Using VR in a Two-Month University Course

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ABSTRACT

This paper describes the experience of using VR in a two-month University course. The experience was performed in the School of Economics, Universidad de la República, Uruguay. Fourteen students and the professors attended the "Accounting in integrated management systems" class using Meta Quest 2 VR headsets during seven 1-hour sessions, one session per week. Different aspects were analyzed during the sessions, including audiovisual quality, comfort, sickness, immersion, presence, fatigue, cognitive load, and useful of the technology for the academic purposes.

Keywords: Virtual Reality; Education.

1 INTRODUCTION

The use of technologies for attending classrooms remotely was extensively used during the last Covid-19 pandemic. After the end of the pandemic, Zoom, MS Teams, Google Meet and other videoconference tools remained commonly used for any kind of remote courses. Now, with the last developments of Virtual Reality (VR) applications and low costs of the head mounted displays (HMD) devices, these courses can eventually be performed in an immersive classroom.

Various VR classroom studies include analyzing emotions and learning in primary education [1], evaluating performance in virtual collaborative tasks [2], and reviewing immersive VR in STEM education [3]. These studies highlight improvements in learning outcomes, positive user experiences, and usability. However, its applicability beyond STEM and broader conclusions remains the subject of future research.

Most of the previous studies were performed for courses where special designed material in 3D is relevant for the course content. The use of VR in classical, non-technical remote university courses has not been systematically studied yet. There is not enough evidence if there is any benefit from using VR technology instead of the classical videoconference tools for this kind of courses.

This paper presents the results of performing part of a course, during two-month, at the School of Economics, Universidad de la República, Uruguay. The University provided the HMDs for the students, the professors and the virtual classroom environment.

In the following sections, the virtual classroom environment is described along with the results of the experiences of the students and professors.

2 VIRTUAL CLASSROOMS

In [4] the authors explore the possibility of teaching and learning in VR using a Metaverse Classroom. They conclude that Meta (formerly Facebook) Horizon Workrooms shows promise as an affordable tool for facilitating an engaging experience within a virtual workspace. They also state that there is great potential for VR to support multiple learning modalities. Meta Horizon Workrooms was chosen due to its focus on natural, intuitive VR interactions, aligning with trends towards immersive, realistic experiences beyond just high resolution. This platform enhances presence, key for effective learning, reflecting advancements in VR technology focusing on realism, as analyzed in a 2021 Frontiers in Psychology study [5].

Figure 1 - Students attending the Virtual Classroom.

2.1 Head Mounting Device

For our VR educational study, we chose the Meta Quest 2 HMD due to its high-resolution display (1832 x 1920 pixels per eye) and adjustable interpupillary distance (IPD), ensuring visual clarity and comfort. Its six degrees of freedom (6DoF) tracking allows natural user movements, and the ergonomic design with an adjustable, padded strap system provides comfort and stable fit for various head sizes, essential for consistent VR experiences.

2.2 Classroom

A course with 15 participants (14 students, 5 males and 9 females, and a professor) combined 1-hour Zoom sessions and 1-hour VR classes using Meta Quest 2 in Horizon Workrooms. This setup created a VR-based traditional classroom environment, facilitated by the professor's avatar and student interactions. Technical support and feedback were integral for ongoing improvements. A typical classroom is shown in Figure 1.

3 RESULTS

After each session, the students and the professor answered a series of questions, in order to obtain information regarding audiovisual quality, comfort, sickness, immersion, presence, fatigue, cognitive load, and the useful of the technology for the academic purposes. The evaluation of theses aspects was performed using the general guidelines provided in Recommendation ITU-T P.1320 "Quality of experience assessment of extended reality meetings" [6]. The main insight of each aspect is described in the following subsections.

3.1 Audiovisual quality

Questions covered aspects of audiovisual quality, audio, video, avatar audio-video synchronization, response delay, and video freezing. Audiovisual quality was consistently high during all sessions. Audio, video and audiovisual quality was reported in average with 4.2, in a standard Mean Opinion Score (MOS) scale from 1 to 5, where 1 is Bad and 5 is Excellent, as recommended by the ITU-T P.800 [7]. Synchronization was rated as an average of 4.6 while delay was 4.7 averaged for all sessions. Even though audiovisual quality has scored very high, 25% of the students perceived moderated freezing on some occasions, and 2% severely freezing events during some of the seven sessions.

3.2 Comfort

One of the questions refers to the general comfort of using the HMDs, in a 5-points scale, with 1-"Very uncomfortable" and 5-"Very comfortable". In the first session, the average answer was 3.1, with one person responding 1 ("Very uncomfortable"). In the last session, the average answer was 3.7, with the lowest value of 3. These responses indicate a habituation to wearing the HMD. Nevertheless, the punctuations of the last session are low. In the open comments, some students reported neck fatigue.

3.3 Sickness

Three questions were related to different kinds of sickness. The students were asked to report nausea, dizziness, stomachache or similar symptoms during the session and after ending the session (when they returned to the "real world"). The responses were presented in a 5-points scale, each with a specific description, from the worst case 1-"I feel nausea, dizziness and other severe effects, I had to interrupt the session" to the best case 5-"I didn't feel any effects, I felt normal". The average answers started with an average of 3.7 in the first session and ended with an average of 4.8 in the last session. In a similar way to the general comfort feeling, the responses show a habituation to the HMD. In the last session, the worst punctuation was 4-"I felt some light effects".

3.4 Immersion

A question regarding the immersion felling was asked, rating the following statement: "Everything seemed so authentic to me that it made me think that virtual avatars and objects really existed". As the other questions, a 5-point scale was used, starting with 1-"Totally disagree. At no point did it seem authentic to me, I was always aware that it was an unreal situation" to 5-"Totally agree, during the entire session it felt like something real". The second session had the lowest qualification, with an average of 3.2 and the last two sessions have the highest with 3.7.

3.5 Presence and plausibility

Two questions addressed presence and plausibility aspects, asking for how natural the interactions with the environment were (looking at the environment, using the hands, interact with other members, etc.) and about the effort required to interrupt another participant. The first aspect (interactions with the environment) was answered with an average of 3.8. The second aspect (the effort required to interrupt another participant) was qualified with an average of 4.7. Both aspects were roughly the with the same values in all sessions.

3.6 Fatigue and cognitive load

Fatigue and cognitive load were evaluated with two questions. In the first session, the average students reported some kind of fatigue, while in the last three sessions, most of the student reported that they did not feel any fatigue. The cognitive load was qualified with an average of 3.6 (being 1-"Very high" and 5- "Very low"), with no considerable variation across the sessions.

3.7 Usefulness of the technology

One question asked how useful the VR technology was in improving the understanding of the educational material in this class. The average responses were 3.4 (being 1-"Nothing useful" and 5-"Very useful").

3.8 Technical issues

The students were asked if they suffered any kind of technical issue during the session, with a "yes" or "no" answer. If "yes", detailed were asked. In the first session, 60% of the participants responded that they had some kind of technical issue. This percentage decreased throughout the sessions, with a minimum of 20% in the fifth session. Typical issues were related to Wifi problems, freezing, low battery, black screens among others.

3.9 Other comments

Besides the tabulated set of questions for each session, open comments were asked to the students and the professors. The students' answers highlighted feeling close in class, close to their classmates and teachers. The professor stated that the experience was good on a motivational level. The students felt freer to participate than in classical conference platforms or in the "real" classroom. There was more participation from the students even than in the class. According to the professors, the anonymity of the avatar makes it easier for the students to overcome barriers and they participate more.

4 Conclusion

In this university course conducted in a VR classroom using Meta Horizon Workrooms, students adapted to VR's initial discomfort and motion sickness. The VR environment improved student participation, with educators noting its ease of use and potential for enhanced interaction. Technical challenges and limitations in sharing materials were identified. Participants experienced physical and visual strain, with concerns about remote student engagement. While VR offers unique dynamics and motivates students, it hasn't yet replaced traditional methods. This experience shows that, although VR technology is not mature enough to replace classic videoconferencing systems at its current state, it has interesting advantages, especially related to motivation and interaction between students and the professors.

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