educational tools and opportunities that these environments offer, highlighting the need to remove barriers to access to maximize the positive impact of metaverses on higher education.

The features of headset compatibility, cross-platform capability, and full immersion are present in the UPC Cultural, VR Engineering, UDEP Metaverse, and UCHverse metaverses, significantly enriching the user experience in virtual reality. However, its absence in the other metaverses limits immersive interaction, reducing the educational impact. On the other hand, the ability to recreate real university environments is observed in the Segunda USMP, ContiVerso, Metaverse UDEP and UCHverso metaverses, allowing students to become familiar with virtual spaces that are loyal to their institutions. This feature fosters university identity and the strengthening of interpersonal connections, which does not happen in metaverses that lack this functionality.

Freedom of movement is a feature present in all the metaverses studied, allowing for a seamless experience without spatial restrictions. On the other hand, simultaneous online users are enabled in all metaverses except VR Engineering, where multiple users are not allowed to enter, limiting social and collaborative interaction. Object control, present in the Second USMP, VR Engineering and UCHverse, offers a significant advantage by improving the user experience through interactive manipulation, something that is lacking in other metaverses, where interaction is more limited. The reproduction of professional scenarios and experiences is designed in most metaverses, except in UPC Cultural and Metaverse UDEP, which focus only on basic journeys, reducing their contribution to students' practical and professional learning.

Instant transition is enabled in the Segunda USMP, ContiVerso, Meta Waka, and UCHverse metaverses, facilitating quick movement between scenarios and optimizing the user experience. In contrast, metaverses without this feature require full walkthroughs, leading to significant delays. On the other hand, the adaptation of avatars is present in all metaverses except in VR Engineering, where the impossibility of customizing avatars limits the user's identification with their virtual representation, reducing the satisfaction of the experience. In addition, communication tools, such as voice or text chat, are available in all the analyzed metaverses, favoring user interaction and fluidity in transmitting messages, which enriches virtual collaboration.

Student-crafting is a feature unique to Engineering VR and UCHverse, evidencing the commitment of students and universities to innovation and career development, in contrast to other metaverses created by third parties. On the other hand, realistic surfaces are characteristic in all the metaverses analyzed, except in UPC Cultural and Meta Waka, where the

lack of realistic details limits the immersion and authenticity of virtual environments. This absence can give the impression of a video game-like environment rather than an educational space that is true to reality, which can negatively influence the perception and use of these environments.

6. Conclusion

The present study reveals significant findings on the development of metaverses by Peruvian universities, a topic that is still little explored. The chronological identification of seven metaverses shows that these institutions have ventured into this area since 2008, with continuous efforts to the present day, to adapt and improve these technologies. The analysis of each metaverse shows its positive impact on university education, providing virtual platforms that strengthen theoretical knowledge and facilitate practical activities with greater frequency and control. In addition, the integration of these environments fosters innovative educational methods that not only enrich the learning experience but also prepare students for the challenges of the world of work and technological advancement.

The analysis of the characteristics of university metaverses made it possible to identify both significant similarities and differences. The results show that not all metaverses have all the necessary functionalities to maximize their use and integration in the educational field. However, the UCHverse stood out by possessing all the features evaluated, positioning itself as the most complete university metaverse to date. This finding highlights its potential as a model for future implementations. It should be noted that most of the metaverses studied remain active and in constant development, suggesting that this situation may evolve with further updates and improvements, further consolidating their impact on higher education.

In conclusion, this study managed to meet the objective of chronologically analyzing the metaverses developed by Peruvian universities and their impact on higher education. It was evident that these virtual environments are in constant development, although we find significant limitations. One of the main restrictions is access, as several metaverses are not for public use, making it difficult to analyze more closely. In addition, the topic still lacks sufficient scientific publications, which limits the scope of available knowledge and underscores the need for deeper and more collaborative research to better understand its educational potential and optimize its implementation for the benefit of university learning.

Finally, this study establishes a solid foundation for future research on metaverses developed by Peruvian universities, providing a detailed analysis of their characteristics, similarities, and differences. This information constitutes a valuable starting point to deepen the educational impact of these environments and explore new perspectives in their development. In addition, the findings are expected to favor both the academic and research fields, encouraging the design of innovative strategies that optimize the use of metaverses in higher education and promote their integration as a key tool for learning and interaction in virtual environments.

References

[1] Goal 4: Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All, The United Nations, Sustainable Development Goals, 2023. [Online]. Available: https://www.un.org/sustainabledevelopment/es/education/

[2] Ahmad Almufarreh, and Muhammad Arshad, "Promising Emerging Technologies for Teaching and Learning: Recent Developments and Future Challenges," *Sustainability*, vol. 15, no. 8, pp. 1-21, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[3] Santiago Criollo-C et al., "Towards the Integration of Emerging Technologies as Support for the Teaching and Learning Model in Higher Education," *Sustainability*, vol. 15, no. 7, pp. 1-17, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[4] A UNESCO Survey Reveals that Less than 10% of Schools and Universities have Formal Guidance on AI, Unesco, 2023. [Online]. Available: https://www.unesco.org/es/articles/una-encuesta-de-la-unesco-revela-que-menos-del-10-de-las-escuelas-y-universidades-disponen-de/

[5] How the World Views the Metaverse and Extended Reality, Public Polling Institute of the Opinion Sector, Ipsos, pp. 1-11, 2022. [Online]. Available: https://www.ipsos.com/sites/default/files/ct/news/documents/2022-05/Global%20Advisor%20-%20WEF%20-%20Metaverse%20-%20May%202022%20-%20Graphic%20Report_ES.pdf

[6] Sirkka L. Jarvenpaa, and Elizabeth Keating, "Fluid Teams in the Metaverse: Exploring the (un)Familiar," *Frontiers in Psychology*, vol. 14, pp. 1-14, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[7] Will Page, "Advancing Human Adoption of Technology," *IEEE 2nd International Conference on Human-Machine Systems*, Magdeburg, Germany, pp. 1-3, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[8] Aldo Alvarez-Risco et al., "Social Cognitive Theory to Assess the Intention to Participate in the Facebook Metaverse by Citizens in Peru during the COVID-19 Pandemic," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 8, no. 3, pp. 1-14, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[9] Gazi Mahabubul Alam, and Md. Abdur Rahman Forhad, "The Impact of Accessing Education via Smartphone Technology on Education Disparity-A Sustainable Education Perspective," *Sustainability*, vol. 15, no. 14, pp. 1-14, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[10] Jairo Eduardo Márquez Díaz, Camilo Andrés Domínguez Saldaña, and Camilo Alberto Rodríguez Ávila, "Virtual World as a Resource for Hybrid Education," *International Journal of Emerging Technologies in Learning*, vol. 15, no. 15, pp. 94-109, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[11] Georg David Ritterbusch, and Malte Rolf Teichmann, "Defining the Metaverse: A Systematic Literature Review," *IEEE Access*, vol. 11, pp. 12368-12377, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[12] A. Basi Reddy et al., "Introduction of Virtual Environment with Learning Personalized Content Recommendation for Realistic Avatar Creation in Online Platform using Machine Learning," *2nd International Conference on Augmented Intelligence and Sustainable Systems*, Trichy, India, pp. 540-545, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[13] Thien Huynh-The et al., "Artificial Intelligence for the Metaverse: A Survey," *Engineering Applications of Artificial Intelligence*, vol. 117, no. 1, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[14] Mohammed H. Alsamh et al., "Multisensory Metaverse-6G: A New Paradigm of Commerce and Education," *IEEE Access*, vol. 12, pp. 75657-75677, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[15] Saeed Hamood Alsamhi et al., "Decentralized Metaverse: Towards a Secure, Autonomous, and Inclusive Virtual World," *International Conference on Electrical, Computer and Energy Technologies*, Cape Town, South Africa, pp. 1-7, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[16] Becky Spittle et al., "A Review of Interaction Techniques for Immersive Environments," *IEEE Transactions on Visualization and Computer Graphics*, vol. 29, no. 9, pp. 3900-3921, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[17] Seunga Venus Jin, "In the Metaverse We (Mis)trust? Third-Level Digital (In)equality, Social Phobia, Neo-Luddism, and Blockchain/Cryptocurrency Transparency in the Artificial Intelligence-Powered Metaverse," *Cyberpsychology, Behavior and Social Networking*, vol. 27, no. 1, pp. 64-75, 2024. [CrossRef] [Google Scholar] [Publisher Link]

[18] PengchengQi, and ZidanChen, "The Origin, Characteristics and Prospect of Metaverse," *Advances in Education, Humanities and Social Science Research*, vol. 1, no. 1, pp. 315-318, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[19] Brian E. Mennecke et al., "Second Life and Other Virtual Worlds: A Roadmap for Research," *Communications of the Association for Information Systems*, vol. 22, no. 1, pp. 1-22, 2008. [CrossRef] [Google Scholar] [Publisher Link]

[20] Parth Rajesh Desai et al., "A Review Paper on Oculus Rift-A Virtual Reality Headset," *arXiv Preprint*, vol. 13, no. 4, pp. 1-5, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[21] Toks Dele Oyedemi, "Global Digital Capitalism: Mark Zuckerberg in Lagos and the Political Economy of Facebook in Africa," *International Journal of Communication*, vol. 13, pp. 1-17, 2019. [Google Scholar] [Publisher Link]

[22] Sascha Kraus et al., "Facebook and the Creation of the Metaverse: Radical Business Model Innovation or Incremental Transformation?," *International Journal of Entrepreneurial Behavior & Research*, vol. 28, no. 9, pp. 52-77, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[23] Maylee Lisbeth Ordoñez Valencia et al., "Analysis of Metaverse Tools and their Impact in Educational Contexts," *Sapienza: International Journal of Interdisciplinary Studies*, vol. 3, no. 2, pp. 610-630, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[24] Ayala Pezzutti, and Rocío Janett, "*Immersive Learning and Virtual Worlds in University Education*," Master's Thesis, Cesar Vallejo University, pp. 1-14, 2020. [Google Scholar] [Publisher Link]

[25] Jose Luis Avalos Pulcha, "*Metaverse in University Digital Education*," Master's Thesis, Cesar Vallejo University, pp. 1-124, 2023. [Google Scholar] [Publisher Link]

[26] José Luis Avalos-Pulcha et al., "The Metaverse: A Strategy to Boost Digital Education," *Koinonia Interdisciplinary Refereed Magazine*, vol. 8, no. 2, pp. 662-683, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[27] Dmitry Frolov et al., "Parsimonious Generalization of Fuzzy Thematic Sets in Taxonomies Applied to the Analysis of Tendencies of Research in Data Science," *Information Sciences*, vol. 512, pp. 595-615, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[28] Rita Roy et al., "Development of a Framework for Metaverse in Education: A Systematic Literature Review Approach," *IEEE Access*, vol. 11, pp. 57717-57734, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[29] A University in the Metaverse? Discover the Contiverso, Universidad Continental, 2024. [Online]. Available: https://blogs.ucontinental.edu.pe/una-universidad-en-el-metaverso-conoce-el-contiverso/temas/innovacion/

[30] UDEP Expands and Explores Metaverse Technology with Spatial.io, University of Piura, 2023. [Online]. Available: https://www.udep.edu.pe/hoy/2023/05/la-udep-se-expande-y-explora-la-tecnologia-del-metaverso-con-spatial-io/

[31] UCHVERSO: An Educational Immersion with Unlimited Transcendence, University of Sciences and Humanities, 2024. [Online]. Available: https://www.uch.edu.pe/uch-noticias/p/uchverso-una-inmersion-educativa-con-trascendencia-ilimitada