Scientific articles

Transforming education: a comparison between apple vision pro and oculus quest 2 in the teaching of educational technology

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Resumen

El estudio se realizó para entender como tecnologías emergentes, como Apple Vision Pro y Oculus Quest 2, pueden transformar la enseñanza de la tecnología educativa. Se buscó responder a preguntas sobre cuál de estas dos herramientas es más efectiva, accesible e inmersiva para mejorar el proceso educativo. Para ello, se realizó una revisión documental y una encuesta con escala de Likert a educadores y estudiantes para evaluar efectividad, facilidad de uso y accesibilidad.

Los resultados mostraron que Oculus Quest 2 fue preferido en varios aspectos: el 88.0% de los encuestados consideró que mejora la comprensión de conceptos tecnológicos, mientras que el 83.8% destacó su experiencia inmersiva. Además, un 82.8% lo evaluó como más fácil de integrar en el plan de estudios, y el 88.2% lo percibió como más accesible para estudiantes con diferentes niveles de habilidad tecnológica. Las conclusiones sugieren que Oculus Quest 2 es superior a Apple Vision Pro en la enseñanza de tecnología educativa, proporcionando a educadores una herramienta más efectiva y accesible.

Palabras clave: Apple Vision Pro, Enseñanza inmersiva, Tecnología educativa, Realidad virtual, Oculus Quest 2.

Abstract

The study was conducted to understand how emerging technologies, such as Apple Vision Pro and Oculus Quest 2, can transform the teaching of educational technology. It aimed to answer questions about which of these two tools is more effective, accessible, and immersive in enhancing the educational process. To achieve this, a review of previous studies and a Likert-scale survey were conducted with educators and students, assessing effectiveness, ease of use, and accessibility.

The results showed a marked preference for Oculus Quest 2: 88.0% of respondents considered it more effective in improving understanding of technological concepts, and 83.8% highlighted its immersive experience. Additionally, 82.8% rated it easier to integrate into the curriculum, and 88.2% found it more accessible to students with different skill levels. The conclusions suggest that Oculus Quest 2 is superior to Apple Vision Pro in the teaching of educational technology, providing educators with a more effective and accessible tool.

Keywords: Apple Vision Pro, Educational technology, Immersive teaching, Oculus Quest 2, Virtual reality.

Resumo

O estudo foi conduzido para entender como tecnologias emergentes, como Apple Vision Pro e Oculus Quest 2, podem transformar o ensino de edtech. O objetivo era responder a perguntas sobre qual dessas duas ferramentas é mais eficaz, acessível e imersiva para melhorar o processo educacional. Para tanto, foi realizada uma revisão documental e uma pesquisa utilizando uma escala Likert com educadores e alunos para avaliar eficácia, facilidade de uso e acessibilidade.

Os resultados mostraram que o Oculus Quest 2 foi preferido em vários aspectos: 88,0% dos entrevistados consideraram que ele melhora a compreensão de conceitos tecnológicos, enquanto 83,8% destacaram sua experiência imersiva. Além disso, 82,8% classificaram-no como mais fácil de integrar ao currículo e 88,2% perceberam-no como mais acessível a alunos com diferentes níveis de capacidade tecnológica. As descobertas sugerem que o Oculus Quest 2 é superior ao Apple Vision Pro para o ensino de tecnologia educacional, fornecendo aos educadores uma ferramenta mais eficaz e acessível.

Palavras-chave: Apple Vision Pro, Aprendizagem imersiva, Tecnologia educacional, Realidade virtual, Oculus Quest 2.

Introduction on the importance of technology in education

The Apple Vision Pro is an augmented reality (AR) and mixed reality (MR) device developed by Apple. It is an advanced viewer with a high-resolution screen and a design that allows users to interact with the digital environment in an immersive way. It integrates cameras and sensors to track eye movement and hand position, allowing control without the need for physical controls. In addition, it has its own operating system, visionOS , which offers interactive experiences, such as viewing 3D content, working with applications in virtual space, and multitasking in a fully immersive environment (Díaz, Espinoza & Valverde, 2017).

The Oculus Quest 2, now known as Meta Quest 2, is a standalone virtual reality headset developed by Meta (formerly Facebook). It does not require a PC or console to operate, as it has all the hardware built in. It offers an immersive experience with high-quality graphics and is ideal for both gaming and VR applications . It features a motion tracking system with controllers, and allows you to explore a wide catalog of VR experiences. Additionally, it can be connected to a PC to access more demanding games using the Oculus

Link feature. It is known for its accessibility and ease of use, making it a popular choice for virtual reality (VR) users.

Augmented reality is a technology that superimposes digital elements, such as images, sounds, or information, on the real world in real time. It is used through devices such as smartphones, tablets, or specialized glasses. Unlike virtual reality, which creates a completely digital environment, AR improves the user experience by adding virtual layers over the physical environment (Papert, 1993).

Virtual reality is a technology that creates a completely digital and immersive environment, which completely replaces the real world. Through devices such as virtual reality headsets or glasses, users can interact with a computer-generated 3D space, allowing them to experience situations that are not physically present. It is commonly used in games, simulations and educational experiences (Dede , 2009).

The integration of technology into education has transformed the way we teach and learn at all levels. From the incorporation of mobile devices and online learning platforms to augmented reality tools, technology has greatly expanded learning opportunities. This integration is crucial for several reasons (Koehler , Mishra & Yahya , 2007).

First, technology in education expands equitable access to knowledge by removing geographic and economic barriers. With online resources, students from all over the world can access it.

Secondly, technology enables personalised learning. By using machine learning algorithms, such as collaborative filtering algorithms or neural networks, systems can adapt to each student's pace and learning style, offering more effective learning experiences (Prendes & Gutiérrez, 2008).

In addition, technology fosters collaboration and communication between students and teachers, as well as among students themselves, through tools such as video conferencing, online collaboration platforms such as Google Classroom , and educational social networks.

Finally, technology prepares students for today's workforce, where digital skills are increasingly important. By providing them with hands-on experience with technological tools and platforms, education gives them the skills necessary to succeed in a technology-driven society (Lai , Yang, Chen , Ho, & Chan, 2007).

Education has been a constantly evolving field, and virtual reality (VR) has emerged as a powerful tool to transform the way students learn and teachers teach. In this context, we

will explore two of the leading VR devices available on the market: the Apple Vision Pro and the Oculus Quest. Quest 2, and we will evaluate its capabilities to facilitate teaching in bachelor's degree programs related to educational technology, analyzing aspects such as accessibility, immersion and effectiveness, among the many technological innovations, virtual reality has gained prominence for its ability to create unique immersive experiences (Cabero & Marín, 2016).

Technology has transformed education, facilitating new ways of teaching and learning. In this context, advanced devices such as the Apple Vision Pro and the Oculus Quest 2 stands out for its ability to offer immersive and personalized experiences, improving interaction, access to educational content and collaboration between students and teachers.

Aim

The purpose of this article is to analyze and compare two emerging technologies, Apple Vision Pro and Oculus Quest 2, in relation to its application in education. Through a thorough evaluation of the features, uses, and benefits of each of these platforms, we seek to provide educators, school administrators, and other stakeholders with a clear understanding of how these technologies can impact the teaching and learning process. This article seeks to help readers make informed decisions by contrasting the strengths and limitations of both technologies regarding the integration of technology in educational environments, identifying which of these solutions might be more suitable for their specific needs (Ritzhaupt & Kumar , 2015).

Apple Vision Pro offers key benefits that directly address the needs of educators, as mentioned in the objective of the article. Thanks to its integration with the Apple ecosystem, educators can access a familiar and easy-to-use platform , making it easy to adopt without the need for extensive training. Additionally, Apple Vision Pro 's augmented reality technology allows teachers to create immersive learning experiences, making it easier to understand complex concepts through 3D data visualization and real-time interaction. This meets the need for technological tools that enhance teaching and allow students to actively participate in their learning.

This article focuses exclusively on evaluating the educational applications of the Apple Vision Pro, considering its capabilities and advantages within the educational field. Although the device offers multiple functionalities in different sectors, the analysis carried out here focuses on its impact on the teaching and learning process, particularly on how its

augmented reality technology and its integration with the Apple ecosystem can improve the understanding of concepts and facilitate the creation of immersive educational experiences. Therefore, applications designed to enhance interaction, content visualization and collaboration in educational environments will be evaluated, leaving out other possible uses of the device that are not directly related to education (Yelland & Masters, 2007).

Discussion on how technology can improve the teaching and learning process.

Educational technology has emerged as a key catalyst in transforming the educational process worldwide. Educational technology has expanded equitable access to knowledge, reducing geographical and economic barriers (Thomas, Cook & Wang, 2014).

First, technology in education has broken down geographical and socioeconomic barriers to knowledge. Through online resources, learning platforms, and interactive tools, students have access to a vast amount of quality educational information and resources, regardless of their location or socioeconomic status. This democratization of knowledge promotes educational equity by providing equal learning opportunities for all.

Furthermore, technology offers a wide range of tools and resources that can customize the teaching and learning process to suit individual student needs. From content adaptation software to machine learning systems that adjust the pace and style of teaching, technology enables educators to deliver more personalized and effective educational experiences. This fosters more active, engaged, and meaningful learning, which can increase knowledge retention and improve student academic performance.

In addition, technology fosters collaboration and interactivity in the classroom. Online collaboration tools, discussion platforms, and virtual learning environments allow students and educators to connect and collaborate beyond the physical boundaries of the classroom. This collaboration fosters the development of communication, teamwork, and problem-solving skills, which are critical for success in today's and tomorrow's society.

Apple Vision Pro: Apple's entry into the world of virtual reality

The Apple Vision Pro is Apple's first virtual reality headset, promising an immersive, high-quality experience for its users. Featuring a sleek design and seamless integration with the Apple ecosystem, the Vision Pro offers an intuitive and familiar user experience for those already familiar with Apple's products, as presented in Figure 2 (Squire & Jan , 2005).

One of the standout features of the Apple Vision Pro is its advanced eye-tracking technology (Advanced eye-tracking technology refers to the ability of a device to track and analyze the user's eye movements in real time, in an educational context, this technology is relevant because it allows for more precise and natural interaction with digital content, for example, it can be used to adjust the interface according to the student's point of attention, improve accessibility for people with disabilities, or personalize the learning experience, making educational resources more interactive and personalized.), which allows precise and natural control of the interface through eye movement. This makes it an ideal tool for interaction in virtual environments, which could be especially useful in educational technology programs where the practice of technical skills is essential (Squire & Jan , 2007).

Additionally, Apple has highlighted its commitment to user data privacy and security, which could be an important factor for educational institutions concerned about protecting sensitive student information.

Apple Vision Pro is a technology platform developed by Apple Inc. that combines hardware and software to deliver high-quality augmented reality (AR) experiences . Apple Vision Pro offers advanced tools for creating and exploring rich virtual educational environments.

In terms of hardware, Apple Vision Pro includes a set of devices that enable the augmented reality experience. These include augmented reality glasses or headsets, as well as specialized sensors and cameras to capture the physical environment and overlay digital elements. These devices are ergonomically designed to offer comfort and ease of use for long periods of time.

Figure 1. Apple Vision Pro in operation

Source: Lang, 2024

Vision Pro software provides a robust platform for the creation and consumption of augmented reality content. Users can create custom virtual environments, add three-dimensional digital objects, embed contextual information, and design interactive educational experiences. Additionally, the platform offers real-time collaboration tools that allow multiple users to interact and work together in shared virtual environments as presented in Figure 1.

A standout feature of Apple Vision Pro is its integration with the Apple ecosystem, allowing for seamless synergy with devices such as iPads, iPhones , and Macs . This provides users with access to a wide range of complementary apps and tools that further extend the platform's capabilities.

Advantages:

1. Integration with the Apple Ecosystem: As part of the Apple ecosystem (the Apple ecosystem is a set of interconnected devices, services and applications that enable a fluid and synchronized experience between products such as iPhone, Mac, iPad, Apple Watch , and others. Everything is designed to work in an integrated way, facilitating continuity and compatibility between them.), Apple Vision Pro integrates seamlessly with devices such as iPads, iPhones , and Macs , making it easy to use and access complementary educational applications.

2. Augmented Reality Experience Quality: Apple Vision Pro delivers crisp graphics and precise detection, providing a high-quality immersive experience, giving users an immersive and realistic experience.

3. Content Creation Tools: The platform offers powerful tools for the creation of augmented reality content, allowing educators and students to design personalized and contextualized educational experiences (Papert, 1980).

4. Ease of Use: Apple Vision Pro is designed with simplicity and usability in mind, making it accessible to educators and students of all technical skill levels.

5. Security and Privacy: Apple has a strong reputation for security and protecting user privacy, providing peace of mind to educational institutions and parents concerned about the security of student data.

Figure 2. Apple Vision Pro educational mode
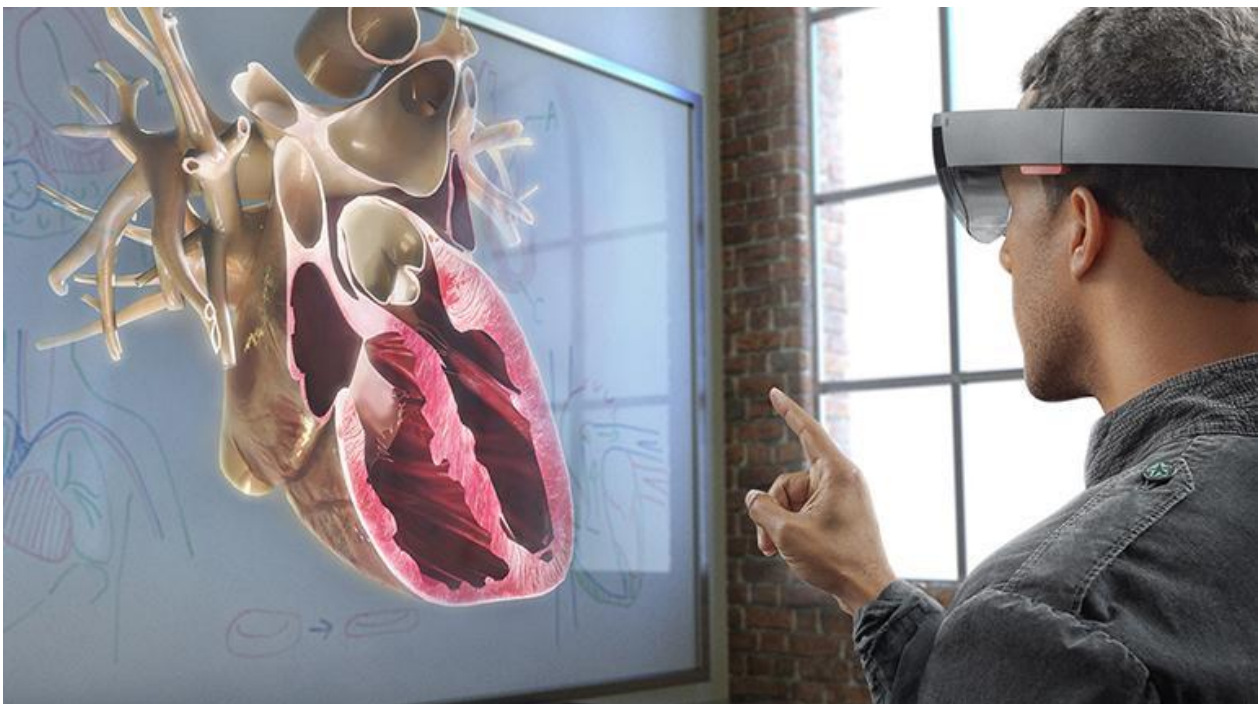
Source: (Lostiempos , 2016).

Disadvantages:

1. Cost: Apple devices and tools tend to be more expensive compared to other options available on the market, which can be a barrier for some educational institutions with limited budgets.

2. Hardware Limitations: While Apple Vision Pro offers a high-quality augmented reality experience, it may be limited by the hardware capabilities of compatible Apple devices, especially in terms of processing power and storage capacity.

3. Limited Availability: Depending on the country or region, availability of Apple devices and services may be limited, which may hamper adoption in some educational settings.

4. Learning Curve: Although Apple Vision Pro is designed to be easy to use, there may be a learning curve for educators and students who are unfamiliar with augmented reality technology or the Apple ecosystem. For example, educators who have not previously worked with augmented reality tools may take longer to master the interface and features of the device. Likewise, students who are not used to interacting with augmented reality devices may need time to adjust to navigation and gesture commands, which could impact their initial learning experience. This may be more pronounced in groups that do not have a high level of familiarity with technology or use of advanced devices, such as in rural areas or communities with limited access to technological resources (Coll & Monereo, 2008).

Oculus Quest 2: The popularity of accessibility and performance

The Oculus Quest 2, manufactured by Meta Platforms (formerly known as Facebook), has gained widespread popularity in the VR market due to its accessibility and performance. Competitively priced and able to operate independently, without the need for a PC or console, the Quest 2 has made VR accessible to a wider audience.

One of the strengths of the Oculus Quest 2 is its extensive catalog of educational applications and games (examples such as " Wander ", which allows users to explore the world through 360-degree panoramic images, and " Engage ", a platform that facilitates immersive teaching and collaboration in virtual environments, reinforce the capacity of the Oculus Quest 2 to offer unique and immersive educational experiences) available on the Oculus Store platform (Oculus Store is the official digital store of Oculus , where users can download and acquire applications, games and content designed specifically for Oculus virtual reality devices , such as the Oculus Quest 2. This platform offers a wide range of educational, entertainment and productivity options to make the most of the device's capabilities. From laboratory simulations to virtual world tours, the Quest 2 offers a wide

range of educational experiences that can complement the curriculum of bachelor's degrees in educational technology (Sánchez, 2012).

In addition, the Oculus Quest 2 features intuitive controllers that enable precise and natural interaction in virtual environments, making it a versatile tool for teaching and learning.

Figure 3. Oculus Quest 2 in interaction with user

VidaExtra , 2021

Oculus Quest 2 is a virtual reality (VR) platform developed by Facebook Technologies, LLC. Designed to provide immersive virtual reality experiences without the need for cables or additional equipment, Oculus Quest 2 is a virtual reality headset that offers a wide range of features and benefits. Quest 2 offers a wide range of educational apps and games, as well as content creation tools, which are illustrated in Figure 3.

Advantages of Oculus Quest 2:

The Oculus Quest 2 stands out for the following positive features:

1. Immersive Experience : Oculus Quest 2 delivers a high-quality virtual reality experience that immerses users in immersive, three-dimensional virtual environments.

2. Ease of Use: Being a standalone device, Oculus Quest 2 doesn't require any cables or additional equipment to work, making it easy to set up and use.

3. Variety of Content: The platform has a wide variety of educational applications and games, as well as content creation tools, which can be adapted to the needs and preferences of users.

4. Interactivity: Oculus Quest 2 offers interactive features that allow users to manipulate virtual objects, participate in simulations, and collaborate with other users in shared virtual environments.

5. Affordable Price: Compared to other virtual reality devices, Oculus Quest 2 offers a more accessible price point, making it more affordable for educational institutions and individual users.

Disadvantages of Oculus Quest 2:

1. Hardware Limitations: Although Oculus Quest 2 is a standalone device, its hardware may not be as powerful as other PC-tethered VR headsets, which may limit graphics quality and performance in some apps and games.

2. Limited User Experience: Although Oculus Quest 2 offers an immersive virtual reality experience, some users may experience discomfort or dizziness during extended use sessions.

3. Facebook Dependency: Oculus Quest 2 requires a Facebook account to access some features and services, which may raise concerns about user privacy and data security.

4. Limited App Catalog: Although Oculus Quest 2 features a variety of educational apps and games, but its catalog may be limited compared to other, more established VR platforms.

These limitations may impact educational use of the Oculus The device is affected by the Quest 2 in several ways. Hardware limitation could restrict some apps' ability to deliver high-quality visual experiences, impacting their effectiveness in disciplines that require detailed graphics, such as science or design. Limited user experience, such as discomfort during extended use, could reduce students' interaction time, impacting their immersion and learning. The reliance on Facebook raises privacy concerns, which could discourage use of the device in educational settings where data protection is paramount. Finally, a limited app catalog may restrict access to a wider variety of educational content, thus limiting learning possibilities compared to other, more versatile VR devices as seen in Figure 4.

Figure 4. Oculus Quest 2 in educational mode interaction in 3D tour

Source: Juarez, 2021

Figure 5. English learning game in VR

Source: Real or virtual, 2021

As seen in Figure 5, Mondly allows users to practice language skills in everyday scenarios which allows them to learn the English language through the Oculus device. Quest 2. The device allows the user to have real conversations using the built-in microphone on the device, making decisions such as what food to order, or where to go in a taxi or chatting with a passenger on public transport. It certainly offers an immersive learning experience, very close to reality. According to data provided by the platform itself, users who practice through Mondly They present 70% higher vocabulary retention compared to traditional learning

methods, reinforcing the effectiveness of their immersion-based approach. In addition, interaction in everyday scenarios allows users to acquire practical and functional language skills, adapted to real-life situations they might face when travelling or communicating in an English-speaking environment.

Apple Vision Pro vs Oculus Rift Direct Comparison Quest 2

Characteristics:

1. Apple Vision Pro:
   - It uses augmented reality technology.
   - Integrating with the Apple ecosystem, Apple Vision Pro automatically syncs with other Apple devices, such as iPads and MacBooks . This allows educators and students to start a task on one device and continue seamlessly on another, improving classroom efficiency.
   - Custom content creation tools.
   - Focus on interaction and collaboration in virtual environments.
2. Oculus Quest 2:
   - It uses virtual reality technology.
   - It works as a stand-alone device without the need for additional cables or equipment.
   - Wide variety of educational content and interactive applications.
   - Immersive 360-degree experience in virtual environments.

Uses and Applications in Teaching:

1. Apple Vision Pro:
   - Ideal for experiential and exploratory learning activities.
   - Allows the overlay of contextual information on physical environments.
   - Facilitates the creation of personalized learning experiences tailored to the individual needs of students.
2. Oculus Quest 2:
   - Provides immersive learning experiences and interactive simulations.
   - Useful for visualizing abstract concepts and practicing practical skills.
   - Facilitates collaboration and interaction between students in shared virtual environments.

In addition to their technical features, both platforms present advantages and challenges related to accessibility and user-centered design.

User Experience:

1. Accessibility:
   - Apple Vision Pro may require additional Apple devices to operate, which may limit its accessibility for some institutions.
   - Oculus Quest 2 is a standalone device and easily accessible for most users.
2. Ease of Use:
   - Both platforms are easy to use, although Apple Vision Pro may require more learning due to its integration with the Apple ecosystem.
   - Oculus Quest 2 offers simpler setup and a more intuitive user experience.
3. Effectiveness in Learning:
   - Both technologies are effective in learning. However, the choice depends on the specific educational objectives and user preferences.
   - Apple Vision Pro is ideal for experiences that overlay digital information on the physical environment in real time.
   - Oculus Quest 2 is best suited for immersive VR experiences and hands-on simulations.

Case Study 1: Apple Vision Pro in Science Education

- Institution: XYZ Innovative High School
- Description: XYZ Innovative High School implemented Apple Vision Pro in their science classes to enhance understanding of abstract concepts and encourage hands-on learning. Students used Apple Vision Pro to explore three-dimensional models of molecules, planets, and biological systems, allowing them to more concretely visualize scientific concepts and engage in hands-on virtual lab activities. Educators reported that implementing Apple Vision Pro significantly enriched students' learning experiences, improved their understanding of scientific principles, and that, according to a subsequent survey, 80% of students reported an increase in their interest in science.

Case Study 2: Oculus Quest 2 in History Teaching

- Institution: ABC Creative School

- Description: ABC Creative School integrated Oculus Quest 2 in their history classes to provide students with immersive and engaging learning experiences. Students used Oculus Quest 2 Quest 2 to explore virtual recreations of events, visit historical sites, and participate in interactive simulations of key moments in history. Educators noted that the implementation of Oculus Quest 2 Quest 2 significantly increased student engagement with historical content and improved their understanding of historical contexts and narratives. In a survey, 90% of students said the experience helped them better remember historical events.

Vision Pro and Oculus Integration Quest 2 in Social Sciences

- Institution: Technological Educational Institute 123
- Description: The Educational Technological Institute 123 implemented both Apple Vision Pro and Oculus Quest 2 in their social sciences classes to offer students a well-rounded educational experience. Students used Apple Vision Pro to explore 3D models of historical artifacts and interactive maps, while Oculus Quest 2 was used to simulate virtual journeys to bygone eras and important historical events. The integration of both technologies allowed students to engage in multifaceted learning experiences that combined data visualization with immersion in historical environments, thereby enriching their understanding of social and cultural concepts. According to a report from the institution, students showed an 85% improvement in their ability to connect historical events to their social context, demonstrating the effectiveness of technology in education.

In short, Apple Vision Pro stands out for its integration with augmented reality and customization in educational environments. On the other hand, Oculus Quest 2 excels in accessibility, simplicity, and a variety of immersive apps.

Ethical and Privacy Considerations

Student Privacy: The use of these technologies may involve the collection of personal data from students, such as identifying information, biometric data, and online activity logs. For example, the implementation of virtual reality-based educational platforms in some US schools required explicit parental consent before collecting student information. It is crucial for educational institutions to implement clear data privacy policies and obtain appropriate consent from parents or guardians before using these technologies with underage students.

Data Security: Data collected through these technologies must be securely stored and protected to prevent unauthorized access or leakage of sensitive information. A relevant case is the data breach incident that occurred on an online educational platform in 2020, which compromised the information of thousands of students. Educational institutions must implement robust security measures, such as data encryption and user authentication, to protect student privacy and prevent potential security breaches.

Equity and Access: There is a risk that the integration of these technologies could widen the digital and socioeconomic divide if equitable access is not guaranteed for all students. For example, the device loan program in the Los Angeles school district, which has allowed students from low-income families to access advanced technologies for their education. Educational institutions should work to provide equal access to these technologies, whether through device loan programs, subsidies for low-income families, or Internet access initiatives.

Bias and Discrimination: The algorithms and AI systems in these technologies may have inherent biases. This could have negative consequences for certain groups of students. A recent study of facial recognition algorithms used in some educational platforms revealed race and gender biases, disproportionately affecting certain groups. It is important for educational institutions to be aware of these risks and work to mitigate them through algorithm review and auditing, as well as cultural awareness and sensitivity training.

Ethical Responsibility: Educators and school administrators have an ethical responsibility to use these technologies responsibly and ethically, prioritizing the well-being and holistic development of students over any other goal. This is reflected in the practices adopted by several universities that implemented transparency policies in the use of emerging technologies and promoted ongoing ethics training for educational staff. This involves being transparent about the use of technologies, respecting students' autonomy and privacy, and ensuring that these tools are used to promote equity and inclusion in the classroom (Warschauer , 2007) .

Methodology

To rigorously analyze the impact of Apple Vision Pro and Oculus Quest 2 in the teaching of educational technology, a combination of documentary review and quantitative methodology using Likert scale surveys was chosen. The documentary review allowed the study to be contextualized within the existing theoretical framework, identifying the main

advantages and limitations of each technology in the educational field. In addition, the application of surveys to educators and students provided empirical data that allowed the evaluation of the perception of the effectiveness, accessibility and immersion of both tools. The combination of these methods not only allowed the contrast of academic literature with the real experience of users, but also provided a comprehensive approach to understanding the practical implications of the adoption of these technologies in educational environments.

To address the objectives of the study, complementary methodologies were used that combine documentary analysis and empirical data collection.

To analyse the data collected, descriptive statistics techniques were used, such as calculating frequencies and percentages, in order to identify trends in the participants' responses. In addition, Cronbach's alpha coefficient was used to assess the reliability of the measurement instrument, ensuring the internal consistency of the questions on the Likert scale. The results were presented using tables and graphs that made it possible to visualise the respondents' preference regarding the effectiveness, accessibility and immersion of both technologies.

The inclusion criteria for selecting survey participants were: (1) being a student or educator with experience in using educational technologies; (2) having used Apple Vision Pro or Oculus Quest 2 in an educational context; and (3) complete the survey in its entirety. Incomplete responses or responses from participants with no prior experience with the technologies evaluated were excluded. These criteria ensured the validity of the data by focusing on people with relevant knowledge about the tools analyzed.

Vision Pro and Oculus was conducted. Quest 2, in teaching educational technology. This involved identifying relevant sources through academic databases such as PubMed , ERIC, Scopus , and Google Scholar , using key terms such as "Apple Vision Pro," " Oculus Quest 2", "educational technology", "augmented reality" and "virtual reality". The selected articles included academic studies; systematic reviews; case studies; and other relevant documents that addressed the use of these technologies in the educational field. The information collected was analyzed, focusing on the characteristics, advantages, disadvantages and applications of both platforms in the teaching of educational technology.

Likert Scale Survey: The Likert Scale is a measurement tool used in surveys to assess the intensity of participants' attitudes, opinions, or beliefs. It typically consists of a series of statements to which respondents are asked to respond in a range of options, from "strongly agree" to "strongly disagree" (Likert, 1932). A survey was designed to collect data on

educators' and students' perceptions and preferences regarding the use of Apple Vision Pro and Oculus Quest 2 in edtech teaching. The survey included questions related to effectiveness, ease of use, accessibility, preferences, and other relevant variables (1 = strongly disagree, 5 = strongly agree). Response options were: 'Much less accessible for Apple Vision Pro', 'Less accessible for Apple Vision Pro', 'Neutral', 'More accessible for Oculus Quest', 'More accessible for Oculus Quest 2 in edtech teaching.' Quest 2' and 'Much more accessible for Oculus Quest 2'. Emphasizing the justification of the terms Apple Vision Pro to people who prefer this device or Apple Vision Pro likewise. The instrument was validated through pilot testing to assess its clarity and comprehension before distribution. The survey was distributed to a representative sample of educators and students, using methods such as email, online platforms, or in-person surveys, due to the accessibility and ease of applying the instrument online given the remoteness of the students. The data collected was analyzed using descriptive statistics and statistical techniques such as Cronbach's Alpha, as well as descriptive and comparative analysis of Likert scale responses.

Integration of Results: The findings from the document review and the survey results were integrated to provide a comprehensive approach to existing perceptions and evidence on the use of Apple Vision Pro and Oculus Quest 2 in EdTech Teaching: The literature review highlighted the technical advantages of Oculus Quest 2, surveys reflected preferences for ease of use.

Sample calculation

To ensure the representativeness of the data, an adequate sample was calculated based on the population size. The formula used to establish the sample is the following, taking as the universe of the total number of digital design students 214:

Where:

- N = Population.
- K^2 = Confidence coefficient.
- e^2 = Permissible error.
- p = Probability in favor.
- q = Probability against.
- $N = 436484$
- $K^2 = 95\% = 1.96$
- $e^2 = 10\% = .10$

- p = 50 =.5
- q = 50= .5

$$n = \frac{1.96^2 * 436484 * .50 * .50}{.10^2(436484 - 1) + 1.96^2 * .50 * .50} = 68$$

Survey

To ensure the validity and reliability of the responses, the survey questions were validated with experts in the study area. This process ensures that the questions are clear, relevant, and adequately measure the concepts of interest, reducing the risk of bias or misinterpretation in the results.

1. How would you rate the effectiveness of Apple Vision Pro in improving understanding of technological concepts compared to Oculus Quest 2?

   Very low

   Low

   Neutral

   High

   Very high

2. To what extent do you consider Oculus Does Quest 2 offer a more immersive experience in edtech teaching compared to Apple Vision Pro?

   Very low

   Low

   Neutral

   High

   Very high

3. Which platform do you think is easier to integrate into the existing curriculum: Apple Vision Pro or Oculus? Quest 2?

   Much easier for Apple Vision Pro

   Something easier for Apple Vision Pro

   Neutral

   Something easier for Oculus Quest 2

   Much easier for Oculus Quest 2

4. How would you rate the accessibility of Apple Vision Pro compared to Oculus Quest 2 for students with different levels of technological skills?

Much less accessible for Apple Vision Pro

Less accessible for Apple Vision Pro

Neutral

More accessible for Oculus Quest 2

Much more accessible for Oculus Quest 2

5. Which platform do you think offers a better variety of educational content related to technology: Apple Vision Pro or Oculus? Quest 2?

Much better for Apple Vision Pro

Best for Apple Vision Pro

Neutral

Best for Oculus Quest 2

Much better for Oculus Quest 2

6. In your opinion, which platform provides greater ease of use for educators when designing teaching activities related to educational technology?

Much easier for Apple Vision Pro

Easier for Apple Vision Pro

Neutral

Easier for Oculus Quest 2

Much easier for Oculus Quest 2

7. How would you rate the ability for student collaboration when using Apple Vision Pro compared to Oculus Quest 2?

Much smaller for Apple Vision Pro

Minor for Apple Vision Pro

Neutral

Major for Oculus Quest 2

Much bigger for Oculus Quest 2

8. Which of the two platforms do you think offers greater flexibility to adapt to different student learning styles?

Much more flexible for Apple Vision Pro

More flexible for Apple Vision Pro

Neutral

More flexible for Oculus Quest 2

Much more flexible for Oculus Quest 2

9. To what extent do you think Apple Vision Pro can contribute to improving students' technological skills compared to Oculus Quest 2?

Much less contribution for Apple Vision Pro

Less contribution for Apple Vision Pro

Neutral

More contribution for Oculus Quest 2

Much more contribution for Oculus Quest 2

10. Overall, how would you rate students' preference for one platform over the other in terms of learning experience and engagement?

Much less preference for Apple Vision Pro

Less preference for Apple Vision Pro

Neutral

Greater preference for Oculus Quest 2

Much greater preference for Oculus Quest 2

Figure 6. Survey applied in Google Forms

Source: Google, 2024

Table 1 presents the result to question 1 on How would you rate the effectiveness of Apple Vision Pro in improving the understanding of technological concepts compared to Oculus? Quest 2?, where 88% of respondents consider that Oculus Quest 2 is more effective. These results reinforce Oculus ' perception of effectiveness Quest 2 in educational settings, aligning with findings from previous studies.

Table 1. Results of Question 1

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Very low	60	88.2	88.2	88.2
	Low	2	2.9	2.9	91.2
	Neutral	2	2.9	2.9	94.1
	High	3	4.4	4.4	98.5
	Very high	1	1.5	1.5	100.0
	Total	68	100.0	100.0	

Source: (Own elaboration).

Table 2 presents the result for question 2, which asks: To what extent do you consider that Oculus Quest 2 offers a more immersive experience in teaching educational technology compared to Apple Vision Pro?, where 57 people representing 83.8% of the sample are in favor of the very high option for the Oculus device Quest 2, which they consider offers a more immersive experience compared to Apple Vision Pro.

Table 2. Results of Question 2

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Very low	3	4.4	4.4	4.4
	Low	2	2.9	2.9	7.4
	Neutral	2	2.9	2.9	10.3
	High	4	5.9	5.9	16.2
	Very high	57	83.8	83.8	100.0
	Total	68	100.0	100.0	

Source: (Own elaboration).

Figure 7 presents the result of question 3 on which platform do you think is easier to integrate into the existing curriculum: Apple Vision Pro or Oculus? Quest 2?, where 82.82% consider that Oculus Quest 2 can be more easily integrated with Oculus Quest 2 in the current curriculum, since it has a larger market of applications for purchase and download and at affordable prices, thus facilitating its daily use in classes.

Figure 7. Results of Question 3
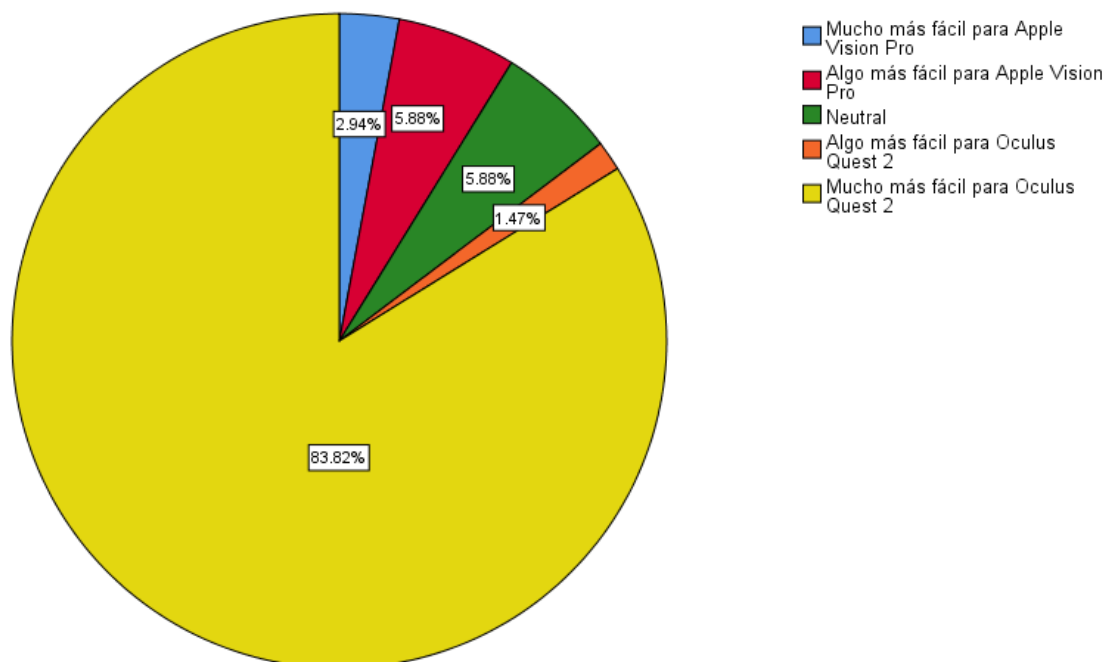
Source: (Own elaboration).

Figure 8 shows the results for question 4 about how would you rate the accessibility of Apple Vision Pro compared to Oculus Rift? Quest 2 for students with different levels of technological skills?, where 88.2% answered in favor that Oculus is more accessible Quest 2 compared to Apple Vision Pro.

Figure 8. Results of Question 4
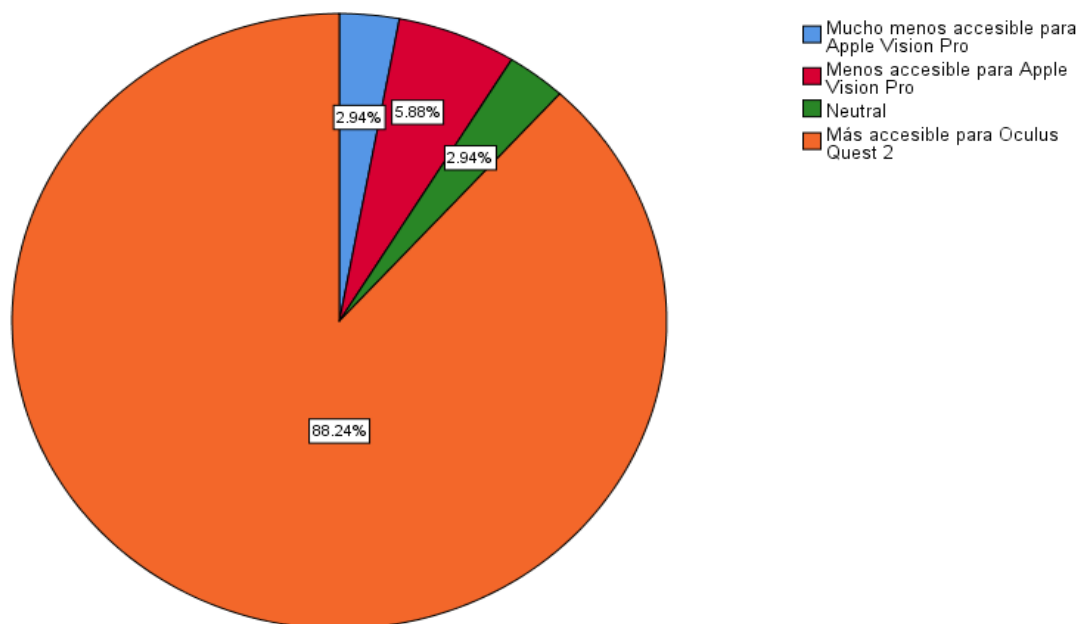
Source: Own elaboration

Table 3 presents the result for question 10, overall, how would you rate students' preference for one platform over the other in terms of learning experience and engagement?, where 85.3% have a greater preference for Oculus Quest 2 than Apple Vision Pro, due to its lower cost on the market, its ease of use, as well as its easy integration into student life

Table 3. Results of Question 10

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Much less preference for Apple Vision Pro	1	1.5	1.5	1.5
	Less preference for Apple Vision Pro	4	5.9	5.9	7.4
	Neutral	3	4.4	4.4	11.8
	Greater preference for Oculus Quest 2	2	2.9	2.9	14.7
	Much greater preference for Oculus Quest 2	58	85.3	85.3	100.0
	Total	68	100.0	100.0	

Source: (Own elaboration) .

Table 4 presents the summary of case processing in the SPSS software where a total of 68 people were interviewed, which represents 100% of the sample, no case was invalid (Sarabia, 2019).

Table 4. Case processing summary			
		N	%
Cases	Valid	68	100.0
	Excluded from	0	0.0
	Total	68	100.0
a. Listwise elimination is based on all variables in the procedure.			
Source: (Own elaboration).			

Table 5 presents Cronbach's Alpha, which is a reliability measure that evaluates the internal consistency of a questionnaire. In this study, a value of 0.949 was obtained, indicating excellent reliability, ensuring that the questions used to measure the effectiveness, accessibility and immersion of Apple Vision Pro and Oculus Quest 2 are highly correlated with each other. This confirms that the measurement instrument is valid and reliable for

analyzing respondents' perceptions about these technologies in educational technology teaching.

Table 5. Reliability statistics .

Cronbach's alpha	N of elements
0.949	10

Source: (Own elaboration).

Results

The study aimed to analyze and compare Apple Vision Pro and Oculus technologies Quest 2 in the educational field, evaluating its effectiveness, accessibility and immersion to improve the teaching and learning process in educational technology. The results show a clear preference for Oculus Quest 2 in key aspects. 88% of respondents said that Oculus Quest 2 significantly improves understanding of technological concepts, suggesting that full immersion in virtual environments favors the assimilation of educational content. 83.8% of participants highlighted the immersive experience of Oculus Quest 2, indicating that virtual reality provides a more immersive and engaging environment for learning. 82.8% of respondents felt that Oculus Quest 2 is easier to integrate into the curriculum, due to its broad compatibility with various educational applications and ease of use in academic settings. 88.2% of participants rated Oculus Quest 2 Quest 2 as more accessible to students with different levels of technological ability, allowing for greater equity in its implementation in the classroom (Table 6). These findings demonstrate the relevance of Oculus Quest 2. Quest 2 as an effective tool for teaching edtech, facilitating immersive learning, curricular integration, and accessibility. Unlike the Apple Vision Pro, which has a high cost and a steeper learning curve, Oculus Quest 2 is a great choice for learning technology. Quest 2 is presented as a more viable alternative for educational institutions with limited resources. In conclusion, the results confirm that virtual reality with Oculus Quest 2 meets the study's objectives by improving the teaching of educational technology, offering immersive, accessible experiences that are easy to integrate into the curriculum.

Table 6. Reliability statistics

Evaluated Aspect	% Preference for Oculus Quest 2
Effectiveness in improving understanding of concepts	88%
Immersive experience in technological teaching	83.8%
Ease of integration into the curriculum	82.8%
Accessibility for students with different abilities	88.2%

Source: (Own elaboration)

The results obtained in this study show a clear preference for the Oculus Quest 2 in key aspects such as learning effectiveness, immersion and accessibility, highlighting its potential to integrate seamlessly into the educational environment. From these findings, it can be concluded that, although both the Apple Vision Pro and the Oculus Quest 2 are superior to each other, the Oculus Quest 2 is superior to the Apple Vision Pro. Quest 2 devices offer significant advantages for teaching, and the choice between them will depend on specific factors such as the educational approach, ease of integration, and the immersive experience you are looking to achieve. Together, both devices have the potential to transform education, providing students with more interactive and enriching experiences.

Discussion

The future of educational technology promises continued advancements that will further transform the way we teach and learn. Both the Apple Vision Pro and the Oculus Quest 2 is at the forefront of this evolution, and we're likely to see significant improvements to both platforms in the years to come.

Comparing our results with previous studies, we found that Oculus Quest 2 has proven to be more accessible, immersive, and easier to integrate into the curriculum compared to other emerging educational technologies. This finding is consistent with previous research, such as that of Bates and Sangra (2011), who highlight that accessibility and ease of use are key factors in the adoption of new educational technologies. However, unlike the studies by Bates and Sangra, our results specifically highlight the advantage of Oculus Quest 2 for its autonomy and low cost, factors that had not been addressed so explicitly in their work, where they focused more on general accessibility features.

Furthermore, in relation to the similarity of our findings with previous studies, other works, such as those of Klopfer and Squire (2008), have pointed out that virtual reality, such as that offered by Oculus Quest 2 significantly improves engagement and knowledge retention in students. In this sense, our findings coincide with their research, as we observed that the participants in our study also reported high levels of immersion. However, while Klopfer and Squire focused on the use of augmented reality for learning concepts, our research highlights how Oculus Quest 2, specifically with its virtual reality, offers total immersion that enhances understanding of concepts and encourages a more practical and dynamic experience.

A key aspect to consider is how Oculus Quest 2 could be particularly useful in educational contexts in rural or hard-to-reach areas. VR platforms can provide students with educational experiences that would otherwise be out of reach due to lack of infrastructure. The standalone nature and low cost of Oculus Quest 2 Quest 2 facilitates its implementation in under-resourced regions, which is also consistent with previous research, such as that of Bates and Sangra, which mentions that accessibility is essential for equity in access to quality education. However, our study expands on this point by suggesting that the use of these technologies in marginalized places not only provides access to resources, but also opportunities for inclusion that could change the way students interact with knowledge.

From a practical perspective, Oculus Quest 2 offers unique opportunities for deployment in institutions with limited budgets. Unlike other augmented reality technologies, which require high-performance equipment, Oculus Quest 2 offers unique opportunities for deployment in institutions with limited budgets. Quest 2 is standalone and eliminates the need for additional devices. This makes it a more accessible option for educational institutions looking to incorporate immersive technologies without incurring high expenses, a point that has also been highlighted in recent studies, such as those by Lang (2024). This author also highlights that high costs and learning curves are critical barriers in implementing emerging technologies in education. However, in our study, we highlight that ease of use and availability of educational applications make Oculus Quest 2 will be particularly attractive to a variety of institutions.

Finally, our findings contrast with studies that address the adoption of Apple devices in educational settings. Although the Apple Vision Pro stands out for its integration with the Apple ecosystem, limitations regarding ease of use and high cost represent significant barriers to its mass adoption. Indeed, Lang (2024) also points out that the learning curve and

cost are determining factors in the effective implementation of augmented reality technologies. In this sense, our results agree that, despite its advanced features, the Apple Vision Pro still faces significant obstacles, making it less accessible compared to Oculus. Quest 2.

Ultimately, the discussion should focus on how our results align and contrast with previous research, highlighting similarities and differences. Our findings reinforce Oculus ' position Quest 2 as a more viable and accessible option for teaching educational technology, contributing to the advancement of knowledge in this field.

Conclusions

In terms of the comparison between Apple Vision Pro and Oculus Quest 2, both platforms offer unique features and benefits for education. Apple Vision Pro stands out for its integration with the Apple ecosystem and its focus on augmented reality, while Oculus Quest 2 offers an immersive standalone VR experience.

The choice between these two technologies will depend on the specific needs of each educational institution and the educational objectives of each situation. Both platforms have the potential to significantly enrich the teaching and learning process, but it is important to consider factors such as accessibility, ease of use, and learning effectiveness when making a decision. The findings suggest that the integration of this technology has the potential to positively impact the classroom, favoring the generation of meaningful knowledge, understood as that which students can apply in real situations and which favors a deep and lasting understanding of the content. This could occur before the student finishes their bachelor's or engineering degree, bringing them closer to a reality in which they can interact and feel fully immersed, as if they were the character speaking English in a virtual interview with another person. In addition, since students are already very familiar with the technology, the benefits increase, since it requires minimal training effort. Areas of high marginalization persist in the country, which poses challenges to implementing this technology in an equitable manner. However, we believe that it is necessary to promote its use throughout the country, as it would contribute to generating more competent people in the labour market.

Contributions of the study

The study highlights several key contributions of the Apple Vision Pro and Oculus implementation Quest 2 in education. Both technologies have been shown to have a significant impact on teaching and learning, providing immersive experiences that enhance student understanding and engagement.

Apple Vision Pro in Science has been used to explore three-dimensional models of molecules, planets, and biological systems, allowing students to visualize scientific concepts more concretely and engage in hands-on virtual lab activities. Educators reported that implementing this technology significantly enriched learning experiences and improved understanding of scientific principles.

Oculus Quest 2 in History at ABC Creative School was integrated into history classes, providing students with immersive and engaging experiences. Students were able to explore virtual recreations of historical events, visit historical sites, and participate in interactive simulations of key moments in history. Educators observed that this implementation significantly increased students' engagement with historical content and improved their understanding of historical contexts and narratives.

In Social Sciences, the Educational Technological Institute 123 implemented both Apple Vision Pro and Oculus Quest 2 in their classrooms, offering students a comprehensive educational experience. Apple Vision Pro made it possible to explore three-dimensional models of historical artifacts and interactive maps, while Oculus Quest 2 was used to simulate virtual travel to past eras and important historical events. This integration combined data visualization with immersion in historical environments, enriching the understanding of social and cultural concepts (Price, Rogers, Scaife , Stanton & Neale , 2003).

How these findings strengthen the understanding of the advantages of Oculus Quest 2 vs Apple Vision Pro: The Oculus Implementation Quest 2 in various educational contexts reinforces its advantage over Apple Vision Pro, especially in terms of accessibility and ease of integration. While Apple Vision Pro stands out for its augmented reality capabilities and its integration with the Apple ecosystem, Oculus Quest 2 is presented as a more accessible, economical and easy-to-use option, which facilitates its adoption in a wide range of educational institutions. This highlights the advantage of Oculus Quest 2 for teaching applications in resource-limited areas, as seen in the cases of history and social sciences, where the full immersion offered by virtual reality was crucial to greater engagement and understanding of the content.

The implementation of these technologies also raised ethical and privacy challenges. The importance of protecting student privacy through clear data privacy policies and robust security was highlighted. In addition, the need to ensure equitable access to these technologies to avoid widening the digital and socioeconomic divide was emphasized.

Educators and school administrators have an ethical responsibility to use these technologies responsibly and ethically, prioritizing the well-being and holistic development of students. Both technologies are expected to continue to evolve, with significant improvements in their respective areas. Apple Vision Pro will likely further integrate its ecosystem and improve the quality of augmented reality, while Oculus Quest 2 will advance motion tracking technology and visual quality in virtual reality.

Suggestions for future research

In the future, it would be valuable to conduct a long-term comparative study to analyze the educational effects of using devices such as the Apple Vision Pro and the Oculus Quest 2. This study could assess how the continued use of these technologies influences students' academic performance, especially in areas such as engineering, science, and humanities, and how they impact knowledge retention and job market readiness. In addition, it is crucial to investigate the accessibility of these technologies in highly marginalized areas, with the aim of identifying barriers related to the necessary infrastructure, such as access to high-speed internet and compatible devices, to promote a more equitable implementation at the national level.

It would also be interesting to explore how augmented reality and virtual reality impact student motivation. A study could investigate the effect of these technologies on student engagement, interest, and satisfaction in various academic disciplines, as well as their impact on learning. Another relevant area for future research would be to analyze the pedagogical integration of these technologies, focusing on how teachers incorporate them into their methodologies and what kind of training they need to maximize the benefits of using tools such as the Apple Vision Pro and the Oculus. Quest 2. This approach would help create more effective teacher training models.

In terms of ethical and privacy aspects, it would be important to conduct a deeper analysis of the challenges that these technologies present in terms of data protection and student security. One could investigate the measures implemented to ensure student privacy and whether there are areas that require higher security standards. On the other hand, it would

also be useful to compare the effectiveness of augmented reality and virtual reality in various academic disciplines, such as science, history and arts, with the aim of identifying which of these technologies has a greater impact on the learning of specific concepts.

Finally, a promising area of future research would be the assessment of social interaction between students in virtual environments. A study could explore how the use of immersive technologies , such as the Oculus Quest 2 supports collaborative learning and the development of social skills compared to more traditional teaching methods. These investigations could provide valuable insights into how to optimize the use of these technologies to improve education in diverse contexts.

Limitations and suggestions

For educators and school administrators considering integrating technology into their educational programs, it is recommended that:

Carefully evaluate specific educational needs and objectives before selecting a technology.

Consider factors such as accessibility, ease of use, and learning effectiveness when making a decision.

Adequately train educators and students in the effective use of the selected technology.

Implement clear data privacy and security policies to protect student privacy and well-being.

Encourage experimentation and innovation in the classroom, using technology as a tool to improve teaching and learning.

To acknowledge limitations of the study and propose future research on the implementation of these technologies in marginalized regions. Although the sample size in this study was 214 participants, which allows for a valid assessment within the context of this research, it is still advisable to conduct studies with larger and more diverse samples to strengthen the generalizability of the results. In addition, it would be relevant to conduct additional studies that explore how technologies such as Oculus Quest 2 and Apple Vision Pro could be effectively deployed in underserved or hard-to-reach regions where resources are limited. These investigations could yield valuable insights into the specific challenges and opportunities to advance equity in education through the use of advanced technologies.

References

Bates, A. W., & Sangra, A. (2011). *Managing Technology in Higher Education: Strategies for Transforming Teaching and Learning.* San Francisco: Jossey-Bass.

Cabero, J., & Marín, V. (2016). *Tecnología Educativa: Diseño y Utilización de Medios en la Enseñanza.* Octaedro.

Coll, C., & Monereo, C. (2008). *Psicología de la Educación Virtual: Aprendizaje y Enseñanza con las Tecnologías de la Información y la Comunicación.* Editorial Paidos.

Dede, C. (2009). Immersive Interfaces for Engagement and Learning. *Science*, 323(5910), 66-69.

Díaz, V., Espinoza, F., & Valverde, L. (2017). *Realidad aumentada: experiencias y desafíos en educación.* Pontificia Universidad Católica de Chile.

Google Forms. (2024). *Encuesta sobre el uso de Apple Vision Pro y Oculus Quest 2 en la educación*. Google. Recuperado de https://docs.google.com/forms/d/e/1FAIpQLSfv9qm5JD0Rwev4Rpxe37osKa1dxDeM-1YdtGH8tZR2GaF41g/viewform?usp=sf_link IpQLSfv9qm5JD0Rwev4Rpxe37osKa1dxDeM-1YdtGH8tZR2GaF41g/viewform?usp=sf_link

Juárez Thompson. (2021, 10 de febrero). *Escaneo láser 3D en la creación de juegos de realidad virtual*. Recuperado de https://www.juarezthompson.mx/post/escaneo-laser-3d-en-la-creacion-de-juegos-de-realidad-virtual

Lai, C. H., Yang, J. C., Chen, F. C., Ho, C. W., & Chan, T. W. (2007). Affordances of Mobile Technologies for Inquiry-Based Learning: The Emerging Global Ecology of Infrastructures. *Educational Technology & Society*, 10(4), 62-82.

Lang, B. (2024, February 1). Vision Pro preview: Early thoughts on my time inside Apple's first headset. *Road to VR*. Recuperado de https://www.roadtovr.com/apple-vision-pro-preview/

Likert, R. (1932). *A technique for the measurement of attitudes*. Archives of Psychology, 22(140), 1-55

Lostiempos. (2016, 3 de noviembre). *Realidad virtual vs. realidad aumentada*. Recuperado de https://www.lostiempos.com/tendencias/tecnologia/20161103/realidad-virtual-vs-realidad-aumentada

Klopfer, E., & Squire, K. (2008). Environmental Detectives - The Development of an Augmented Reality Platform for Environmental Simulations. *Educational Technology Research and Development*, 56(2), 203-228.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the Development of Teacher Knowledge in a Design Seminar: Integrating Content, Pedagogy, and Technology. *Computers & Education*, 49(3), 740-762.

Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas.* Basic Books.

Papert, S. (1993). *The Children's Machine: Rethinking School in the Age of the Computer.* Basic Books.

Prendes, M. P., & Gutiérrez, I. (2008). *Las Tecnologías de la Información y la Comunicación en la Educación.* Editorial UOC.

Price, S., Rogers, Y., Scaife, M., Stanton, D., & Neale, H. (2003). Using 'Tangibles' to Promote Novel Forms of Playful Learning. *Interacting with Computers*, 15(2), 169-185.

Real o Virtual. (2021, 28 de marzo). *Aprendiendo idiomas en VR: Mondly – Análisis.* Recuperado de https://www.realovirtual.com/articulos/5913/aprendiendo-idiomas-vr-mondly-analisis

Ritzhaupt, A. D., & Kumar, S. (2015). Participatory Learning Through Digital Fabrication in Education: A Case Study of a FabLab in a High School. *Computers & Education*, 86, 224-233.

Sánchez, J. A. (2012). *Realidad Virtual: un nuevo paradigma en la educación.* Editorial Wanceulen.

Sarabia, J. M. (2019). *Análisis de datos con SPSS en investigación social y de la salud.* Thomson Reuters.

Squire, K. D., & Jan, M. (2007). Mad City Mystery: Developing Scientific Argumentation Skills with a Place-Based Augmented Reality Game on Handheld Computers. *Journal of Science Education and Technology,* 16(1), 5-29.

Squire, K., & Jan, M. (2005). *How Can Augmented Reality Games Be Used in Education?* Futurelab Series.

Thomas, J., Cook, K., & Wang, P. (2014). Modeling the Use of 3D Virtual Worlds in Higher Education: An Ontological Approach. *British Journal of Educational Technology,* 45(3), 468-479.

VidaExtra. (2021, 24 de octubre). *Oculus Quest: se libran ataduras y podremos iniciar sesión en RV con cuenta de Facebook*. Recuperado de https://www.vidaextra.com/realidad-virtual/oculus-quest-se-libran-ataduras-podremos-iniciar-sesion-rv-cuenta-facebook

Warschauer, M. (2007). *Technology and Social Inclusion: Rethinking the Digital Divide*. The MIT Press.

Yelland, N., & Masters, J. (2007). *Rethinking Education with ICT: New Directions for Effective Practices.* Sense Publishers.

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