DOI: https://doi.org/10.56198/U6C0WDL9D

Work-in-Progress—Introduction to Virtual Reality Headset: Experiments with Secondary and Higher Education Students

Diana Morato[1 & 2], Maria Castelhano [3 & 4], Leonel Morgado[3 & 5] and Daniela Pedrosa [2 & 6]

[1] University of Aveiro, Aveiro, Portugal
[2] Research Centre on Didactics and Technology in the Education of Trainers (CIDTFF), Aveiro, Portugal
[3] University Aberta, Coimbra, Portugal
[4] University of Porto, Porto, Portugal
[5] INESC TEC, Porto, Portugal
[6] Higher School of Education, Polytechnic Institute of Santarém, Santarém, Portugal
diana.morato@ua.pt
mfmcastelhano@gmail.com
leonel.morgado@uab.pt
daniela.pedrosa@ese.ipsantarem.pt

Abstract. This work-in-progress aims to analyze perspectives of secondary and higher education students regarding the feasibility of integrating immersive Virtual Reality (VR) into the classroom. The harvesting of students' opinions was conducted through oral and written questionnaires after a Virtual Reality Environment activity held during two sessions of an event and other in an undergraduate class. The answers enable the understanding of challenges they faced during the activity, identifying elements that contributed to participants' immersion, assessment of perceived realism, and individuals' opinions on the integration of VR in the classroom. Conclusions regarding the applicability of VR from the perspective of secondary and higher education students can be drawn.

Keywords: Virtual Reality, Higher Education, High Education, Immersive Learning.

1 Introduction

Throughout the past decades, there has been ongoing discussion regarding the potential of Virtual Reality (VR) to revolutionize education. One argument is the potential of these tools to facilitate, in a simplistic view, the acquisition of skills through simulation, allowing for correction, repetition, and even failure in potentially hazardous environments and tasks, while simultaneously providing access to interaction with scarce, expensive, and sometimes distant environments [1, 2]. Their accounted uses extend beyond simulation to include skill training, multimodal interaction, and collaboration [3]. Their enablement of controlled training environments has also been tested as a promoter of understanding of complex concepts [1]. Furthermore, their potential to promote engagement, motivation, retention, and critical thinking skills, as well as the ability to create experiences in a variety of fields and areas of study [1], has led to an increase in studies based on immersive learning experiences in education alongside technological advancements witnessed over the decades [4, 5].

Given the emerging use of this technology and its purported benefits, we conducted this study with the aim of collecting a diversity of perspectives from students, by holding VR sessions in two different contexts: involving secondary school students (at a local event called “Xperimenta”) and involving higher education students (in an undergraduate teacher education course on use of Information and communications technology in education). In these sessions, we gathered participants' opinions on the activity, the implementation of VR in a classroom setting, the difficulties they experienced, among other aspects, to explore the applicability of VR in educational contexts. We collected information about how students felt using the tool, their views on the adaptability of this tool in their context, and how they perceive the integration of these tools in the classroom.

©2024 Immersive Learning Research Network

2 Background

Virtual Reality is a sensory interaction experience in a virtual environment [6]. This technology harnesses computational resources to create simulated environments that can either mirror or significantly deviate from the real world [1, 7]. The potential of VR to promote skill acquisition among students is often emphasized in the literature. VR offers the opportunity to simulate environments and tasks, allowing for correction, repetition, and even failures in hazardous situations [1, 2].

Moreover, other uses such as: skill training, multimodal interaction, and collaboration, go beyond simulation, as observed by Beck et al [3]. This training in a controlled environment has also been studied as a promoter of understanding complex concepts, with results surpassing those of traditional teaching methods, albeit control for educational methods and approaches is often lacking [1]. VR has also been recognized for its potential to promote engagement, motivation, retention, and critical thinking skills, as well as for offering the possibility of creating experiences in a variety of fields and study areas [1].

The increasing use of VR in education aligns with technological advancements observed over decades. Studies based on immersive learning experiences have proliferated, keeping pace with technological progress [4, 5]. Despite the growing adoption of VR in higher education, there are still debates about its effectiveness and potential benefits for learning and discovery [1].

The adoption of instructional design in this context can be crucial to ensure the practicality and quality of instruction. Instructional design is described as the art and technique of creating detailed specifications that enable the development, evaluation, and maintenance of learning environments, supporting needs analysis, goal setting, definition of assessment criteria, and specific learning outcomes. It enables instructors to develop guidelines on how to develop and optimize the learning process in a viable and quality-based approach.

Efforts have been made to obtain practical guidelines, notably regarding available instructional design models. However, the lack of information about its implementation and the use of generic models have been common practices [8]. It is from this starting point that conducting case studies, such as the one we present, becomes relevant, as well as developing applications that allow identifying the necessary elements for planning a class or session using VR from the user's perspective. These approaches are essential to promote effective integration of technology into the educational process, ensuring a more enriching and efficient learning experience.

3 Pedagogical Contextualization

Three sessions about Virtual Reality were carried out within the scope of the REVEALING project (https://revealing-project.eu/) that aims to implement VR classes in higher education.

The first session was titled “Virtual Reality Setting: Xperimenta, play, share” and took place on April 28th, 2023, at an event called “Xperimenta”, held at 11:30 am in the University of Aveiro for secondary students. The session was attended by 7 students and 1 teacher from a school in the North region of Portugal, who were part of the 11th grade of vocational educational and training of Electronics, Automation, and Computers. The group was composed of a mathematics teacher (who was also the class director), 6 boys, and 1 girl. Later that day, at 3 pm, the second session of Xperimenta took place, with only 3 students: 1 girl from the 12th grade from a school in the Center region of Portugal, and 1 girl and 1 boy (from the same class) from the 11th grade from a school in the North region of Portugal.

The third session, a Virtual Reality (VR) workshop, which occured on May 5th, 2023, was conducted with a higher education class from the Basic Education undergraduate degree at the University of Aveiro. This workshop was part of their Information and Communication Technologies and Basic Education (“TIC e EB”) course. The class lasted for 3 hours. Due to limited space, the main instructor divided the class into two sessions, each lasting 90 minutes. The first part of workshop had 6 students: 5 women and 1 man. The second part of workshop also had 6 students, all of whom were women. These students were aged between 20 and 25, and their secondary education training varied between professional courses linked to Education, Science and Technology, Socioeconomic Sciences, and Languages and Humanities.

The structure of both the Xperimenta sessions and those on May 5th was similar. When we were planning the session, the novelty of the Virtual Reality experience was considered, as the equipment was unavailable, and there was no prior application. With the goal of providing an initial VR experience, the sessions were organized in detail, offering various exercises for participants to familiarize themselves with the project progressively.

Activities included prior knowledge assessment via Kahoot, followed by a brief presentation and discussing about project goals, target audience, partners, and key concepts related to the REVEALING project, taking 5 minutes.

Afterwards, we involved the participants in practical tasks organized in 10-minute slots (as groups): 1) VR headset handling tutorial, 2) Digital Puzzle solving based on the project logo, 3) Digital Escape Room, and 4) Augmented Reality activity created to support student engagement. VR headset (Oculus Quest 2) use aimed to gather initial student insights, highlighting challenges, methods of interaction, and educational interest. We only had 2 Oculus devices available.

Finally, a Quizalize quiz was conducted to assess students' understanding of the concepts covered, followed by a feedback form for students to express their satisfaction with the experience and suggest improvements to the project. This segment lasted 10 minutes.

The Xperimenta sessions were conducted to gather the students' opinions and identify possible improvements for the REVEALING project. The sessions on May 5th students provided their opinions on the implementation of VR in their classes and its potential application in basic education, given they context as teacher education students.

After the first Xperimenta session, some adjustments were made to the structure. The Augmented Reality activity was deemed too simple for the age group, so it was excluded from subsequent sessions. Additionally, the Escape Room activity proved time-consuming due to the videos involved, resulting in the extension of the first Xperimenta session to 3 hours.

The overall aim of these sessions was to evaluate the suitability of VR in educational settings, considering the reactions and attitudes of students regarding the potential implementation of VR in higher education classes.

Fig. 1: Xperimenta session.

Fig. 2: "ICT and EB" (higher education teacher ed.) session.

4 Methodology

Our research goal was "Investigating the impact of using Virtual Reality (VR) in the sessions on students' perceptions of the applicability of this tool in an educational context," the research question was framed as: "What differences exist in reactions among students regarding the Virtual Reality Setting?", and we used convenience sampling.

To explore problems and potential for inform future research efforts, we aimed for an exploratory, descriptive approach. Therefore, a qualitative methodology was employed, involving the collection of data through oral and online questionnaires using Survio. The goals were (1) identify suggestions and recommendations from students to enhance the use of VR as an educational tool, (2) explore students' opinions on the applicability of VR as an educational tool compared to traditional teaching methods, and (3) determine the primary benefits perceived by students regarding the use of VR in educational sessions.

Following the VR headsets activity, participants responded verbally to inquiries about their experiences. These questions aimed to find the students' feelings towards technology utilization and to identify critical elements necessary for subsequent analysis and utilization as case study elements. These insights are crucial for improving the design of future sessions by ensuring alignment between pedagogical plans and technological integration, as well as devising strategies to alleviate potential discomforts or anxiety associated with using the tool. The questions were:

1) What were the main challenges you encountered when using movement controls during the VR class?
2) How did you engage with the virtual elements during the VR experience? What actions and reactions did you observe?
3) How immersed did you feel in the VR environment? What elements contributed to this sense of immersion?
4) In what ways did the VR experience feel realistic? Were there any aspects that you found unrealistic?
5) What would your experience be like participating in a VR class, and what precautions would be necessary to ensure your safety and comfort?

Upon conclusion of the sessions, participants accessed Survio to respond to additional questions about the activity, with the aim of understanding what still needed to be improved:

1) With how many stars would you rate this activity?
2) Would you recommend using VR to your friends? Why or why not?
3) Are you interested in participating in classes using VR? What draws your interest about it?
4) Do you believe there are areas for improvement in the activity? Please provide reasons.
5) Please indicate what you enjoyed most about the activity, something that surprised you, and something you would like to learn more about.

Through these questionnaires, valuable insights can be gathered regarding participants' experiences, opinions, encountered challenges, and suggestions for enhancing the implementation of VR in teaching practices.

5 Results

As the participants of the different sessions finished the activity, a short questionnaire was carried out on different dimensions: difficulties felt, how they interacted, factors that contributed to their immersion, realistic aspects of VR and their opinion about the implementing VR in a class. Table 1 presents a synthesis of the outcomes.

Table 1. Summary of the responses from verbal questionnaire.

Dimension	"ICT and EB"	*Xperimenta*
Difficulties	Adaptation (space setting). Understanding the buttons and, with them, grasping objects.	Adaptation to buttons. Space setting (transition from the physical world to virtual reality).
Forms of Interaction	Dancing with the doll. Everything felt intuitive. Dialogue between peers.	Dialogue with the doll. Dialogue between peers.
Realistic aspects of VR	Game wasn't real. The room is the most realistic. Doll's response. Movements performed. Grab objects.	Game wasn't real, but the room was. Grab objects.

Immersion	Support on the table. Space exploration. Sound and visualization of hands. Delimitation of space (contributes to immersion).	Support on the table. Space exploration. Sound, visualization of hands and feet. Interaction with elements.
Opinion on implementing VR in a class	Afraid of getting dizzy when changing the world. Really liked it; had never participated. As a future teacher, finds it interesting and follow current affairs a lot. Concern about your own glasses. It has several advantages, such as the fact that they are synchronous online classes, thus avoiding travel. Conducive to distraction. Good way of learning, however you think it's best not to immediately share with students how to use Oculus.	Afraid of getting dizzy when changing the world. Concern about your own glasses. Interesting, but might not be a facilitator for all subjects. Conducive to distraction.

At the end of each session, the last activity was the satisfaction and experience evaluation form, on Survio. This form consists of 6 questions, 2 of which are closed-ended and 2 open-ended. It contains questions about VR counseling for other people, interest in participating in VR classes, what can be improved in this activity, among others.

Table 2. Summary of answers to the Survio questionnaire.

Dimension	"ICT and EB"	*Xperimenta*
Stars for this activity	5/5	5/5
VR advice to others	All answers are affirmative, because: it makes classes less monotonous, more active and is a different way of giving and learning	All answers are affirmative, because: it makes the subject more interesting, it is a fun and interesting way to learn things, it is an incredible and unique experience, and it is of good quality
Interest in participating in classes using VR	All the answers say that it depends on the subjects because they don't think it's practical to solve a lot of exercises, like in mathematics	When the positive answers, the interest is because: different way of learning, captures and captivates attention. When is no interest is because: bad experience with distance education, it's easier to work without glasses (one response). It depends on the subjects, because: one cannot imagine some subjects being taught through VR
Improvement in activity	All responses state that there is nothing to improve, for the participants everything was great	All responses state that there is nothing to improve, for the participants everything was "great"
What did you like most, something that surprised you and what would you like to know more about?	They liked the VR setting the most, which was also what surprised them the most.	The responses collected refer only to what the participants liked, and they report that it was the VR ambience activity

6 Discussion

Analyzing Table 1, there are similar challenges in the two Xperimenta sessions and the "ICT and EB" classes, such as: adapting to commands, dialogue between peers, the game not being real, grabbing objects, support on the table, space exploration sound and visualization of hands, fears of dizziness when changing between the physical and virtual world, worries about physical eye-correction glasses and worries that it may be conducive to

distraction. These are consistent with the limited duration of the sessions, with a significant presence of difficulties in using the controls and discomfort transitioning between the real world and virtual reality. However, it is worth noting that these difficulties varied from person to person, indicating their subjective nature.

In terms of intervention methods, there are similarities in the participants' descriptions and the aspects they focused on regarding the activity, such as dialogue and interaction with the tutorial doll, observed in both environments. In the “ICT and EB” class, some participants also described finding the activities intuitive, possibly due to previous familiarity with Virtual Reality or the perceived simplicity of the tasks.

Regarding the realism of VR experiences, participants did not see similarities between games and real life, but rather see them as gamified environments. This perception is closely linked to the application used. While both groups mentioned the realism of object manipulation, only the “ICT and EB” participants highlighted additional realistic aspects, particularly the lifelike responses of virtual characters.

Factors contributing to immersion include spatial exploration, tangible support structures, audio feedback, and visual cues within the virtual environment. Participants also noted the importance of the headsets spatial boundaries to prevent disorientation and maintain safety.

Opinions on VR implementation in classrooms include concerns about potential dizziness and distractions, especially during initial use. Secondary school students who participated in the Xperimenta sessions expressed reservations about the effectiveness of VR in subjects requiring more problem-solving, such as mathematics. In contrast, higher education students in the “ICT and EB” class showed enthusiasm for integrating VR into teaching practices, recognizing its appeal to technically experienced students. However, some of these future teachers (since this was a teacher ed. course) expressed reservations about disclosing the use of VR to students, fearing it may lead to distraction. Additionally, VR was seen as a potential solution to commute challenges for higher education students residing off-campus.

In summary, while VR may offer numerous benefits, its acceptance presents challenges and considerations that must be addressed when integrating it into educational environments. However, the evaluation methods we used were limited.

Relating this case study to the literature, Pellas et al. [7], with secondary and higher education application and Radianti et al. [5], in higher education, compiled articles that used Immersive Virtual Reality (IVR) in various aspects, with an emphasis on the pedagogical level. Pellas [7] and his colleagues addressed user experience and usability in the context of Virtual Reality (VR). They highlight that user experience and usability issues are critical aspects of VR use. This suggests that if students are facing difficulties, it may be necessary to review and improve the usability of VR applications, potentially indicating that the tool used may not be intuitive enough.

The systematic review conducted by Radianti [5] and her colleagues emphasizes the importance of learning theories in the development of IVR applications. They note that these theories are often overlooked, which may contribute to the difficulties faced by students. This indicates that incorporating more learning theories into application design may be an effective strategy to improve learning outcomes. Also, this emphasizes that the evaluation of educational IVR applications has focused on usability rather than learning outcomes. This suggests that if students are having difficulty learning with IVR, it may be necessary to refocus on learning outcomes in application evaluation.

In this sense, it is crucial to consider students' difficulties and interests when adapting the inclusion of the IVR tool. This can help ensure that IVR is used effectively to enhance learning experiences and achieve desired learning outcomes.

Furthermore, Pellas [7] and his colleagues contribute to the review of how instructional design strategies and techniques can potentially benefit students' learning performance using a wide range of VR applications. They also propose some recommendations to effectively guide and conduct instructional design settings in various teaching and learning contexts to outline a more accurate and updated framework of the current state of the literature. Thus, these results could be relevant in rethinking instructional design to mitigate difficulties and enhance the use of the tool considering their concerns.

7 Conclusion

The sessions provided valuable insights into the considerations necessary for implementing VR classes. It became evident that several factors must be addressed. Firstly, teachers should ascertain whether individuals with visual impairments can participate in VR sessions without their eye-correcting glasses. If eye-correcting glasses are required, their use should not impede participation or cause discomfort, as expressed by participants who faced this issue. Moreover, the handling of controls posed challenges for some participants, highlighting the importance of comprehensive explanations before class implementation to minimize confusion and ensure smooth operation during sessions.

Teachers must also gauge the comfort levels of all students at the outset of each class to mitigate any potential discomfort or dizziness, thereby optimizing the learning environment. Additionally, distractions may arise initially as students explore this new technology, but over time, their focus will shift towards the instructional content.

The participants' enthusiasm underscores the potential of VR as a teaching tool. However, further research is necessary to determine how VR can be integrated across various subjects effectively. This underscores the need for teacher preparation and ongoing professional development to ensure effective implementation of VR-enhanced lessons. Ultimately, investing in this innovative teaching method holds promise, but it requires careful planning, adaptation, and ongoing support to realize its full potential in educational settings.

As future work, we recommended the use of qualitative instruments and methods for data collection and analysis consolidated and assess with another perspective the effectiveness of the VR sessions, include measures of engagement, knowledge retention, or learning outcomes.

Acknowledgements

This work was funded by the European Commission, under project REVEALING – REalisation of Virtual rEAlity LearnING environments (VRLEs) for Higher Education – Erasmus+ / Cooperation Partnerships 2021-1-DE01-KA220-HED-000032098.
This work is financially supported by National Funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the projects (https://doi.org/10.54499/UIDB/00194/2020) and UIDP/00194/2020 (https://doi.org/10.54499/UIDP/00194/2020).
We also extend our thanks to all collaborators and partners involved.

References

1. Mazhar, A.A., Al Rifaee, M.M.: A Systematic Review of the use of Virtual Reality in Education. In: 2023 International Conference on Information Technology (ICIT). pp. 422–427 (2023).
2. Jensen, L., Konradsen, F.: A review of the use of virtual reality head-mounted displays in education and training. Educ Inf Technol. 23, 1515–1529 (2018). https://doi.org/10.1007/s10639-017-9676-0
3. Beck, D., Morgado, L., O'Shea, P.: Finding the gaps about uses of immersive learning environments: a survey of surveys. Journal of Universal Computer Science. Vol. 26, no 8, 1043–1073 (2020).
4. Beck, D., Morgado, L., O'Shea, P.: Educational Practices and Strategies With Immersive Learning Environments: Mapping of Reviews for Using the Metaverse. IEEE Transactions on Learning Technologies. 17, 319–341 (2024). https://doi.org/10.1109/TLT.2023.3243946
5. Radianti, J., Majchrzak, T.A., Fromm, J., Wohlgenannt, I.: A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education. 147, 103778 (2020). https://doi.org/10.1016/j.compedu.2019.103778
6. Antón-Sancho, Á., Vergara-Rodríguez, D., Calatayud, D.G., Fernández-Arias, P.: Virtual Reality as a Teaching Resource in Higher Education: Professors' Assessment. In: Ranganathan, G., Bestak, R., and Fernando, X. (eds.) Pervasive Computing and Social Networking. pp. 139–149. Springer Nature, Singapore (2023).
7. Pellas, N., Mystakidis, S., Kazanidis, I.: Immersive Virtual Reality in K-12 and Higher Education: A systematic review of the last decade scientific literature. Virtual Reality. 25, 835–861 (2021). https://doi.org/10.1007/s10055-020-00489-9
8. Castelhano, M., Morgado, L., Pedrosa, D.: Instructional design models for immersive virtual reality: a systematic literature review. SIIE23. XXV Simpósio Internacional de Informática Educativa. 272–278 (2023).