

Impact of Virtual Reality and Immersive Learning on Higher Education in Peru

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The aim of this research was to evaluate the influence of using virtual reality to enhance university education among Peruvian students. A quasi-experimental design with comparative groups was used, applying a pre-test and post-test to measure the impact of virtual reality on the learning process. The sample included 40 undergraduates, categorized into an experimental group that used virtual reality and a control group that maintained conventional pedagogical approaches. The outcomes displayed that after the intervention, the experimental section demonstrated significant improvements in levels of efficiency in immersive, observational, and experiential learning, indicating that virtual reality promotes greater interaction with content, autonomy in learning, and decision-making in simulated environments. In conclusion, virtual reality proved its ability to improve academic performance and the development of critical skills for professional training. Despite technological challenges, the adoption of this technology in Peruvian higher education has the prospect to reform teaching, yielding students with more dynamic and personalized educational experiences in line with labor market demands.

Keywords: Higher Education, Immersive Learning, Pedagogical Innovation, Professional Skills, Virtual Reality.

1. Introduction

University education has traditionally been an area where teaching methods have remained static over time, with a predominance of lectures, readings, and theoretical evaluations (Espino et al., 2023). Although these methodologies have been effective in certain contexts, they sometimes present limitations when it comes to generating an immersive and dynamic skill-building experience that is adjusted to the particular characteristics and needs of

students (Mejía & Mejía, 2021). In a more digitized world, today's students expect their educational process not only to transmit knowledge but also to actively engage them in order to develop essential skills for their professional future (Jackson & Bridgstock, 2021; Bergdahl et al., 2020).

In this context, emerging technologies have begun to be a cornerstone role in the evolution of pedagogical strategies (Aparicio et al., 2024; Almufarreh & Arshad, 2023). Among these, virtual reality stands out for its ability to create immersive educational environments that allow students to interact directly with content, thus facilitating a deeper and more practical understanding of concepts (Di Natale et al., 2020; Guerra, 2023). This type of technology not only transforms how knowledge is accessed and assimilated but also enables scenarios that would be difficult to replicate in a physical or traditional setting, such as the simulation of complex experiments, virtual visits to remote locations, or recreating historical events (Rojas et al., 2023).

The potential of virtual reality is not limited to its ability to represent realistic environments; it also promotes adaptive learning methods that can be tailored to each student's specific needs (Correia et al., 2021). This personalization is key in an educational environment where students not only seek to absorb information but expect to do so in a way that is relevant to their own learning process (Radianti et al., 2020; Lin et al., 2024).

For example, VR allows students to explore subjects at their own pace, repeating activities or simulations until they master the concepts, which is valuable for those with different learning styles or who need more time to absorb certain content (Valladares et al., 2023; Yang et al., 2023). At the same time, the constant interaction and immediate feedback offered by VR facilitate more autonomous learning, where students become the protagonists of their own educational process (Wang et al., 2022).

Another key feature of virtual reality is its proficiency to foster collaborative comprehension, where students can interact with each other, work on common projects, and even solve complex problems together, all within a shared space regardless of their physical location (Van de Meer et al., 2023; Abdullah et al., 2019). This not only expands the boundaries of collaboration but also develops fundamental skills for future careers, such as teamwork, communication, and conflict resolution (Harrington et al., 2018). For this reason, virtual reality not only adapts to individualized teaching but also strengthens group dynamics, aspects that are increasingly valued (Cao et al., 2023).

Additionally, VR has the potential to increase student motivation and engagement (Allcoat & Von Muhlenen, 2018; Sowells, 2023). Immersive environments, being highly interactive, capture students' attention in a way that traditional methods do not always achieve (Portuguez & Santos, 2024; Ghanbaripour et al., 2024). This can spark greater interest in the content, leading to more active participation and, consequently, greater long-term knowledge retention (Boulton et al., 2019). The intrinsic motivation generated by virtual reality could positively impact academic performance by turning learning into a meaningful experience connected to students' interests (Lund & Wang, 2019; Jiang & Fryer, 2023).

Despite this enormous potential, the adoption of virtual reality in university education has not yet been widespread, due to challenges associated with technological infrastructure,

teacher training, and curriculum integration (Floriano et al., 2024; Rondon, 2020; Martínez & Garcés, 2020). However, an even more decisive factor is the lack of empirical evidence that conclusively demonstrates the impact of VR on academic performance and the development of student competencies.

In the case of higher education institutions in Peru, the implementation of VR remains in its early stages. Although some universities have begun exploring its use, the absence of quantitative studies evaluating its effectiveness limits its widespread adoption. Therefore, it is necessary to conduct research that helps to understand how VR can influence observational and experiential learning, and whether it can truly transform university education in a significant way.

The present study aims to evaluate the influence of virtual reality on improving university education among Peruvian students. It is important to consider that the incorporation of emerging technologies like VR presents teaching-learning opportunities and faces challenges related to technological infrastructure, teacher training, and curricular adaptation. Additionally, this study seeks to contribute theoretically by demonstrating that VR enables deeper and more interactive learning, overcoming the limitations of traditional methods, and socially, as it can help reduce access gaps to quality educational experiences by offering students immersive learning opportunities that were previously inaccessible. Methodologically, it justifies the need to generate empirical evidence in the Peruvian context, where the adoption of this technology is still in its early stages.

2. Literature Review

Virtual reality (VR) is a technical advancement that provides audience to submerge themselves in three-dimensional, software generated spaces with a high capacity for real-time interaction. In the educational field, its ability to enhance the learning experience by allowing students to explore abstract or complex concepts through simulations has been investigated (Hu-Au, 2024; Safadel & White, 2020). VR has proven effective in disciplines that require a high degree of visualization, such as medicine, engineering, and architecture (Sung et al., 2024; Ayoub & Pulijala, 2019). Its potential has also been explored in the humanities and social sciences, where the recreation of historical contexts can improve the understanding of the studied environment (Checa & Bustillo, 2020).

From another perspective, Zhang et al. (2024); Yang et al. (2024) mention that virtual reality, as the electronic processing of components, seeks to accomplish the identical effects as physical reality elements by isolating people from physical surroundings through specialized equipment pieces. In this way, digital mechanism and gadgets are core features of VR that may be employed in the learning space to provide apprentices closer to real-world instruction.

Moreover, VR enhances competencies from technological framework for assorted fields of insights in a beneficial process in fact. In accordance with Achuthan et al. (2021), in the guiding of natural studies, platforms ease the perception and cooperation with digital elements and the application of lab devices in a guarded environment with no negative outcome. On the flip side, Mystakidis et al. (2021) define within the context of societal

theory fields, that technical advancements like VR boost career competencies and furnish realistic educational engagements. Hence, the implementation of these techniques is useful for the diverse paths in which university students learn, especially in content dynamics which demand hands on practice and a method of engaging with knowledge grounded in realness. In other words, under these circumstances, digital solutions serve as purposeful resources that permits educators to incorporate concepts into real scenarios, and embedded in a digital realm, suggest independent and collective education based on obstacles or endeavors.

Gao et al. (2021); Fussell & Truong (2021) specify that virtual reality represents possibilities for establishing innovative and varied perspectives to exchange and dialogue, meaning that these tools can revitalize understanding and, in turn, allow students to learn in different ways and through various tools. Furthermore, Kiryakova & Kozhuharova (2024); Basilotta et al. (2022) argue that employing technological solutions facilitates the integration of resources and the capabilities developed through online competencies. So, it is reviewed that the integration of VR in cognitive development represents progress in students' knowledge. However, it requires teachers to incorporate technological tools and, more importantly, to grasp them in a way that ensures their integration into the classroom is effective and impactful. Therefore, immersive experience holds academic growth for higher education students in a way that its implementation contemplates progressive teaching approaches. Nevertheless, it is indispensable for educators to recognize and develop online competencies that enable them to generate meaningful educational methods.

To build on this concept, Paszkiewicz et al. (2021); Silva et al. (2023) determine that the basic existence of the given tech advancements is not sufficient to ensure their proper and capable implementation within an educational perspective. Thus, the definition of VR methodologies requires teachers to adapt learning and digital competencies, allowing virtual reality platforms and tools to become a viable teaching option. This involves integrating pedagogical and disciplinary knowledge with digital competencies to create a comprehensive and diverse curriculum structure for teaching objectives. Additionally, Alalwan et al. (2020) mention due the adoption of digital innovations struggle with complications related to the technopedagogical competencies essential for developing tools using diverse approaches, which in turn requires skilled professionals to expand, this highlights how the integration of VR represents an obstacle for educators, meaning it requires specific knowledge that can transform university teaching and enable formal integration of technologies into education.

Among the standout characteristic of virtual reality is its ability to offer customized educational experiences, enabling apprentices to engage with learning materials tailored to their individual needs. This approach is useful in university settings where students come from different academic backgrounds and have diverse ways of assimilating knowledge (Hamilton et al., 2021; Kasapakis et al., 2024).

Another key aspect is that simulations in virtual environments allow students to practice skills that will be crucial in their future professions, such as decision-making under pressure, teamwork, and solving complex problems (Elendu et al., 2024). These competencies, which are difficult to develop in an exclusively theoretical setting, can be better cultivated through immersive environments where students face situations similar to those in the real world

(Johnson et al., 2021). In the field of engineering, VR has enabled students to experiment with prototypes and technological solutions that would be too costly or risky to replicate in reality (Davila et al., 2020). In the Peruvian context, this adoption could help prepare students for the demands of the global labor market by improving their ability to face practical and real-life situations in a controlled environment.

3. Methods

This study will use a quantitative quasi-experimental design, a method that allows for the evaluation of whether an intervention, in this case virtual reality, has a direct effect on student learning by comparing an experimental group with a control group, using pre-tests and post-tests to measure the results (Hernández & Mendoza, 2018).

The sample size used in the analysis involved 40 undergraduates, categorized between two sections. The primary section was an experimental group made up of 20 students who used VR tools during the academic semester, while the other group was a control group of 20 students who continued with traditional teaching methods.

Regarding data collection, a 20-question questionnaire was employed. A pre-test was applied before the virtual reality intervention, and a post-test was administered at the final stage of the study period to measure the repercussion of VR on learning. To ensure the accuracy of the instrument, it was assessed adopting Cronbach's Alpha coefficient, achieving a value of $\alpha = 0.863$. The data were analyzed using SPSS 27, with the Mann-Whitney U test put into action to appraise meaningful variations across the groups.

4. Results and Discussion

The following provides the evidence collected from analyzing the students' responses across different dimensions of learning (observational and experiential). Comparisons were made between the pre and post intervention scores of both the experimental and control groups to identify significant differences after the virtual reality intervention.

Table 1. Frequency Levels of Immersive Learning in Peruvian University Students

Level	Pre-test				Post-test			
	Control Group		Experimental Group		Control Group		Experimental Group	
	f	%	f	%	f	%	f	%
Deficient	16	80.0	15	75.0	17	85.0	0	00.0
Little efficient	4	20.0	5	25.0	3	15.0	11	55.0
Efficient	0	00.0	0	00.0	0	00.0	9	45.0
Total	20	100.0	20	100.0	20	100.0	20	100.0

Source: SPSS V.27

As shown in Table 1, the pre-test for both teams shows a predominance of the "deficient" level, with 80% and 75% respectively. However, after the intervention, the experimental group improves significantly in the post-test, with 45% of students reaching the efficient level and none remaining at the deficient level, in contrast, the control group shows no improvement. This highlights a positive impact of virtual reality on immersive learning.

Table 2 Mann-Whitney U Test for Immersive Learning

Test Statistic	Immersive Learning Pre-test	Immersive Learning Post-test
Mann-Whitney U	165.500	0.000
Sig.	0.349	0.000

Source: SPSS V.27

The data reflect that the control and experimental sections performed similarly in the pre-test, showing no notable variations. However, in the post-test, a significant difference between both groups was evident, indicating that the intervention with virtual reality yielded beneficial influence on the performance representing the experimental section.

Table 3 Frequency Levels of Observational Learning in Peruvian University Students

Level	Pre-test				Post-test			
	Control Group		Experimental Group		Control Group		Experimental Group	
	f	%	f	%	f	%	f	%
Deficient	15	75.0	13	65.0	14	70.0	0	00.0
Little efficient	5	25.0	7	35.0	6	30.0	10	50.0
Efficient	0	00.0	0	00.0	0	00.0	10	50.0
Total	20	100.0	20	100.0	20	100.0	20	100.0

Source: SPSS V.27

The results indicate that, during the pre-test, both groups show a high proportion of students at the deficient level, with 75% and 65% respectively. After the intervention, the experimental group shows improvement in the post-test, with 50% of students reaching the efficient level, while the control group remains with a large percentage (70%) at the deficient level, this denotes a substantial improvement in the group that used virtual reality.

Table 4 Mann-Whitney U Test for Observational Learning

Test Statistic	Observational Learning Pre-test	Observational Learning Post-test
Mann-Whitney U	167.500	0.000
Sig.	0.377	0.000

Source: SPSS V.27

In Table 4, it is shown that both teams exhibit no considerable discrepancies in the pre-test. However, in the post-test, statistically significant differences were detected, indicating that the virtual reality intervention notably improved observational learning in the experimental group.

Table 5 Frequency Levels of Experiential Learning in Peruvian University Students

Level	Pre-test				Post-test			
	Control Group		Experimental Group		Control Group		Experimental Group	
	f	%	f	%	f	%	f	%
Deficient	13	65.0	14	70.0	17	85.0	0	00.0
Little efficient	7	35.0	6	30.0	3	15.0	13	65.0
Efficient	0	00.0	0	00.0	0	00.0	7	35.0
Total	20	100.0	20	100.0	20	100.0	20	100.0

Source: SPSS V.27

In the initial assessment, both groups had a predominant number of undergraduates at the deficient level (65% and 70% respectively), with no students at the efficient level. Following the intervention, the experimental group highlighted a considerable advancement in the post-test, with 35% of students at the efficient level and no students at the deficient level, in

comparison to the control group, which showed no improvements, this indicates that virtual reality did have a favorable effect on the experiential learning of the experimental group.

Table 6 Mann-Whitney U Test for Experiential Learning

Test Statistic	Experiential Learning Pre-test	Experiential Learning Post-test
Mann-Whitney U	197.00	0.000
Sig.	0.935	0.000

Source: SPSS V.27

In Table 6, the data shows no notable disparities between the groups in the pre-test, compared to the post-test, where statistically significant differences were detected, indicating that the virtual reality intervention created a favorable and considerable outcome on the experiential learning of the experimental group.

5. Conclusion

The research has demonstrated that the integration of virtual reality as a pedagogical tool significantly impacts immersive, observational, and experiential learning in undergraduates. Through the implementation of this technology, a clear improvement was observed in the experimental group's ability to engage more deeply with academic content, especially when compared to the control group, which did not show similar progress, this reflects that virtual reality facilitates the acquisition of knowledge and the development of critical skills for professional training, such as critical thinking and problem-solving in simulated contexts.

One of the main findings is that virtual reality not only reinforces theoretical learning but also enhances observational and experiential learning. Students who used virtual reality showed considerable improvement in these dimensions, reaching higher levels of competence contrasted to the control section. This indicates that virtual reality can proficiently simulate real-world situations, allowing students to make informed decisions in a controlled environment that encourages teamwork and autonomy in learning.

Furthermore, virtual reality demonstrates its ability to overcome the limitations of traditional teaching by providing a more interactive and personalized educational experience. Virtual environments also provide students to take a more dynamic job in their personal learning process, giving them greater control over the pace and depth of their understanding, this characteristic is key to increasing student motivation and engagement, as observed in the experimental group, which showed higher levels of participation and knowledge retention after the virtual reality intervention.

Finally, although this study has shown that virtual reality improves both academic performance and practical skills in students, it has also identified the importance of overcoming certain challenges such as technological infrastructure and teacher training. Despite these barriers, the research supports that the adoption of virtual reality in Peruvian higher education can have a transformative impact, providing unique learning opportunities that are increasingly demanded in the global context.

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