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Article

University students' views on the application of virtual reality in higher education

Eloisa Gabriela Zúñiga Valencia[1,*], Joffre Stalin Monar Monar[2], Martin Gómez Lujan[3], Cecilia Laura Mogrovejo López[1]

[1] Catholic University of Santa Maria, Arequipa 04001, Perú
[2] Chimborazo Polytechnic Higher School, Orellana 220150, Ecuador
[3] National University of Chimborazo, Riobamba 060110, Ecuador
*** Corresponding author:** Eloísa Gabriela Zúñiga Valencia, ezunigav@ucsm.edu.pe

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Abstract: This study analyzes the perception of university students regarding the use of virtual reality (VR) in higher education, focusing on their level of knowledge, usage, perceived advantages and disadvantages, as well as their willingness to use this technology in the future. Using a mixed-methods approach that combines questionnaires and semi-structured interviews, both quantitative and qualitative data were collected to provide a comprehensive view of the subject. The results indicate that while students have a basic understanding of VR, its use in the educational context is limited. A considerable number of students recognize VR's potential to enhance the learning experience, particularly in terms of immersion and engagement. However, significant barriers to adoption were identified, such as technical issues, the high cost of equipment, and inadequate access to technological infrastructure. Additionally, there is a need for broader training for both students and faculty to ensure the effective use of this technology in academic environments. The semi-structured interviews confirmed that perceptions of VR vary depending on prior exposure to the technology and access to resources. Despite the challenges, most students appreciate VR's potential to enrich learning, although its effective adoption will depend on overcoming the identified barriers. The study concludes that strategies must be implemented to facilitate the integration of VR into higher education, thus optimizing its impact on the teaching-learning process.

Keywords: virtual reality (VR); higher education; student perceptions; educational technology; barriers to adoption

1. Introduction

Over the past decade, technological advancements have transformed key sectors such as medicine, entertainment, engineering, and education. Among these innovations, virtual reality (VR) has emerged as a fundamental tool to enhance interaction and enrich user experiences. In the educational field, VR offers the possibility of creating immersive learning environments that promote greater understanding and knowledge retention. However, its integration into higher education still faces obstacles, such as limited availability of equipment, inadequate technological infrastructure, and a lack of sufficient training for both students and educators.

Studying university students' perceptions of VR is essential, as their experiences and opinions are crucial for the success and acceptance of this technology in academic settings. If universities do not effectively adopt VR, they risk falling behind other sectors that are already leveraging its benefits. Additionally, in a context where

students demand more innovative learning experiences, higher education institutions must adapt to offer a more dynamic and personalized educational model.

Analyzing how students perceive VR will not only help identify the barriers hindering its adoption but also develop strategies to optimize its application in the teaching process. This research is essential for universities to maintain their relevance and competitiveness in an increasingly digitalized and technologically innovative environment. Failing to address this issue means missing the opportunity to prepare educational institutions for the technological challenges of the future.

In addition, interest in virtual reality has experienced a notable increase. As noted by Barja et al. (2023), there has been a significant growth in research on this technology and its applications, particularly in the educational field. Scientific production in this area remained stable between 2012 and 2018 but has shown an upward trend from 2019 to 2021, highlighting the growing importance of this topic within the academic community. Currently, higher education institutions face the challenge of adapting to rapid technological innovations and rising student expectations. Virtual reality (VR) emerges as an innovative tool that could transform the educational experience by offering immersive and interactive learning environments. However, the integration of VR in academia faces several obstacles.

Additionally, Luna et al. (2023) note that VR is an emerging technology that has gained increasing relevance in the educational field. These innovations are becoming more popular and are being increasingly integrated into various educational contexts. In this digital transformation, Montenegro and Fernández (2022) suggest that educational institutions, especially in higher education, must continuously adapt, as the connections between teaching and technology are emerging as a crucial factor in evaluating educational quality. The effectiveness of these technologies will largely depend on the level of capability.

Virtual Reality (VR) have emerged strongly in higher education, radically transforming how students access and assimilate knowledge. These emerging technologies have introduced new possibilities for education, where immersion and interaction become central elements of the learning process. According to a recent analysis by Calderón et al. (2023), Virtual Reality (VR) and Augmented Reality (AR) not only allow for the development of more immersive educational environments but also enhance direct interaction with the material, offering students much richer learning experiences. This technological transformation highlights the potential of these tools to revolutionize higher education and significantly improve the quality of learning.

In the realm of immersive technologies applied to education, virtual environments stand out as effective tools for learning. Iglesias (2022) notes that these environments can be created through animations that mimic reality or through videos that capture an entire space, such as 360-degree videos, providing a highly interactive experience. In these simulations, users do not merely observe but also actively participate; for example, in immersive virtual reality with (Head Mount Display) HMD devices, users can control their perspective through head movements. Similarly, in desktop virtual reality versions, interaction is achieved through mouse movements, allowing users to explore and manipulate the virtual environment directly. This makes virtual reality an interactive experience that enriches the educational process by deeply

engaging students with the content.

One of the main challenges is the limited knowledge and experience with virtual reality among both students and educators. Despite advances in this technology, its adoption in higher education remains limited, highlighting the need to investigate how university students perceive its usefulness and effectiveness. Additionally, the high cost of the equipment and infrastructure required to implement VR, along with the need for specialized training, can serve as significant barriers to its integration. Furthermore, Marín et al. (2023) point out that the lack of specific studies examining university students' perceptions of virtual reality in higher education makes it essential to conduct detailed research in this area. Understanding students' attitudes, expectations, and potential reservations regarding this technology will provide valuable insights for designing more effective and acceptable implementation strategies for users.

The University of the Arts in Guayaquil, located in Ecuador, stands out for its commitment to high-quality artistic education and its innovative approach to higher education. In an academic environment that continually seeks to adapt its teaching methods to current technological demands and opportunities, the integration of advanced tools like Virtual Reality (VR) emerges as a potential solution to enhance the educational process. VR offers a unique opportunity to transform learning in the arts by allowing students to experience simulated environments that facilitate creative exploration and the development of technical skills in contexts that extend beyond the physical limits of the classroom.

In the last decade, higher education has faced numerous challenges stemming from rapid technological evolution and the changing needs of society. In this context, universities have been driven to rethink their pedagogical approaches and integrate new tools that facilitate learning and improve educational outcomes. Lerma et al. (2020) recently noted that the university-level educational system has focused its efforts on researching technologies aimed at generating alternatives to support the development of teaching and learning processes, in a context where society's needs are evolving rapidly. This effort has led to the creation and implementation of innovations such as virtual reality, artificial intelligence, and other emerging technologies that are transforming the way knowledge is delivered and received, making education more accessible, interactive, and relevant for today's students.

This study focuses on the implementation of VR at the University of the Arts in Guayaquil, evaluating how this technology can influence students' educational experiences, enhance their understanding and practical skills, and add an additional dimension to artistic training. As noted by Agurto and Guevara (2023), although educators are aware of the benefits that virtual reality offers as an educational tool, most do not use it due to a lack of training in its methodological application. The research aims to provide a detailed insight into how the adoption of VR could redefine pedagogical methodologies at the institution, strengthening its position as a leader in innovative artistic education in Ecuador.

Consequently, the central problem of this research is to determine how university students perceive the use of virtual reality in their studies, identifying both the opportunities they see and the challenges that could limit its adoption. This understanding will help educational institutions make informed decisions about

incorporating virtual reality into their academic programs, thereby maximizing the potential of this technology to enhance the quality and effectiveness of learning in higher education.

This study seeks to thoroughly investigate the perception of university students at the University of the Arts in Guayaquil regarding the use of virtual reality in higher education. Specifically, it aims to answer the research question: What is the perception of university students at the University of the Arts in Guayaquil regarding the use of virtual reality in higher education, considering their level of knowledge, current usage, perceived advantages and disadvantages, and willingness to use this technology in the future? This approach will provide a comprehensive understanding of how this emerging technology is viewed and accepted by students, and what factors influence their willingness to incorporate it into their learning process.

2. Research objectives

General objective:

To analyze university students' perception of the use of virtual reality in higher education.

Specific objectives:

a) To assess the level of knowledge and usage of virtual reality among university students.
b) To identify the perceived advantages and disadvantages of using virtual reality for learning.
c) To determine the students' willingness to use virtual reality in their future studies.

3. Justification

The introduction of virtual reality (VR) in higher education presents a significant opportunity to revolutionize the teaching and learning process. In an increasingly technology-oriented academic environment, it is essential to understand how university students perceive this innovative tool to optimize its application and effectiveness.

At the University of the Arts in Guayaquil, this research holds particular significance due to the institution's focus on artistic and technological development. It faces the challenge of integrating innovative tools that can enrich learning in creative disciplines. Virtual reality (VR), with its ability to generate interactive environments and immersive experiences, has the potential to revolutionize the educational process in this field. However, to ensure successful implementation, it is crucial to understand the expectations, barriers, and opportunities that students perceive regarding this technology.

Virtual reality has the potential to transform the educational experience by allowing students to interact with content in a more immersive and engaging manner. This technology can provide simulations and virtual environments that facilitate deeper understanding and better retention of knowledge. Understanding students' opinions and evaluations of these possibilities will enable the design of a VR integration that maximizes its benefits.

Moreover, understanding how students perceive virtual reality can reveal both

their expectations and reservations regarding this technology. This insight is crucial for overcoming obstacles such as the high cost of equipment, lack of experience with the technology, and resistance to change. Identifying these challenges will aid in the development of strategies to address these barriers and promote more effective adoption of VR in academic programs.

The use of virtual reality tools in education has proven to be positive from the students' perspective. Menjívar (2021) notes in his study that students have observed significant improvements in class time efficiency, increased participation and motivation, as well as notable advances in their academic performance. By offering a more dynamic and immersive learning experience, virtual reality significantly enhances the quality of the educational process and the academic development of students.

At the local level, there is not a vast body of literature that explores students' perceptions of VR in higher education institutions in Ecuador. While some studies have addressed the impact of technologies in education, this research provides a novel contribution by focusing specifically on the University of the Arts, an institution that, due to its artistic nature, could greatly benefit from the creative applications of virtual reality. Thus, the results obtained will allow the university to design VR implementation strategies that are better aligned with the needs of its students and the unique aspects of its academic offerings.

Moreover, this study fills an important gap in the research by providing empirical evidence on university students' perceptions of virtual reality in a local context. Most existing studies have focused on international institutions or specific fields such as medicine or engineering, leaving a void regarding research on the use of VR in artistic programs. Therefore, this research is not only original in its geographical and disciplinary focus but also addresses the growing demand for technological innovation in higher education in Ecuador, offering key insights for informed and strategic decision-making in this institution and others alike.

In summary, this research will not only contribute to the academic advancement of the University of the Arts by optimizing the use of VR but also enrich the scientific literature in the field of educational technology. It provides a contextualized and relevant perspective for institutions seeking to improve the quality of their programs through the use of advanced technological tools, while also facilitating the creation of a more innovative learning environment that meets modern demands.

4. Theoretical framework

In the field of artistic careers, immersive experiences hold particular relevance, as these disciplines heavily rely on emotional connection and creativity. By utilizing immersive environments, art students not only become more motivated but also find a conducive space to explore and experiment more freely and creatively. Véliz et al. (2021) notes that these experiences, by leaving a lasting impression on their psyche, facilitate not only the memorization of content but also the internalization of artistic techniques and abstract concepts. Moreover, the ability to repeat actions as in the real world within these environments allows students to refine their practical skills in a safe and controlled context, which is crucial for artistic training. Thus, integrating

immersive technologies into artistic education not only enriches the learning process but also enhances the development of creative and technical talent among future art professionals.

The theoretical framework provides the context and conceptual foundation for understanding university students' perceptions of using virtual reality (VR) in higher education. The following sections address key concepts related to virtual reality in education, its benefits and challenges, as well as relevant technological adoption theories.

Virtual reality emerges as a transformative tool that enables the creation of highly interactive and flexible learning environments. In this regard, Serrano (2023) states that virtual reality facilitates the formation of a "virtual classroom" where students can interact digitally with the environment and with each other. This ability to generate immersive educational experiences does not rely on the need to replicate a physical space but rather offers a wide range of possibilities for designing scenarios tailored to learning needs and objectives.

4.1. David Kolb's experiential learning theory

Posits that learning occurs through a cycle consisting of concrete experience, reflection, conceptualization, and active experimentation. Virtual Reality (VR) provides immersive environments that enable students to interact directly with educational content, thereby promoting a deeper understanding and retention of knowledge. This theory is crucial for analyzing how VR can influence perception and learning within the context of higher education.

In the realm of higher education, technological advancements have led to the creation of increasingly sophisticated learning environments. These immersive environments offer a multisensory experience, combining visual, auditory, and tactile stimuli that not only capture students' attention but also enhance knowledge retention. Furthermore, Véliz et al. (2021) highlight that these environments' ability to replicate and control real-world situations allows students to practice and reinforce skills in a safe and repetitive setting, which is essential for consolidating learning.

Understanding immersive learning methods is crucial for the effective implementation of experiential learning, which has been shown to enhance student performance and engagement. According to Ayala et al. (2020), this approach utilizes interactive environments and simulations, which not only help students better grasp concepts but also strengthen their involvement in learning. Moreover, many of the skills required in today's job market are based on practical experiences. Therefore, integrating immersive learning into the educational process not only enriches the academic experience but also prepares students to meet labor market demands, where skills gained through real-world experiences are highly valued.

The implementation of Virtual Reality (VR) in learning provides an immersive experience that is highly enriching and engaging for students. As Martínez (2024) notes, by interacting with real or simulated scenarios, students have the opportunity to learn through various phases of experimentation, as outlined by Kolb's model. This approach allows students to have concrete experiences, reflect on them, develop theoretical concepts, and apply these concepts to new situations, facilitating a deeper

and more meaningful learning process.

Consequently, Ortí et al. (2022) note that in the context of university students in education degrees, the experiential learning cycle manifests as a dynamic process where concrete experiences are transformed into abstract concepts. These concepts, in turn, are applied to acquire new experiences. This methodology allows students not only to interact with real or simulated situations but also to reflect on their experiences, developing theories that can be applied to future scenarios. Kolb's cycle facilitates active and continuous learning, essential for professional and personal development in the educational field.

Adding to this, the adoption of immersive technologies such as Virtual Reality (VR) has shown notable effectiveness in enhancing learning. These technologies not only facilitate a more direct interaction with content but also increase students' emotional engagement. In particular, Juca et al. (2020) have highlighted that immersion strengthens learning through direct experiences coupled with emotion, providing multiple benefits to the educational process.

4.2. Virtual reality in education

In the context of technological evolution in education, Virtual Reality (VR) is defined by Muñoz et al. (2021) as the use of computational modeling and simulation to create artificial three-dimensional (3D) environments with which users can interact immersively. This technology allows individuals to experience and manipulate virtual spaces that imitate or simulate aspects of reality, providing a rich and dynamic interface for learning and exploration. In the current digital education framework, it is crucial to consider how different technological components affect the teaching-learning process. Estrada and Pinto (2021) assert that this educational model establishes that effective integration of technology, communication, and education can lead to more accurate communication and a more successful learning process, provided that technology is used appropriately.

Virtual Reality (VR) has become an increasingly utilized tool in the educational field, offering new learning methods that blend virtual interaction with real-world experience. This technology enables students to experience various situations without leaving the classroom, creating immersive experiences that enhance the learning process. According to Ruiz-Ariza et al. (2022), VR not only transforms the way students interact with content but also fosters active and participatory learning, resulting in greater knowledge retention and increased motivation to learn.

Furthermore, as Betancurt et al. (2024) state, from this perspective, Virtual Reality (VR) is understood as a resource that can support knowledge construction by offering immersive and contextualized experiences that promote deep and meaningful learning. This type of experiential learning is especially valuable in higher education, where students are expected to develop practical and theoretical competencies that prepare them for the workforce. González et al. (2023) also note that VR facilitates inclusion by allowing students with disabilities to access educational experiences that might otherwise be difficult to achieve.

Although Virtual Reality has been implemented in various sectors, its widespread adoption has not yet been solidified. This underscores that the primary purpose of this

technology lies in providing a deeper understanding, whether by facilitating the absorption of abstract concepts, allowing the practice of concrete skills, or providing an immersive experience to better grasp a narrative. According to Sousa et al. (2021), the essential goal of Virtual Reality is precisely this: to enrich learning and practice through simulated experiences that enhance user comprehension.

Currently, the advancement of technologies such as Augmented Reality (AR) and Virtual Reality (VR) is beginning to significantly impact the educational field, including the arts. For instance, Maldonado et al. (2021) mention that Microsoft's HoloLens enhances understanding through an immersive experience. Similarly, applications like VR Chat are used to conduct virtual classes in an interactive environment. Although these tools have not yet been fully explored in education, more advanced universities are already incorporating these technologies into certain courses. In the context of artistic careers, the integration of AR and VR provides innovative opportunities for creation and experimentation, allowing students to explore and develop their creative skills in unprecedented ways. The implementation of these technologies in artistic education can transform the way students interact with art, offering new forms of expression and learning.

4.3. Benefits and challenges of virtual reality

The use of Virtual Reality (VR) in education offers multiple benefits that can transform the learning experience. VR helps students grasp concepts through more engaging activities and maintains their attention by providing full immersion in a virtual environment. This immersion not only facilitates a deeper understanding of the subjects but also allows students to experience complex situations in a safe and controlled manner. For example, González et al. (2023) notes that in fields such as medicine, students can practice surgical procedures in a virtual environment, providing them with practical experience without the risks associated with real-life practice.

Additionally, VR can be especially beneficial for students with special learning needs, as it provides an adaptive environment that can be tailored to their individual requirements. As Angulo et al. (2023) mentions, by designing VR applications centered on the pedagogical dimension, researchers and educators aim to leverage the immersive potential of this technology to offer more engaging and interactive learning experiences. Crespo et al. (2024) notes that digital tools and technologies become key resources in VR, allowing students to access learning experiences that are closer to real-life situations in the educational environment. Despite this, VR promotes the acquisition of digital skills across various fields of knowledge, benefiting its implementation in different contexts.

Furthermore, in contrast to traditional experiential learning, VR not only enriches the educational process but also provides an innovative way to acquire knowledge by allowing students to interact with content in a simulated yet highly realistic environment. By offering these experiences, VR becomes an invaluable tool for enhancing learning, fostering a more comprehensive and meaningful understanding of the subjects covered, as noted by Caballero et al. (2023). A clear example of the educational advantages of VR lies in its ability to provide immersive and lasting

learning experiences. This technology allows students to engage in educational experiences uniquely and without physical constraints, facilitating a deeper understanding of the topics studied. For instance, VR enables students to take virtual tours of historical sites like Machu Picchu, simulate excursions to the Colosseum in Rome, or even explore the surface of Mars.

However, despite these benefits, there are also significant challenges in implementing VR in education. A specific set of skills is required from students to use these tools effectively. This implies that educational institutions must provide adequate training for both students and educators, ensuring that everyone is equipped to make the most of the technology. Additionally, Mundana (2023) notes that the technological infrastructure and the cost of VR devices can be obstacles to widespread adoption.

4.4. Theories of technology perception and adoption

The adoption of technologies in educational and business settings has been studied through various theories and models that aim to explain how and why individuals decide to use new technologies. Among these models, the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) are the most prominent.

TAM, developed by Davis (1989), posits that two main factors influence the intention to use a technology: perceived usefulness and perceived ease of use. According to Alharbi and Alshammari (2021), if users believe that a technology will be useful and is easy to use, they are more likely to adopt it. This model has been widely validated in various studies, demonstrating its applicability across multiple technological contexts.

On the other hand, UTAUT, proposed by Venkatesh et al. (2003), expands on TAM by incorporating additional factors such as social influence and facilitating conditions. This model is based on the premise that technology adoption depends not only on individual perceptions but also on the social and organizational context in which the user is situated. Recent research by Bashir et al. (2022) has confirmed that UTAUT is effective in predicting technology acceptance in educational settings, suggesting that perceived institutional support and social pressure are key determinants of adoption.

5. Materials and methods

5.1. Methodology

The methodological approach adopted in this research was based on a mixed-methods approach, integrating both qualitative and quantitative methods to obtain a comprehensive and detailed understanding of students' perceptions of the use of virtual reality (VR) in higher education. According to Bagur et al. (2021), this integrative methodology not only combines these two perspectives but also provides a more complete and thorough view of the research problem. In this way, the analytical potential was maximized, and the interpretation of the data was enriched.

The selection of this mixed methodology was deliberate, as its nature allowed for

addressing the inherent complexity of the phenomenon under study from different perspectives, combining the rigor of quantitative data with the depth and interpretive richness of qualitative data.

To conduct this research on university students' perceptions regarding the use of virtual reality (VR) in higher education, a mixed-methods approach was employed, combining both qualitative and quantitative methods. This approach was essential for providing a comprehensive view, allowing for the collection of statistical data and gaining a deep understanding of students' opinions and attitudes.

Within the framework of the quantitative approach, structured questionnaires were applied to precisely measure the level of knowledge, current use, perceived advantages and disadvantages, as well as the students' willingness to use VR in their future studies. This quantitative approach provided a general overview of student perceptions, facilitating the identification of patterns and trends regarding the adoption of the technology. The statistical data provided a solid foundation for comparative analysis of the responses from different subgroups, enriching the analysis of student perceptions regarding VR.

On the other hand, the qualitative approach was implemented through semi-structured interviews, which allowed for an in-depth exploration of students' subjective experiences and attitudes toward virtual reality. Unlike the quantitative approach, which focuses on measurement and generalization, the qualitative approach captured personal narratives, revealing motivations, expectations, and concerns that cannot be fully expressed in closed formats. This qualitative perspective was essential for understanding the perceived barriers and contextual factors that might influence students' willingness to adopt VR in their academic activities.

The use of this mixed methodology presented several advantages. Firstly, it provided both depth and breadth in the results, as the quantitative approach offered an overall view of perceptions, while the qualitative approach captured the nuances and subtleties of these perceptions. Secondly, it facilitated data triangulation, which increased the validity of the findings, as the results obtained through the questionnaires were complemented and contrasted with the information derived from the interviews, ensuring greater robustness in the analysis. Additionally, the mixed methodology offered flexibility, allowing for a complementary approach to both numerical and experiential aspects of the study, thereby generating a more holistic view of the investigated phenomenon.

In the context of the University of the Arts in Guayaquil, the implementation of this mixed methodology was particularly relevant. The quantitative approach facilitated the quantification of the level of knowledge and use of virtual reality among students, identifying significant gaps in its adoption, while the qualitative approach allowed for a deeper understanding of how students perceived this technology, exploring the barriers and opportunities that influenced their willingness to use it in an educational setting. Thus, the combination of both approaches enabled a comprehensive understanding of the phenomenon, allowing not only the identification of general trends but also a detailed comprehension of individual experiences.

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In summary, the use of a mixed methodology in this research was crucial for addressing the complexity of the studied phenomenon. This methodological approach provided a solid foundation upon which practical recommendations could be formulated, considering both general trends and individual characteristics of the students. By integrating quantitative and qualitative approaches, the study was able to capture perceptions of virtual reality in higher education more precisely and deeply, thereby reinforcing the relevance and validity of the obtained results.

The mixed-methods approach was deemed the most suitable for this study, as it allowed for detailed exploration of students' perceptions (qualitative method) and measurement and analysis of quantitative data regarding the use and acceptance of VR. This approach facilitated data triangulation, which enriched the findings and added greater validity to the results. Mixed methodology stands out for its ability to combine qualitative and quantitative approaches, allowing for a more holistic and detailed understanding of the research issues. According to Bagur et al. (2021), this integrative methodology not only merges these two perspectives but also provides a more comprehensive and thorough view of the research problem. Thus, it maximized the analytical potential and enriched the interpretation of the data.

The research design was non-experimental and cross-sectional, collecting data at a single point in time. This design was appropriate for describing and analyzing phenomena as they occurred in the present, without manipulating variables.

The target population for this study consisted of 1500 university students enrolled in various faculties and academic programs at the University of the Arts of Guayaquil. To determine the sample size, the formula for finite populations was used, resulting in a total of 90 students.

The formula for calculating the sample size in finite populations is:

$$n = (N - 1) \times \text{E2} + \text{Z2} \times p \times q$$

- N is the population size (1500 students).
- is the critical value corresponding to the confidence level (1.96 for a 95%

confidence level).

- p is the estimated proportion of the characteristic being studied (assumed to be 0.5 to maximize variability).
- q is $1 - p$.
- E is the margin of error (0.1 for a 10%).

Applying this formula yields a sample size of 90 students.

5.2. Instruments

Data collection was carried out using two primary instruments: questionnaires and semi-structured interviews. The questionnaire included both closed and open-ended questions to assess the level of knowledge, use, and perceptions of VR. Closed-ended questions provided quantitative data for statistical analysis, while open-ended questions offered qualitative insights into the students' experiences and opinions. Likert scales were used to measure attitudes and perceptions, and demographic questions were included to contextualize the results.

Additionally, semi-structured interviews were conducted with a subgroup of 10 students randomly selected from the total sample. These interviews allowed for a deeper exploration of the perceived experiences, advantages, disadvantages, and barriers to the adoption of VR. The interviews were conducted via videoconferencing tools such as Zoom or Google Meet and were recorded for subsequent analysis.

The data collection procedure included distributing the online questionnaire through platforms like Google Forms, facilitating efficient access and data gathering. Subsequently, the questionnaire data were analyzed using descriptive and inferential statistical techniques with SPSS software. Before data collection began, the research instruments were validated to ensure their reliability and validity. Content validity was ensured by asking a panel of experts in education and technology to review the questionnaire and interview guides. In addition, a pilot test was conducted with a small group of students (n = 10) to verify the clarity and reliability of the instruments, making adjustments as necessary.

Consequently, a pilot test was conducted with the aim of validating the clarity, reliability, and relevance of the research instruments, including both the questionnaire and the interview guides. This preliminary phase was crucial to ensure that the measurement tools were aligned with the study's objectives and could adequately capture students' perceptions of virtual reality (VR) in higher education.

The pilot test was carried out with a group of 10 randomly selected students from the University of the Arts in Guayaquil, who participated in the evaluation of the questionnaire and the semi-structured interviews. During this phase, the comprehension of the questions, the relevance of the items, and the time required to complete each part of the instrument were assessed.

The results of the pilot test revealed that, overall, the questionnaire questions were understandable to the participants. However, some students noted that the response options on the Likert scales were not sufficiently differentiated. As a result, adjustments were made to the response scales to allow for a more precise measurement of attitudes and perceptions regarding VR.

Regarding the open-ended questions, the need for greater specificity was

identified, as some items were perceived as too broad. These questions were rephrased to better focus on the key aspects of VR, facilitating more relevant and detailed responses. The interview guides were also adjusted by reducing the redundancy of some questions and increasing their specificity to improve the quality of the responses.

An important aspect that emerged during the pilot test was the time required to complete the questionnaire and interviews, which turned out to be longer than initially anticipated. This finding led to a restructuring of the estimated time to ensure that participants could respond comfortably and without rush.

Finally, the pilot test revealed technical issues with the online platform used for the questionnaire, prompting technical adjustments that ensured a smooth data collection process. In summary, the changes made after the pilot test confirmed the validity and reliability of the instruments, improving their clarity and effectiveness for data collection in the main study.

Ethical considerations were also taken into account. Informed consent was obtained from all participants, clearly explaining the purpose of the research, the procedures, and ensuring the confidentiality and anonymity of their responses. The collected data were stored securely and used solely for research purposes, and the recorded interviews were destroyed after analysis.

In summary, the methodology employed provided a comprehensive and detailed view of university students' perceptions of the use of virtual reality in higher education. By combining the depth of qualitative data with the precision and generalizability of quantitative data, this information was crucial for designing effective strategies for the implementation and adoption of virtual reality in the educational field.

6. Results

This section presents the results obtained from the questionnaire administered to university students regarding their perceptions of the use of virtual reality (VR) in higher education. The results reflect a range of perspectives, from limited knowledge and sporadic use to the identification of significant disadvantages and barriers to its adoption. The specific findings related to students' perceptions of VR, as well as the factors that could influence its implementation and acceptance in the academic sphere, will be detailed below.

During the pilot phase, significant adjustments were made to improve the effectiveness and clarity of the research instruments. The preliminary review of the questionnaire revealed that, overall, the closed-ended questions were understandable to most participants. However, some noted that the response options on the Likert scales were not sufficiently differentiated. In response, the scales were adjusted to allow for a more precise measurement of attitudes and perceptions about virtual reality.

Regarding the open-ended questions, the need for greater specificity was identified to better guide participants. Some questions were too general, leading to a reformulation to focus on key aspects of virtual reality, facilitating more relevant and detailed responses. The interview guides also proved effective in obtaining rich qualitative information. However, it was observed that some questions were too broad

or repetitive for the participants. In response, adjustments were made to make the questions more specific and to avoid redundancies, which improved the quality and accuracy of the responses. Another important aspect that emerged during the pilot test was the time required to complete the questionnaire and interviews, which was longer than anticipated. As a result, the estimated duration was adjusted to ensure that participants could respond without haste and with adequate time.

Additionally, issues with accessing the online platform used for the questionnaire were detected, leading to technical adjustments to ensure uninterrupted data collection. Suggestions received from participants regarding question formulation and the overall structure of the instruments were incorporated to further enhance the quality of the questionnaire and interview guides. In summary, the adjustments made after the pilot test confirmed the overall validity of the instruments, improving their clarity and effectiveness for data collection in the main study.

The results of **Table 1** on the knowledge and use of Virtual Reality from the questionnaire applied to the students are shown below.

Table 1. Section 1 of the questionnaire applied to students.

Section	Category	Number of Students	Percentage	Weighting
1. Knowledge and Use of Virtual Reality	Basic Knowledge	20	22.2%	Low
	Use in Education	40	44.4%	Low-Medium
	Prior Knowledge	30	33.3%	Low-Medium
	Use in Education (Yes)	25	27.8%	Low-Medium
	Use in Education (No)	50	55.6%	Medium
	Use in Education (No)	15	1.7%	Low

Note: The analysis of the table reveals that the knowledge and use of virtual reality among university students is limited. Most have basic knowledge (22.2%) and moderate use in education (44.4%). Although 33.3% had prior knowledge, only 27.8% currently use VR in their studies, while 55.6% do not use it in education. The use of VR in other contexts is very low (1.7%). This indicates an insufficient adoption of the technology in higher education and suggests the need to promote its integration and use.

These data reveal a lack of integration of VR into academic programs, which could limit its adoption by students. Prior knowledge of VR does not necessarily translate into continuous use within the educational environment, suggesting that strategies need to be implemented to more actively promote its inclusion in the classrooms.

In **Table 2** of the same questionnaire, students express their Perception of Virtual Reality in Education, the results of which are shown below.

Table 2. Section 2 of the questionnaire administered to students.

Section	Category	Number of Students	Percentage	Weighting
1. Perception of Virtual Reality in Education	Moderate Positive Impact	30	33.3%	Medium
	Limited or Minimal Impact	40	44.4%	Medium Low
	No Impact	20	22.2%	Low
	Positive Attitude	20	22.2%	Low
	Neutral Attitude	35	38.9%	Medium Low

Table 2. (*Continued*).

Section	Category	Number of Students	Percentage	Weighting
	Negative Attitude	35	38.9%	Medium Low

Note: The table indicates that students' perceptions of virtual reality in education vary. Thirty-three-point three percent believe that VR has a moderate positive impact, while forty-four-point four percent perceive a limited or minimal impact. Only twenty-two-point two percent think that VR has no impact. Regarding attitudes towards VR, twenty-two-point two percent exhibit a positive attitude, while thirty-eight-point nine percent have a neutral or negative attitude. This reflects a diverse and predominantly critical perception of virtual reality in education, with a significant portion of students showing skepticism about its impact and usefulness.

Although some students value VR as a useful tool, there is a lack of consensus on its actual impact on improving education. This indicates that, to change perceptions and increase acceptance, it is necessary to make the concrete benefits of VR for learning more visible.

Table 3, on the other hand, reveals the advantages and disadvantages perceived by the students, the results of which are given below.

Table 3. Section 3 of the questionnaire applied to students.

Section	Category	Number of Students	Percentage	Weighting
3. Perceived Advantages and Disadvantages	Significant advantages	25	27.8%	Medium
	Minor advantages	40	44.4%	Medium
	No significant advantages	25	27.8%	Medium-Low
	Major disadvantages	30	30.3%	Medium-Low
	Minor disadvantages	40	44.4%	Medium
	No disadvantages	20	22.2%	Low

Note: The analysis of the table reveals that perceptions of the advantages and disadvantages of virtual reality are divided. About 27.8% of students perceive significant advantages of VR, while 44.4% see minor advantages. Another 27.8% believe there are no significant advantages. Regarding disadvantages, 30.3% report major disadvantages, and 44.4% perceive minor disadvantages. Only 22.2% see no disadvantages. This indicates that while a significant proportion of students recognize some advantages of VR, notable disadvantages are also perceived, suggesting a critical and balanced evaluation of the technology.

Although some students see the advantages of VR, the disadvantages related to technical issues and limited access outweigh the perceived benefits. This reinforces the need to improve infrastructure and training in the use of VR to maximize its benefits.

Table 4 shows the results obtained on barriers to the adoption of virtual reality, the results of which are presented below.

Table 4. Section 4 from the questionnaire applied to students.

Section	Category	Number of Students	Percentage	Weighting
4. Barriers to the Adoption of Virtual Reality	Lack of access to technology	40	44.4%	Medium
	Insufficient infrastructure	35	38.9%	Medium
	No access issues	15	16.7%	Low
	Lack of adequate training	35	38.9%	Medium

Table 4. (*Continued*).

Section	Category	Number of Students	Percentage	Weighting
	Insufficient training	30	33.3%	Medium
	No training issues	25	27.8%	Medium Low

Note: The table shows that the main barriers to the adoption of virtual reality among students are the lack of access to technology (44.4%) and insufficient infrastructure (38.9%). Additionally, 38.9% also consider the lack of adequate training to be a significant obstacle, while 33.3% perceive insufficient training. Only 16.7% do not face access issues, and 27.8% do not perceive training problems. This suggests that technological and educational limitations are the primary challenges for integrating virtual reality into the academic environment.

The identified barriers confirm that lack of access and inadequate infrastructure are the major challenges that must be overcome for the adoption of VR in higher education. Additionally, the lack of proper training limits the potential of VR, highlighting the importance of investing in training programs to facilitate its adoption.

The overall results of the questionnaire indicate a diverse perception of virtual reality (VR) among university students. In terms of knowledge and use of VR, it is observed that students have a basic level of familiarity and a moderate use of this technology in the educational sphere, with minimal adoption in additional contexts. Regarding the perception of VR in education, most students perceive its impact as limited or marginal. Attitudes toward VR are divided, with a segment of students showing both positive and neutral or negative attitudes.

Regarding perceived advantages and disadvantages, while students acknowledge some advantages, these are mostly considered minor. Disadvantages are also widely identified, with a significant proportion reporting both major and minor drawbacks. Finally, barriers to VR adoption primarily center on the lack of access to technology and inadequate infrastructure, along with insufficient training. These findings suggest that, although there is recognition of the potential advantages of virtual reality, substantial obstacles need to be addressed to achieve effective integration of this technology in the academic environment.

Consequently, during the semi-structured interviews conducted with a randomly selected subgroup of 10 students, the following results were obtained:

Most students reported having had limited exposure to virtual reality, mostly through extracurricular activities and not in a formal academic setting. However, some students highlighted positive experiences, noting that VR provides an immersion and level of interactivity that facilitates a deeper understanding of content. These students appreciated how the technology allowed them to experience concepts in a more tangible and participatory manner compared to traditional methods.

Regarding perceived advantages, several students mentioned that virtual reality offers an immersive learning experience that makes content more dynamic and engaging. They highlighted its ability to simulate environments and situations that would be difficult or impossible to replicate in reality, such as virtual tours of historical sites or the simulation of complex processes. This ability to create unique learning experiences was widely appreciated.

However, the interviews also revealed several disadvantages and barriers to the adoption of virtual reality. Among the disadvantages, many students mentioned technical issues, such as equipment malfunctions and difficulties with software, which

negatively impacted their experience. Additionally, the high cost of equipment and the lack of access at their institutions were identified as significant limitations. The lack of adequate training for using VR was also highlighted as an important barrier. Students indicated that increased training could improve their ability to use the technology effectively in an educational context.

Finally, some students exhibited a certain resistance to change, preferring traditional teaching methods with which they are familiar. This resistance is based on the perception that virtual reality is a technology and not always necessary for learning.

7. Discussion

The results from the questionnaire and interviews reflect a nuanced view of virtual reality (VR) in higher education, particularly among students at the University of the Arts in Guayaquil. Although a significant portion of students shows basic knowledge and limited use of VR in educational contexts, perceptions of its impact are varied. These findings suggest that while some students value VR for its potential educational benefits, others see its effects as marginal or even problematic, as noted by Serrano (2023), who emphasizes that the lack of effective integration into educational programs can limit its impact.

Regarding knowledge and use of VR, the study reveals that most students have a basic familiarity with the technology and use it sporadically in their education. Despite 33.3% having prior knowledge of VR, only 27.8% actively use it in their current studies, and a notable 55.6% do not use it at all in their academic environment. This low level of adoption may be related to practical barriers, such as lack of infrastructure and adequate training, which aligns with the observations of Ruiz-Ariza et al. (2022), who point out that the effectiveness of VR largely depends on its proper implementation and the preparation of educators for its use.

The perception of VR in education shows a significant divide. While 33.3% of students believe that VR has a moderately positive impact, 44.4% consider its impact to be limited or minimal. This skepticism may be related to the identified barriers and the lack of effective integration of the technology into educational programs, as mentioned by Martínez (2024) and Angulo et al. (2023), who emphasize that resistance to new technologies, combined with insufficient training, can diminish the potential of VR to transform learning. Students' attitudes toward VR vary, with a balance between positive, neutral, and negative attitudes, reflecting an ambivalent reception of the technology in the educational context.

In terms of advantages and disadvantages, the study shows that while some students recognize significant advantages of VR, such as immersion and interactivity, these are counterbalanced by notable disadvantages. Technical issues, lack of adequate access, and the high investment required for the technology limit VR's potential. The critical perception of these disadvantages aligns with the observations of Sousa et al. (2021), who argue that despite the recognized benefits, practical obstacles such as the high cost of implementation and technological barriers remain significant challenges. This suggests that while VR has the potential to transform the educational experience, careful planning is required to overcome these impediments.

The semi-structured interviews corroborate these findings by providing a deeper

insight into individual experiences. Students who have had contact with VR appreciate its ability to offer immersive and dynamic learning, but they also face significant difficulties related to equipment malfunctions, high costs, and insufficient training. This situation reflects the observations of González et al. (2023), who highlight that inadequate training to handle these technologies can limit their impact on learning. Additionally, resistance to change among some students reinforces the need for a more effective strategy to introduce VR into the educational environment, as mentioned by Juca et al. (2020), who emphasize that the effective integration of immersive technologies depends on adequate preparation and an environment conducive to their adoption.

In conclusion, while VR has the potential to enrich university learning, its effective implementation is conditioned by several challenges. To maximize its impact, it is essential to address the identified barriers, such as lack of infrastructure, technical issues, and insufficient training. Improving access to appropriate resources and providing extensive training to students and educators are crucial steps for effectively integrating VR into higher education. This discussion underscores the need for strategies aimed at overcoming these obstacles and enhancing the benefits of virtual reality in the academic context, following the recommendations of authors such as Muñoz et al. (2021) and Betancurt et al. (2024), who argue that the success of VR in education depends on its proper planning and execution.

8. Conclusions

Based on the results obtained from the questionnaire and semi-structured interviews, several conclusions can be drawn that align with the objectives of this research, which aimed to analyze university students' perceptions of using virtual reality (VR) in higher education, considering their level of knowledge, current use, perceived advantages and disadvantages, and willingness to use this technology in the future.

Firstly, regarding the level of knowledge and use of VR, it is evident that while students have a basic understanding of this technology, its application in the educational environment remains limited and is not fully integrated into teaching processes. Although a significant portion of students acknowledges that VR has a moderately positive impact on education, many do not yet view it as an essential tool in their studies. This suggests that, despite its potential, VR has not yet reached a level of adoption that establishes it as a fundamental pedagogical tool in higher education.

Regarding perceived advantages and disadvantages, the results reveal diverse opinions. While some students highlighted the immersive and participatory capabilities of VR as a significant advantage, they also noted considerable disadvantages, such as recurrent technical problems, device malfunctions, and limited technological infrastructure. Additionally, the high cost associated with implementing VR was identified as a relevant obstacle. These limitations suggest that, although VR has great potential to transform the educational experience, its effective adoption and use depend on overcoming practical challenges that still prevail.

The semi-structured interviews provide valuable information that complements the results obtained from the questionnaire, offering a deeper analysis of students'

experiences and attitudes towards VR. It was found that perceptions of VR's usefulness and effectiveness vary significantly depending on prior access and training received. Students who have had direct experience with VR tend to view it more positively, whereas those with less exposure to this technology express skepticism about its applicability and effectiveness in the academic context.

Finally, regarding students' willingness to use VR in the future, the results suggest that while there is openness towards its use, it is imperative to overcome the previously identified technological and training barriers. Implementing strategies that address these shortcomings will be crucial for fostering greater acceptance and widespread use of VR in the academic realm.

In conclusion, virtual reality holds considerable potential to enhance the teaching-learning process in higher education, particularly in generating more immersive and participatory learning experiences that can significantly contribute to student understanding and engagement. However, its effectiveness is conditioned by the need to improve access to technological infrastructure, provide adequate training for both students and educators, and address technical and economic challenges. To maximize the benefits that VR can bring to higher education, it is crucial for educational institutions to implement strategies that mitigate these barriers and promote a more effective and integrated use of this technology in their academic programs.

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