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Assessment of the Impact of Virtual Reality on Empathy and Learning in University Students

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Abstract

This quasi-experimental study examined the effects of a virtual reality (VR) intervention on the empathy and learning of university students studying Law and Administration, using a random sample of 300 students, divided into an experimental group and a control group of 150 students each. The research was based on the potential of VR as an immersive educational tool. The students were randomly selected, and detailed demographic and academic information was collected from them. The experimental group participated in VR activities designed to promote empathy through experiential learning. Empathy was measured using the Interpersonal Reactivity Index (IRI), and academic performance was assessed through structured questionnaires before and after the intervention. The quantitative results revealed a significant increase in empathy levels and academic performance in the experimental group compared to the control group. Qualitative interviews and surveys confirmed these findings, highlighting a greater understanding and empathy towards others among participants in the VR activities. The VR intervention proved effective in enhancing empathy and learning, suggesting that integrating immersive technologies into the academic curriculum can offer significant benefits for the personal and academic development of students. Future research is recommended to explore the application of VR in other educational contexts and disciplines.

Keywords: *Virtual Reality (VR), Higher Education, Immersive Learning*

INTRODUCTION

In recent years, virtual reality (VR) has emerged as a cutting-edge technology with the potential to transform various sectors, including higher education. VR offers immersive experiences that can overcome the limitations of traditional pedagogical methods by providing interactive, three-dimensional environments that facilitate active and engaging learning.

The adoption of VR in higher education is increasing for several key reasons. VR allows students to fully immerse themselves in virtual environments, significantly enhancing their level of engagement and focus. This is particularly beneficial in disciplines that require high visualization and hands-on experimentation, such as medicine, engineering, and the natural sciences. According to Bailey & Bailenson (2017), VR enables students to participate in realistic simulations of complex situations that would be difficult, expensive, or dangerous to recreate in real life, thus facilitating experiential learning where students learn by doing and reflecting on their experiences. Additionally, as noted by López (2023), VR can be a powerful tool for developing transversal skills, such as empathy, by allowing students to experience situations from the perspectives of others, promoting deeper understanding and greater empathy towards others. Finally, VR offers the possibility of accessing educational resources from anywhere, democratizing education and making it more accessible to students from diverse geographical locations and socioeconomic backgrounds.

Recent studies, such as Palacios & López (2022), have highlighted that virtual reality (VR) has the potential to revolutionize higher education. According to their research, VR enables the creation of immersive learning environments that can enhance students' information retention and conceptual understanding. The literature

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indicates that VR provides an interactive three-dimensional space where students can safely and controlledly experience complex situations.

The advantages of VR in education are varied and significant. Sánchez et al. (2022) demonstrated that immersive VR environments increase student motivation and engagement, indicating that VR can significantly boost intrinsic motivation by making learning more appealing and exciting. Jensen and Konradsen (2018) found that VR's ability to offer practical and visual experiences facilitates a better understanding of abstract concepts, showing that students using VR have greater information retention compared to those using traditional methods. Riva et al. (2016) noted that VR allows simulations of situations that would be impossible or dangerous to recreate in the real world, which is particularly useful in fields like medicine, where VR practice can better prepare students for real-life scenarios.

VR not only enhances cognitive aspects of learning but also has the potential to develop socio-emotional skills such as empathy. The ability to "walk in someone else's shoes" is a key component of empathy, and VR can effectively facilitate this process.

Key studies on virtual reality (VR) and empathy have revealed significant findings in the educational realm. Bailenson (2021) demonstrated that VR can significantly increase empathy levels by allowing users to experience situations from the perspective of others; in their study, participants who used VR to experience life as a homeless person showed a notable increase in empathy towards the homeless. Herrera et al. (2018) found that VR experiences can have lasting effects on empathy, noting that participants who used VR to live through experiences of racial discrimination maintained heightened levels of empathy even weeks after the experience. Bertrand et al. (2018) emphasized that VR has been employed in various practical applications to foster empathy, including mental health, healthcare professional training, and education on diversity and inclusion, underscoring its potential as a cross-disciplinary educational tool.

Despite the numerous advantages of virtual reality (VR) in higher education, its implementation also presents significant challenges. Huang et al. (2019) pointed out that VR equipment can be costly and requires advanced technological infrastructure, which may limit accessibility for some educational institutions, particularly those with limited budgets. Additionally, Radianti et al. (2020) highlighted that both students and educators may require time and training to familiarize themselves with VR technology and effectively integrate it into the curriculum, implying a steep learning curve. Finally, Schutte and Stilinović (2017) underscored that while VR may enhance empathy in the short term, further research is needed to understand long-term effects and how these emotional improvements can be sustained in the educational context. These challenges must be addressed to maximize the potential of VR in higher education.

The existing literature highlights the significant potential of VR to enhance both learning and empathy in higher education. However, it is essential to continue researching to address challenges and maximize the benefits of this emerging technology. Understanding the specific impact of VR on university students will enable the development of more effective and equitable educational strategies.

The study will employ a quasi-experimental design to investigate the effects of a virtual reality (VR) intervention on empathy and learning in university students. An experimental group receiving the VR intervention will be compared with a control group. Participants, randomly selected from Law and Administration students, will engage in a VR experience integrated into courses on social or ethical topics over six weeks, aligned with the model by Riva et al. (2016). The Interpersonal Reactivity Index (IRI) will be used to measure empathy, and qualitative methods such as semi-structured interviews will capture perceptions and changes in empathy. Additionally, formative, summative assessments, and self-assessments tailored to each VR session will evaluate learning. This study aims to explore the potential impact of VR in higher education.

The research focuses on investigating how the implementation of virtual reality (VR) can impact the development of empathy and learning among university students in Law and Administration fields. The main objective is to analyze the effects of this intervention using a quasi-experimental design to contrast an

experimental group participating in VR activities with a control group not experiencing this modality, thus seeking to establish clear comparisons regarding its effects on participants.

Theoretical Framework

Virtual Reality (VR) and Augmented Reality (AR) are considered innovative technologies that can revolutionize higher education by providing immersive experiences that foster deep and meaningful learning. This theoretical framework analyzes the theoretical and conceptual principles supporting the use of VR and AR in higher education, focusing on creating immersive educational experiences that facilitate comprehensive learning.

Technology has become a fundamental element transforming numerous aspects of society today. According to Aksyonov et al. (2021), technological innovations are changing how people interact, learn, and work. The integration of artificial intelligence and ubiquitous connectivity has created interconnected digital ecosystems, significantly impacting the global economy and organizational structures. With technology advancing rapidly, understanding its implications in terms of privacy, security, equity, and its influence on shaping new social and cultural paradigms, as highlighted by Coccia (2019), is crucial. This study aims to analyze the impact of these technological trends on higher education, evaluating both their benefits and the challenges they present.

The educational realm has undergone constant changes due to the incorporation of technology in teaching and learning processes. Herranz & Sidorenko (2023) note that educational technology, defined as the use of digital tools in education, has significantly influenced the interaction between teachers and students, as well as the design of learning experiences. The increasing adoption of online learning platforms, as indicated by Huamán & García (2022), has provided flexibility in accessing content and promoted active student participation. According to Domínguez (2011), gamification has emerged as a pedagogical strategy integrating game elements into the educational environment to enhance student motivation and engagement. However, Carrillo (2023) points out that alongside benefits, challenges such as the digital divide perpetuate educational inequality by limiting access and technological competence. Additionally, concerns about data privacy and security on online learning platforms are highlighted by Calderón et al. (2020).

Constructivism, which emphasizes the active construction of knowledge by students, aligns with the capabilities of VR and AR, allowing students to interact and explore tangibly. Vargas & Acuña (2020) affirm that both constructivism and experiential learning are pedagogical approaches that foster active knowledge construction through direct participation and practical experience. From this perspective, Moreno & Pérez (2018) state that learning is a dynamic process in which students construct meanings from their experiences and prior knowledge, finding VR and AR to be fertile ground for this type of learning.

Mendoza et al. (2021) highlight that engagement and motivation are crucial aspects in the use of VR and AR. According to these authors, the immersive environments provided by these technologies can significantly transform how people interact with educational content, making it more participatory. By offering highly immersive and participative experiences, VR and AR can notably enhance user engagement, as immersion in first-person situations and scenarios allows users to develop a greater sense of connection and emotional involvement with the content, thereby fostering a higher level of commitment to learning and exploration.

The theory of situated learning, postulated by Jara (2020), argues that learning is more effective when conducted in authentic and meaningful contexts. These authors contend that VR and AR create virtual environments that simulate real-world scenarios, enabling students to practice knowledge transfer to concrete situations. For Barja et al. (2023), these immersive technologies offer unique opportunities to enhance the contextualization of learning and facilitate effective knowledge transfer to real-life situations.

To comprehend how innovative educational tools like virtual reality (VR) can significantly influence empathy development, other theories beyond experiential learning are explored.

Experiential Learning Theory: Experiential learning posits that knowledge is constructed through direct experience and reflection on those experiences (Kolb, 1984). This process, as outlined by Kolb (1984) cited by Sánchez (2021), includes concrete experience, reflective observation, abstract conceptualization, and active experimentation. This approach not only promotes deep and meaningful learning but can also enhance

empathy development by engaging students in practical activities that emotionally connect them to the situations and issues they study. VR, by simulating realistic contexts and enabling direct interaction, provides a conducive environment for this type of experiential learning and empathetic development.

Theory of Mind Perspective: The theory of mind perspective argues that empathy is rooted in the human capacity to adopt the mental perspective of others, enabling us to understand their thoughts, emotions, and experiences from their unique point of view. According to Baron-Cohen (1995) cited by Maldonado & Barajas (2018), this ability to interpret and share others' mental experiences is crucial for genuine empathy and can be influenced by innovative educational tools such as virtual reality (VR). VR facilitates the creation of immersive environments that can stimulate empathetic reflection by allowing students to experience and understand different perspectives in a more vivid and personal manner.

Theory of Mind and Empathy Theory:

The theory of mind examines how individuals develop the ability to infer and understand others' mental states, such as thoughts, emotions, and beliefs (Wellman, 1990 as cited by Zabala et al., 2018). In an educational context, VR can be an effective tool for cultivating this skill by offering scenarios where students must interpret and respond to the simulated emotions and thoughts of virtual characters. This practical interaction can enhance empathetic sensitivity by fostering a deeper and nuanced understanding of others' emotional experiences.

Simulation Theory: Simulation theory suggests that empathy can be developed through mental or experiential simulation of emotionally significant situations (Gallese, 2003; Goldman, 2006, cited by Hernández, 2008). VR, by creating immersive environments where users can experience and feel situations from different perspectives, facilitates this type of emotional simulation. This capability for deep immersion can strengthen empathy by allowing students to virtually experience how others feel, which is crucial for their personal and social development in an innovative educational context.

METHODOLOGY

The study was structured using a quasi-experimental design to examine the effects of a virtual reality (VR) intervention on empathy and learning among university students. According to Amores (2023), this design facilitated comparison between an experimental group, which experienced the VR intervention, and a control group without this intervention, thereby allowing the evaluation of changes before and after the experience. Participants were randomly selected from law and administration students at various higher educational institutions. Demographic data such as age, gender, and academic level, as well as academic information like grade point average and previous experience with educational technologies, were collected to contextualize the study's results.

The VR intervention consisted of an immersive experience designed to promote empathy through experiential learning, aligning with the model proposed by Rivadulla & Rodríguez (2020). This experience was integrated into the curriculum of courses related to social or ethical topics, spanning a duration of five weeks. Students participated in weekly sessions of one hour, engaging in interactive simulations designed to facilitate practical application of theoretical concepts.

The research adopted a mixed-methods approach, as suggested by Mostaza (2017), combining qualitative and quantitative methods to provide a comprehensive understanding of the studied phenomenon. This approach allowed for capturing both the depth of individual experiences and the breadth of numerical data, offering a more complete and accurate insight into the effects of the VR intervention on empathy and learning among university students. Quantitative methods facilitated obtaining statistical data on changes in empathy and academic performance, while qualitative methods, such as semi-structured interviews, allowed for exploring in detail the students' subjective experiences with immersive technology.

The study was of an applied nature; according to Castro (2018), this type of research is characterized by its focus on solving practical and specific problems, using theoretical knowledge to find solutions that can be implemented in real contexts. In this regard, the application of results to enhance practices, processes, or

existing systems was prioritized, thereby contributing to the optimization and advancement in the field of using virtual reality practically to improve specific competencies in educational contexts. The goal was not only to generate theoretical knowledge but also to provide concrete and applicable solutions to educational practice, aiming to directly influence students' academic and emotional development.

The VR intervention was designed to integrate concepts of empathy and experiential learning, following theoretical models as proposed by those who highlighted VR's capability to create immersive experiences that promote deeper and more empathetic understanding of educational content.

The scope of the research was descriptive and exploratory; according to Arévalo (2020), a descriptive approach allows detailing and documenting the characteristics of a specific phenomenon, providing a clear and precise understanding of its nature and functioning. When combined with an exploratory approach, it facilitates the identification of patterns, relationships, and key variables that may not have been previously considered. This combination of approaches enables a deeper and more comprehensive understanding of the study topic, laying the groundwork for future, more specific and detailed research.

Thus, the study meticulously described the observed phenomena, providing an accurate portrayal of how virtual reality impacted students. The reactions of students to VR experiences were documented, including how these experiences influenced their ability to empathize with others and their understanding of academic topics. Additionally, new areas of study were explored, identifying patterns, trends, and relationships that had not been previously documented, thereby contributing to expanding existing knowledge on the application of immersive technologies in education. This exploration included identifying variables that affected the effectiveness of VR in learning, such as session duration, simulation quality, and content relevance for students.

The methods employed included both documentary research and fieldwork. According to Zarco & Lloréns (2022), documentary research involves the review and analysis of secondary sources such as books, articles, reports, and other relevant documents, providing a solid theoretical and contextual framework. On the other hand, fieldwork allows for the collection of primary data directly from the studied environment, offering up-to-date and specific information. The combination of these methods ensures a comprehensive and robust approach, integrating both existing theoretical knowledge and direct observations of the phenomenon under study.

In this study, documentary research entailed a thorough review of existing literature on virtual reality, empathy, and experiential learning, providing a solid theoretical basis for the study. Previous studies demonstrating the effectiveness of VR in various educational contexts were analyzed, along with research exploring the relationship between empathy and experiential learning. Fieldwork involved the practical implementation of the VR intervention and the collection of data directly from students through surveys and interviews, enabling a direct and concrete evaluation of the intervention's outcomes. These methodologies allowed not only for measuring changes in empathy and learning but also for capturing students' perceptions regarding the usefulness and effectiveness of VR in their education.

This rigorous and systematic methodological approach enabled a profound and detailed understanding of the impact of virtual reality in the educational context, offering valuable insights for future research and practical applications in higher education. The findings of this research provided critical evidence on the benefits and challenges of integrating VR in higher educational settings, emphasizing the importance of considering factors such as the duration of interventions and the need for technical and pedagogical support to maximize the positive impact of this technology on students' learning and emotional development.

Techniques and Instruments

The research employed a variety of techniques and instruments to comprehensively and rigorously collect data. Below are detailed the main methods and tools used:

Data Collection Techniques

1. Structured Questionnaires for Surveys: Pretest and Posttest: Structured questionnaires were administered before and after the VR intervention to assess changes in students' empathy and learning. These questionnaires included items designed to measure various dimensions of empathy, using Davis's (1983) Interpersonal Reactivity Index (IRI), as well as specific questions about academic performance and understanding of theoretical concepts.

2. Semi-Structured Interviews: Teacher Satisfaction Interview: Following the intervention, semi-structured interviews were conducted to assess students' perceptions and experiences with the VR proposal. These interviews aimed to capture feedback and suggestions, as well as identify strengths and areas for improvement in the technology implementation.

3. Satisfaction Surveys: Post-Intervention Student Surveys: Satisfaction surveys were administered at the conclusion of the intervention to obtain a quantitative evaluation of students' experience with VR. These surveys included items on the quality of simulations, relevance of content, usability of the technology, and perceived impact on learning and empathy.

4. Formative Assessments:

During the Intervention: Formative assessments were not implemented throughout the VR sessions to monitor student progress and provide continuous feedback. These assessments did not include practical activities and tailored questionnaires for each session, which did not allow students to apply and reinforce theoretical concepts in an immersive environment.

Measurement Instruments

1. Interpersonal Reactivity Index (IRI): Empathy Assessment: The IRI, developed by Davis (1983), was used to measure individuals' capacity to understand and emotionally respond to others' experiences. This instrument consisted of four subscales assessing different dimensions of empathy: Cognitive Perspective Taking (PT), Empathic Concern (EC), Fantasy (FS), and Personal Distress (PD).

Learning Assessment Questionnaires: Pretest and Posttest The questionnaires designed to assess learning included questions about theoretical concepts taught in courses related to social or ethical issues. These assessments allowed for comparing the level of understanding before and after the VR intervention.

2. Semi-Structured Interview Guides: Development and Validation: Semi-structured interview guides were developed to explore teachers' experiences and perceptions in depth. These guides included both open-ended and specific questions about the utility of VR, the quality of simulations, and the impact on empathy and learning.

3. Surveys of Satisfaction: Design and Implementation: Satisfaction surveys were designed to evaluate various aspects of the VR intervention, including the technical quality of simulations, the relevance of content, and students' overall perception of VR effectiveness in their education.

These techniques and instruments allowed for a multifaceted and detailed understanding of the impact of virtual reality on empathy and student learning, providing both quantitative and qualitative data for a thorough and rigorous analysis.

Population and Sample

In the quasi-experimental study on the effects of virtual reality (VR) intervention on empathy and learning among university students, the total population consisted of 1000 students from various higher educational institutions, specifically from the fields of Law and Administration. Using a quasi-experimental design, a representative sample of 300 students was randomly selected. Among these, 150 were assigned to the experimental group that received the VR intervention, while the other 150 formed the control group without intervention. This methodology allowed for the comparison of effects before and after the experience, assessing changes in both empathy and academic performance.

This rigorous and systematic methodological approach enabled exploration of how virtual reality can significantly influence empathy and learning among university students. This study contributed to the emerging field of education based on immersive technologies, providing critical evidence on the benefits and challenges of integrating VR in higher educational settings.

Methodology of the proposal

<table>
<tr><th>Phase</th><th>Description</th></tr>
<tr><td>Preparation</td><td>Quasi-Experimental Design: A quasi-experimental design was established to compare an experimental group with VR intervention against a control group without intervention. The objective was to evaluate the effects of the intervention by observing changes before and after the experience, using statistical methods to analyze differences between both groups. According to Torres & Benachi (2018), the quasi-experimental approach is suitable for studies aiming to investigate the effects of an intervention under controlled conditions, such as the impact of virtual reality on empathy and learning among university students.</td></tr>
<tr><td></td><td>-Selection and Group Formation: Participants were randomly selected from specific fields such as Law and Administration. Initial training on the study and procedures. To conduct the selection and formation of groups in the research on the effects of virtual reality (VR) intervention on university students, we began with the random selection of participants from specific fields such as Law and Administration. This process ensured that the experimental and control groups were representative and comparable in demographic and academic terms. Subsequently, an initial training phase was implemented to orient participants about the study and the procedures involved. During these training sessions, detailed information was provided about the study's purpose, the nature of the VR intervention, as well as the roles and responsibilities of the participants. Clear educational materials were provided outlining the schedule of activities, expectations during intervention sessions, and evaluation methods. The primary goal of this preparation was to ensure that all participants fully understood the scope of the study, were prepared to actively participate in planned activities, and felt comfortable with the data collection and evaluation process. Through this strategy, we aimed to maximize student collaboration and engagement in the quasi-experimental study, thereby promoting the validity and reliability of the results obtained.</td></tr>
<tr><td></td><td>- Data Collection of Demographic and Academic Information: Detailed acquisition of data such as age, gender, grade point average, and previous experience with educational technologies. To carry out the collection of demographic and academic data in the research, detailed information was obtained from each participant. This included recording data such as age, gender, grade point average, and any relevant previous experience with educational technologies. During this phase, a structured questionnaire specifically designed to capture this information was utilized. Participants completed this questionnaire, providing precise and comprehensive responses, which allowed for a detailed profile of each student in terms of demographic characteristics and academic background. The main objective of this data collection was to provide a clear and relevant context for the research. These data were essential to properly characterize the study sample and ensure that the experimental and control groups were comparable in terms of relevant demographic and academic variables. Furthermore, these data facilitated the subsequent interpretation of the results obtained during the statistical and qualitative analysis of the research.</td></tr>
<tr><td>Intervention</td><td>- Implementation of VR Intervention: Execution of activities designed to promote empathy through experiential learning. To implement the virtual reality (VR) intervention, a series of specific activities were designed and carried out aimed at promoting empathy through experiential learning.
<table>
<tr><th>Activity</th><th>Description</th></tr>
<tr><td>Introductory Session</td><td>Presentation of the study's purpose and specific objectives related to social and ethical issues relevant to Law and Administration students.</td></tr>
<tr><td>Legal Case Simulations in VR Implementation of VR</td><td>sessions that simulated complex legal scenarios where ethical and legal decisions related to law and administration were required.</td></tr>
<tr><td>Ethical Debates and Guided Discussions</td><td>Organization of debates and case-based discussions on ethical dilemmas presented in virtual environments, fostering critical analysis and reflection on specific moral dilemmas in law and administration.</td></tr>
<tr><td>Case Study on Management and Leadership</td><td>Using VR to study practical cases of management and leadership in ethical and social contexts, exploring decision-making and corporate responsibility in the fields of law and administration.</td></tr>
<tr><td>Evaluation and Impact Analysis Final</td><td>evaluation of VR sessions and analysis of their impact on ethical and social understanding related to Law and Administration, using specific criteria adapted to the educational context of Law and Administration.</td></tr>
</table>
These activities were carefully planned and executed following the model proposed by Riva et al. (2016), which emphasizes VR's ability to create immersive experiences that facilitate a deeper and more empathetic understanding of educational content. During this implementation phase, virtual environments were used to simulate situations that required empathetic responses from participants. These simulations were integrated into the curriculum of courses related to social or ethical themes, ensuring that the content was relevant and applicable to the educational context of Law and Administration students.
Each virtual reality session was structured to provide participants with an interactive and immersive experience, where they could apply theoretical concepts through simulated practical situations. The goal was to foster not only cognitive learning but also emotional development through empathy induced by immersion in virtual environments.</td></tr>
</table>

	These activities were executed under constant supervision and guidance, ensuring that the intervention was effectively implemented and that participants could maximize the educational and emotional benefits of virtual reality as a pedagogical tool. These specific activities were designed to address relevant issues in the fields of law and administration, using virtual reality as a tool to enhance the understanding and practical application of ethical and social concepts in these domains.
Evaluation	**- Measurement of Empathy:** Utilization of the Interpersonal Reactivity Index (IRI) to assess participants' ability to understand and emotionally respond to others. To measure empathy in the context of research on the impact of virtual reality on university students' learning and empathy, the Interpersonal Reactivity Index (IRI) was employed. Developed by Davis in 1983, this instrument was chosen for its ability to evaluate how individuals understand and emotionally respond to others' experiences. The IRI is structured into multiple subscales that encompass cognitive and emotional aspects of empathy, including perspective-taking, empathic concern, and personal distress. In the study, the IRI was administered at two key points: first, before the virtual reality (VR) intervention, and then after completing the intervention. This methodology allowed not only to establish an initial baseline of participants' empathy but also to measure any changes in this ability after exposure to immersive VR experiences designed to promote empathy. The procedure involved administering the questionnaire to all study participants, both the experimental group that received the VR intervention and the control group that did not. This comparison between groups facilitated the assessment of the specific effects of the intervention on empathy, helping to identify significant differences in empathic capacity between the two groups. Data obtained from the IRI were quantitatively analyzed to determine the magnitude and direction of any observed changes in university students' empathy. This statistical analysis provided crucial insights into the effects of the VR intervention on the development of empathic skills, highlighting the utility of the IRI as a reliable and valid measurement tool in an educational context. Additionally, the limitations and strengths of the IRI were considered within the study, ensuring an informed interpretation of the results and providing recommendations for future research on the use of virtual reality to enhance empathy in higher education settings.
	- **Formative and Summative Assessments**: Application of tailored assessments to measure learning during the VR intervention, providing continuous feedback. To implement Formative and Summative Assessments during the virtual reality (VR) intervention, various types of assessments were designed and applied specifically to measure participants' learning throughout the study. Formative Assessments played a crucial role in each VR session, serving as a tool to assess immediate and ongoing student learning. These assessments focused on verifying understanding of theoretical concepts discussed during immersive activities, tailored to the specific content and educational objectives of each session. On the other hand, Summative Assessments were administered upon completion of the entire intervention. Designed to evaluate overall learning achieved during the entire experience, these assessments offered a comprehensive view of VR's impact on participants' knowledge and skills acquired. They helped consolidate learning outcomes and provided conclusive data on the effects of VR on students' academic performance. Both types of assessments were essential in providing consistent and meaningful feedback on student progress throughout the research. Moreover, they played a crucial role in effectively measuring educational outcomes resulting from the VR intervention, thereby contributing to a comprehensive understanding of how this immersive technology can influence learning and academic development in higher education settings.
Analysis	- **Statistical Analysis:** Various statistical tests were employed to compare significant differences in empathy and academic performance between the experimental and control groups. To conduct the statistical analysis, various statistical tests designed to compare significant differences in empathy and academic performance between the experimental group (which received the virtual reality intervention) and the control group (which did not receive the intervention) were utilized. These tests rigorously and objectively assessed the effects of the VR intervention on the study participants. Initially, a descriptive analysis of relevant variables was conducted, including measures of central tendency and dispersion for each group. Subsequently, inferential tests such as t-tests or Wilcoxon-Mann-Whitney tests were applied to compare differences between groups in terms of empathy measured by the Interpersonal Reactivity Index (IRI) and academic performance assessed through formative and summative evaluations. The use of these statistical tests allowed determining whether the observed differences between groups were statistically significant, thus providing objective evidence on the effects of VR intervention on the study objectives. The results obtained were crucial for accurately interpreting the findings and drawing well-founded conclusions about the effectiveness of virtual reality as an educational tool in the investigated context.
Conclusions	- **Interpretation of Results:** Discussion of the observed effects of the VR intervention on empathy and learning, integrating quantitative and qualitative findings.
	- Implications and Recommendations: Exploration of practical implications for higher education and formulation of recommendations for future research on the effective use of immersive technology in education.

Source: Own elaboration

RESULT AND FINDINGS

The analysis of data obtained in the study reveals the effects of virtual reality (VR) intervention on empathy and learning among university students. The main findings are presented below, based on the comparison of measurements before and after the intervention, as well as the interpretation of subjective perceptions

gathered through interviews and surveys. These results provide a comprehensive understanding of the impact of immersive technology in the educational context and its implications for teaching and academic development.

Pretest Results

In the structured questionnaire used to measure empathy based on the Interpersonal Reactivity Index (IRI), several significant negative outcomes were observed among participants. Particularly, a considerable proportion indicated frequent difficulties in understanding others' feelings, suggesting a potential lack of empathetic skills developed in this area. This finding is crucial for identifying educational intervention points that can enhance individuals' ability to empathize more effectively with others, thereby improving interpersonal relationships and emotional understanding.

Section 1 Demographic Information

Variable	Mean
Age (years)	21.5
Gender	52% Male, 45% Female, 3% Other
Career / Field of study	53% Law, 47% Administration
Academic Year	2 year

Source: Own elaboration

Section 2 Assessment of Empathy (Interpersonal Reactivity Index - IRI)

Questions	Negative Responses (%)
1. I often have difficulty understanding other people's feelings.	20%
2. I can easily understand how others feel.	10%
3. I often worry a lot about less fortunate people than myself.	15%
4. I feel deeply affected when I see someone in trouble.	5%
5. Sometimes I find it difficult to see things from another person's perspective.	25%

Source: Own elaboration

The data shows that, overall, a significant proportion of students reported difficulties in empathy, especially in understanding other people's feelings (20%) and seeing things from another person's perspective (25%). In contrast, a smaller proportion of students indicated difficulties in being deeply affected by others' problems (5%) and caring for less fortunate individuals (15%). These results suggest specific areas where educational programs could focus to enhance empathic skills among students.

Section 3 Assessment of Learning and Understanding

Questions	Negative Responses (%)
1. I feel that I understand the theoretical concepts discussed in class well.	15%
2. I consider myself someone who quickly learns new academic topics.	20%
3. I believe that my academic performance could improve with new educational tools.	10%

Source: Own elaboration

The results indicate that the majority of students expressed a positive perception regarding their understanding of theoretical concepts (85% in agreement), although a significant minority felt they could improve their speed in learning new academic topics (20% disagreed). Furthermore, most believe that new educational tools could enhance their academic performance (90% in agreement). These findings suggest an interest in continuous learning improvement and a willingness to adopt new educational methodologies to enhance academic performance.

Following the implementation of the pretest and analysis of the results, a proposal for virtual reality (VR) intervention was introduced. To assess the effectiveness of this intervention, a posttest was administered, again using the Interpersonal Reactivity Index (IRI) to measure changes in students' empathy. Additionally, satisfaction surveys and interviews were conducted to gather additional data on participants' perceptions and experiences with the immersive technology. The results obtained from these evaluations provided a comprehensive insight into the impact of the intervention on the empathy and learning of university students.

Results of the Posttest

Structured Questionnaire for Posttest (It is divided by sections)

The results of the posttest from the structured questionnaire on learning and comprehension demonstrated a positive receptiveness among participants in the group with the educational intervention. The majority of students showed a solid understanding of the theoretical concepts discussed in class, indicating a high level of agreement with this assertion. Additionally, a significant proportion expressed confidence in their ability to quickly absorb new academic topics, signaling a positive attitude towards knowledge acquisition. This disposition was also reflected in the overall perception that the implementation of new educational tools could benefit their academic performance, highlighting a strong commitment to continuous improvement in their learning process. These findings indicate a solid foundation of understanding and motivation among the evaluated students regarding their academic performance and study methods.

Section 2: Empathy Evaluation (Interpersonal Reactivity Index - IRI)

Questions	Positive Responses (%)
1. I often have difficulty understanding the feelings of other people.	80%
2. I can easily understand how others feel.	70%
3. I often worry a lot about people less fortunate than myself.	85%
4. I feel deeply affected when I see someone in trouble.	75%
5. Sometimes I find it hard to see things from another person's point of view.	60%

Source: Own elaboration

The results show a significant positive trend among students regarding their empathic abilities. The majority indicated that they often understand the feelings of others (80%) and care about those less fortunate (85%). Additionally, a considerable proportion stated that they were deeply affected when seeing someone in distress (75%). However, approximately 60% acknowledged that they sometimes find it difficult to see things from another person's perspective, highlighting a potential area for developing empathic skills. These findings suggest a strong foundation of empathy among students, with opportunities to enhance empathic perspective in specific situations.

Section 3: Learning and Understanding Assessment

Questions	Positive Responses (%)
1. I feel that I understand the theoretical concepts discussed in class well.	85%
2. I consider myself someone who quickly learns new academic topics.	75%
3. I believe that my academic performance could improve with new educational tools.	90%

Source: Own elaboration

The results indicate a predominantly positive trend among students regarding their learning and academic performance. The vast majority feel they understand the theoretical concepts discussed in class well (85%)

and believe they could benefit from new educational tools to improve their academic performance (90%). Furthermore, a significant proportion considers themselves capable of quickly learning new academic subjects (75%). These findings suggest widespread confidence in the comprehension and learning abilities of the evaluated students, supporting the perceived effectiveness of the implemented educational strategies.

Following the intervention, the results from satisfaction surveys and interviews revealed a positive response among participants. The majority expressed satisfaction with the use of virtual reality (VR) to enhance their learning experience and develop empathy skills. Participants highlighted the immersive nature of VR simulations, mentioning they found them engaging and beneficial for understanding complex social and ethical issues discussed in their courses. Moreover, they indicated an increased interest in continuing to use VR as a learning tool, emphasizing its potential to positively impact both their academic and personal development. These findings underscore the promising role of VR in education and its potential future applications for fostering empathy and improving learning outcomes.

Results of Satisfaction Survey on Virtual Reality Intervention

Based on the positive responses from the 150 surveyed students who participated in the educational intervention, the overall conclusions highlight high satisfaction and positive perception regarding the virtual reality (VR) intervention. Generally, students expressed being highly satisfied with the experience and the outcomes achieved, emphasizing VR as a powerful educational tool that not only enhanced their academic understanding but also their ability to approach ethical and leadership situations in a more empathetic and effective manner.

1. How clear did you find the purpose and objectives of the study presented in the introductory session?

For the majority of the 150 participating students, the purpose and objectives of the study presented in the introductory session were considered very clear. During this session, a detailed and accessible explanation was provided on how the virtual reality (VR) intervention could impact their learning and personal development in ethical and social issues relevant to their studies. This initial clarity allowed them to quickly grasp the context and importance of the study, facilitating their active engagement and informed participation throughout the research.

2. How would you rate the quality of the initial training on the study and procedures?

For the vast majority of the 150 surveyed students, the quality of the initial training on the study and procedures was rated as excellent. During this phase, detailed and understandable guidance was provided that allowed them to fully familiarize themselves with the purpose of the study, the methods of virtual reality (VR) intervention, and their roles within the research process. Educational materials were clear and well-structured, facilitating a deep understanding of what was expected of them throughout the study. This robust initial training significantly contributed to their confidence and readiness to actively participate in all stages of the research project.

3. How useful did you find the information provided about the VR intervention and its roles and responsibilities?

For the majority of the 150 participating students, the information provided about the virtual reality (VR) intervention and its roles and responsibilities was highly valued. During the initial phase of the study, they were offered a detailed and clear explanation of how VR would be integrated into their learning, as well as specific expectations for their participation. This information enabled them to fully understand how their involvement in VR activities would contribute to enhancing their understanding of ethical and social issues relevant to their studies in law and administration. Furthermore, it provided them with the clarity needed to effectively assume their responsibilities, ensuring active and committed participation in the research project.

4. How effective did you find the VR intervention in promoting empathy through experiential learning?

For the vast majority of the 150 participating students, the virtual reality (VR) intervention was perceived as highly effective in promoting empathy through experiential learning. The VR sessions provided immersive environments where they could confront complex ethical and social situations safely and reflectively. These experiences not only enhanced their theoretical understanding but also allowed them to emotionally experience the implications of their decisions, thereby fostering greater empathy towards diverse perspectives and realities. The effectiveness of these interventions was reflected in the deep and enriching discussions that arose during the VR activities, underscoring their value for the comprehensive development of ethical and social skills within the context of their law and administration studies.

5. How satisfactory did you find the simulations of legal cases and guided discussions in VR?

For the majority of the 150 participating students, simulations of legal cases and guided discussions in virtual reality (VR) were highly satisfactory. These activities not only complemented their theoretical learning with realistic practical applications but also provided an interactive and stimulating space to explore ethical and legal dilemmas in depth. The simulations allowed them to confront complex scenarios where they had to make critical decisions, while guided discussions in virtual environments facilitated detailed and reflective analysis of the ethical implications of their actions. This combination of hands-on experience and critical reflection significantly contributed to their understanding of law and administration, enriching their learning comprehensively and satisfactorily.

6. How well-structured did you find the VR sessions for studying practical management and leadership cases?

For the vast majority of the 150 participating students, VR sessions designed to study practical management and leadership cases were very well-structured. These sessions provided an immersive and highly interactive environment where they could apply learned theories and concepts to real-life situations practically and engagingly. The session structure allowed for a logical progression of topics, from introducing cases to deeply discussing strategies for ethical management and leadership. Additionally, VR facilitated active learning by simulating complex scenarios that challenged their ability to make informed and ethical decisions. This methodology not only strengthened their theoretical understanding but also enhanced their critical analysis skills and problem-solving abilities in business and leadership contexts, providing a meaningful and well-structured educational experience.

7. Overall, how satisfied are you with the experience and results of the VR intervention?

Overall, the majority of the 150 participating students were very satisfied with the experience and results of the virtual reality (VR) intervention. The opportunity to engage in immersive sessions that integrated VR technology with practical learning on complex subjects like management and leadership was highly valued. Students highlighted that VR not only enhanced their theoretical understanding but also enriched their educational experience by allowing them to tackle practical challenges in a safe and realistic environment. Furthermore, they expressed that the intervention helped them develop key skills such as ethical decision-making and effective management in simulated settings, significantly contributing to their academic and professional preparation. In summary, most students found the VR intervention to be a satisfying experience that effectively complemented their learning in a memorable way.

Satisfaction Interview

Based on the positive responses from the 7 interviewed teachers, the overall conclusions indicate a favorable evaluation of the quasi-experimental design used in the research. Teachers mostly rated it as effective or very effective, highlighting its ability to compare groups under controlled conditions and analyze changes before and after the virtual reality (VR) intervention. Collectively, these findings support the effectiveness and relevance of the VR intervention in the educational context as evaluated by the interviewed teachers.

1. How do you evaluate the quasi-experimental design used in this research?

The quasi-experimental design utilized in this research was highly effective. This approach allowed for a rigorous and controlled comparison between the experimental group, which received the virtual reality

intervention, and the control group, which did not. By observing changes before and after the experience and using statistical methods to analyze differences between the groups, the effects of the intervention could be accurately assessed. The structure and rigor of the quasi-experimental design were crucial in ensuring the validity and reliability of the results obtained, thus enabling a profound understanding of the impact of virtual reality on the empathy and learning of university students.

2. How clear was the information provided during the selection and group formation phase?

The information provided during the selection and group formation phase was very clear. Right from the start, detailed guidance was offered on the study's purpose, the procedures to be followed, and the roles of participants. Educational materials distributed clearly outlined the schedule of activities, expectations during intervention sessions, and evaluation methods. This clarity in communication not only helped participants fully understand the scope of the study but also facilitated their preparation and active participation in planned activities. As a result, all involved felt comfortable and well-informed throughout the process.

3. How would you rate the relevance of collecting demographic and academic data for this study?

The collection of demographic and academic data for this study was highly relevant. By obtaining detailed information on age, gender, grade average, and prior experience with educational technologies, a clear and comprehensive profile of each participant was achieved. This approach ensured that the experimental and control groups were comparable in terms of essential demographic and academic variables. Furthermore, this data provided valuable context for interpreting the results, allowing for a more precise assessment of the impact of the virtual reality intervention. In summary, the relevance of this data collection was crucial for the validity and reliability of the study's findings.

4. How effective do you consider the virtual reality (VR) intervention in promoting empathy among students?

They considered the virtual reality (VR) intervention highly effective in promoting empathy among students. The activities designed, based on immersive simulations of situations requiring empathetic responses, allowed participants to deeply experience and understand diverse perspectives. VR's ability to create interactive and immersive environments facilitated not only theoretical learning but also emotional development, fostering genuine empathetic connections. This innovative methodology proved to be a powerful tool for enriching students' education and personal development.

5. How would you evaluate the implementation of specific activities (simulations, debates, case studies) during the VR intervention?

They evaluated the implementation of specific activities during the VR intervention as excellent. The simulations, debates, and case studies were meticulously designed to offer a rich and profound learning experience. Each activity was carefully structured to encourage active student participation and facilitate a solid understanding of the concepts addressed. Legal case simulations and ethical debates provided an interactive environment that promoted critical thinking and reflection. This effective and well-planned implementation of activities significantly enriched the educational process, demonstrating a high level of quality and relevance.

6. How useful was the Interpersonal Reactivity Index (IRI) in measuring participants' empathy?

The Interpersonal Reactivity Index (IRI) was considered highly useful by the instructors for measuring participants' empathy. This instrument provided a detailed and accurate assessment of students' empathic abilities, enabling a deep understanding of how virtual reality intervention influenced their emotional and cognitive development. The structure of the IRI, with its various subscales covering multiple aspects of empathy, facilitated comprehensive and reliable measurement, which was crucial for the validity of the study's results. Instructors valued the utility of the IRI as a key tool for obtaining meaningful and relevant data on the effects of the intervention.

7. How suitable were formative and summative assessments in measuring learning during the VR intervention?

Formative and summative assessments were considered highly suitable by the instructors for measuring learning during the VR intervention. These assessments provided continuous and detailed feedback on students' progress, allowing for real-time adjustments and optimization of teaching activities. The structure of formative assessments facilitated the identification of areas for improvement during VR sessions, while summative assessments offered a comprehensive view of the learning achieved by the end of the intervention. Instructors appreciated the accuracy and relevance of these tools, highlighting their essential role in validating the educational outcomes of the study.

Comparison Table

Group	Number of classes	Percentage of Grades (%) in the 5 Classes Seen	Comparison
Grupo A (Represents the group that received classes with augmented reality)	5	9-10	Students in this group scored in the range of 9 to 10
Grupo B (Represents the group that received traditional classes)	5	6-7	Students in this group scored in the range of 6 to 7

Source: Own elaboration

DISCUSSION

In recent years, virtual reality (VR) has garnered attention in higher education for its ability to transform the way teaching and learning occur. This technology offers immersive environments that surpass the limitations of traditional methods by providing interactive, three-dimensional experiences. As noted by Sousa et al. (2021), VR allows students to engage in realistic simulations and practical experiences, which is particularly valuable in disciplines requiring high visualization and hands-on experimentation such as medicine and engineering. Moreover, VR facilitates experiential learning by enabling students to reflect on their experiences, thereby promoting deeper and more meaningful learning.

Schroeder (1993), as cited by Amores (2023), emphasizes that VR in higher education enhances information retention and conceptual understanding by offering learning environments that are immersive and highly interactive. These environments not only facilitate the safe exploration of complex situations but also foster a greater emotional connection with educational content. Calderón et al. (2020) have demonstrated that students using VR exhibit higher information retention, suggesting that the technology can optimize the teaching-learning process by enhancing the understanding of abstract concepts through practical experiences.

Virtual reality (VR) not only benefits cognitive aspects of learning but also holds significant potential for developing socioemotional skills such as empathy. According to Fallas (2017), VR's ability to allow users to experience others' perspectives can notably increase empathy levels. This capability to see through another's eyes is crucial for developing a deeper, more empathetic understanding of diverse social and cultural realities, as highlighted in studies such as Rivadulla & Rodríguez (2020). These studies underscore how VR can sensitize students to complex issues and foster stronger empathetic attitudes.

Despite its benefits, implementing VR in higher education faces significant challenges. Palacios et al. (2022) warn about high costs and the need for advanced technological infrastructure, which may limit accessibility for some educational institutions. Radianti et al. (2020) also point out the learning curve for both students and educators, emphasizing the need for proper training and time to effectively integrate VR into the educational

curriculum. Furthermore, Fallas (2017) stresses the importance of further research into the long-term effects of VR on students' emotional and social development, highlighting the need to address these challenges to maximize VR's potential in higher education.

The discussion of the results obtained from the Satisfaction Survey on Virtual Reality Intervention reflects an extremely positive perception from participating students. The overall high satisfaction and positive perception highlight the effectiveness of virtual reality (VR) as a powerful educational tool. Students expressed a high degree of satisfaction with the experience and outcomes, emphasizing how VR not only enhanced their academic understanding but also strengthened their skills in ethical and leadership areas empathetically and effectively. This enthusiastic response suggests that integrating VR into the educational environment could be crucial for enriching the learning experience and developing critical competencies for students' future professional endeavors.

On the other hand, the results from the Satisfaction Interview with teachers also support the effectiveness of VR intervention, albeit from a different methodological and evaluative perspective. Teachers positively evaluated the quasi-experimental design used in the research, emphasizing its ability to compare groups under controlled conditions and analyze changes before and after intervention. This approach allowed for a rigorous assessment of VR's impact on students' learning and empathy, providing solid evidence of this technology's effectiveness as a pedagogical tool. Overall, both students and teachers valued VR as a promising educational innovation that not only enhances academic learning but also fosters the comprehensive development of social and ethical skills necessary in today's educational context.

CONCLUSION

The assessment of virtual reality's (VR) impact on empathy and learning among university students reveals significant and promising results. Through various research studies, it has been demonstrated that VR provides an immersive environment that enhances not only academic understanding but also fosters the development of key emotional and social skills, such as empathy. These virtual experiences enable students to interact with complex and realistic situations where they must make ethical decisions and confront dilemmas that require empathetic responses. VR's ability to simulate diverse and challenging contexts in a safe and controlled environment amplifies its educational impact by providing experiential practice that complements traditional theoretical learning.

Furthermore, the research underscores that VR not only facilitates cognitive understanding of ethical and social concepts but also strengthens students' emotional connection to the topics studied. These immersive experiences not only increase empathy towards different perspectives and realities but also enhance students' ability to relate to others more comprehensively and effectively in professional and academic environments. This aspect is crucial in an increasingly interconnected and diverse world where the ability to empathetically understand and respond to others' needs and concerns is fundamental for personal and professional success.

On the other hand, studies have emphasized the importance of the structure and design of VR activities in achieving positive educational outcomes. Case simulations, guided debates, and practical case studies are key elements that have proven effective in developing leadership, management, and ethical decision-making skills among students. These activities not only reinforce academic learning through the practical application of theories and concepts but also foster critical and reflective analysis essential for the comprehensive education of future professionals.

Furthermore, the evaluation of VR's impact has underscored the need for adequate preparation and training for both students and educators. The successful integration of VR into the educational curriculum requires not only advanced technology and appropriate resources but also pedagogical guidance that effectively directs students in the use and application of this tool. Initial and ongoing training for teaching staff is crucial to optimize the use of VR in the classroom, ensuring that educational benefits are maximized and potential barriers or challenges minimized.

The assessment of VR's impact on empathy and learning among university students confirms that this emerging technology has the potential to revolutionize education by offering more immersive, effective

learning experiences focused on the holistic development of cognitive, emotional, and social skills. As research and practical implementation of VR in educational settings advance, it is crucial to continue exploring and adapting these tools to fully leverage their benefits in preparing students for the challenges of the 21st century.

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