Evaluation of Headset-based Viewing and Desktop-based Viewing of Remote Lectures in a Social VR Platform

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ABSTRACT

We study experiences of students attending classes remotely from home using a social VR platform, considering both desktop-based and headset-based viewing of remote lectures. Ratings varied widely. Headset viewing produced higher presence overall. Strong negative correlations between headset simulator sickness symptoms and overall experience ratings, and some other ratings, suggest that the headset experience was much better for comfortable users than for others. Reduced sickness symptoms, and no similar correlations, were found for desktop viewing. Desktop viewing appears to be a good alternative for students not comfortable with headsets. Future VR systems are expected to provide more stable and comfortable visuals, providing benefits to more users.

CCS CONCEPTS

• **Human-centered computing** → *Virtual reality*.

KEYWORDS

virtual reality, educational VR, teleconferencing, distance learning, remote instruction, Mozilla Hubs, COVID-19, SARS-CoV-2

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1 INTRODUCTION

We study a class that was delivered remotely using the social VR platform Mozilla Hubs. The study evaluates student experiences viewing lectures in both VR headsets and on desktop monitors. Mozilla Hubs is a "social VR platform" on the Web and supports many devices [1]. Outlaw et al. used it for an ACM UIST 2019 virtual poster session and described an increased sense of presence [13].

Figure 1 shows one of the Hubs lectures with a mix of students using desktop VR and headset VR. The image shows a lecture screen (uploaded PDF content) near its center, uploaded video objects to the right of the screen, a teacher avatar near the bottom right of the screen, a live-streamed webcam view of the teacher to the left of the screen, and student avatars in the virtual room. Some students are floating (fly-mode) for a better view.

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Remote class delivery has benefits of reduced travel: reduced carbon use [13], saved student time, and flexible participant location. Recently, many universities used remote classes for instruction during the spread of the SARS-CoV-2 virus. Such classes are commonly delivered with video tools such as Zoom or Skype. These may lack some interactivity or quality of in-person lectures. Networked VR offers an alternative that may provide benefits from increased presence (general and social) and social interactions. Although VR for education has been suggested to support presence, motivation, and engagement in various contexts (e.g., [2], [3], [10], [11], [15], [16]), there is little work on live lecture-style VR classes or on remote delivery directly to homes.

Neither desktop nor headset VR has consistently been found better in VR work comparing viewing approaches. Some studies found that desktop VR outperforms headset VR, e.g., [10], [17], [19], [20]. Others have found benefits of headset VR, e.g., [12], [14].

Technical problems or distractions are common drawbacks for remote learning technologies, e.g., [4], [5], [6], [8].

Figure 1: A Lecture in Mozilla Hubs

2 METHODS

2.1 Overview

Our study was conducted during 7 weeks of a remote class that met entirely in Hubs. The main independent variable was the viewing method used by students (headset or desktop VR), in a within-subjects study design with counterbalanced order. The teacher used a Vive Cosmos headset to present in VR. Lectures introduced VR devices, their relation to human senses, and interface topics.

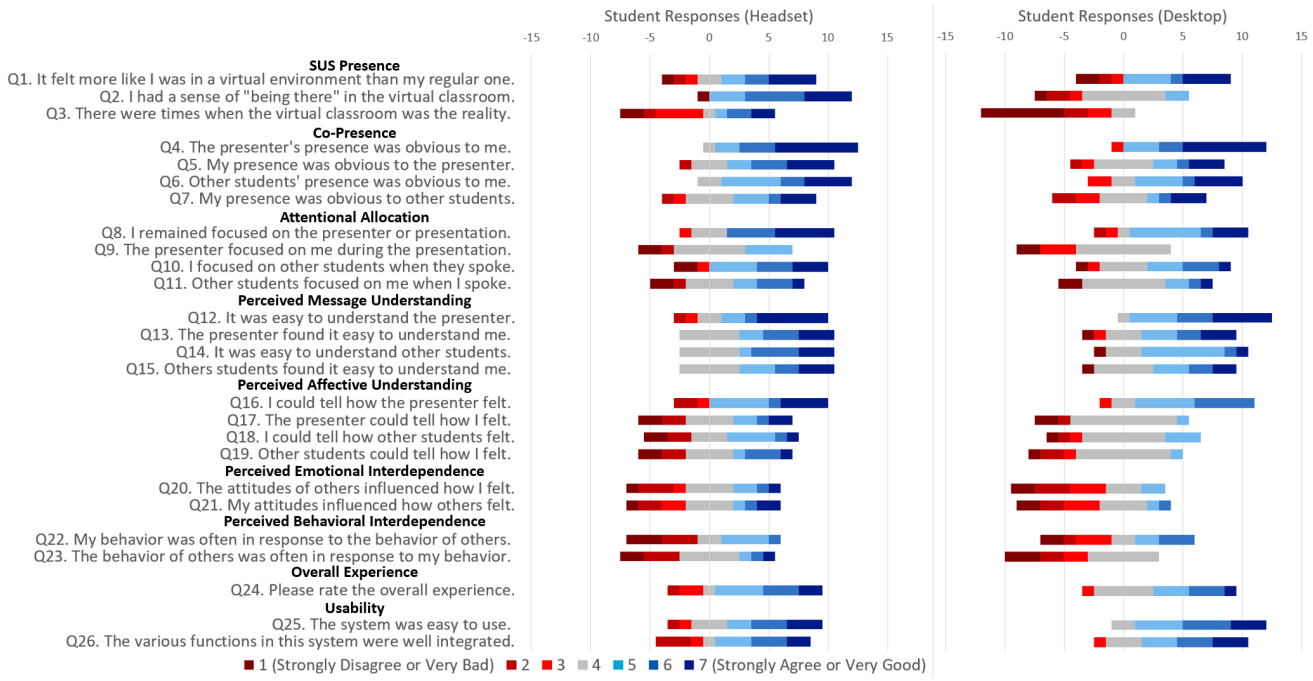

Figure 2: Diverging Stacked Bar Charts, Counting Responses to Main Questionnaire Items (Headset and Desktop VR)

2.2 Participants and Procedure

The study included 13 students: 11 undergraduates (10 being senior-level) and 2 graduate students. All students were pursuing computer science degrees. Most students had limited experience with virtual reality in the past. Various headsets were used, as would be expected for home VR delivery (five Oculus Quest, four Rift CV1s, one Rift S, one Windows Mixed Reality HP headset, one Windows Mixed Reality Odyssey+ headset, and one HTC Vive). All headsets had 6-degree-of-freedom tracking and 2 hand controllers.

On selected days, students answered questionnaires for desktop or headset viewing. These were given during the last 15 minutes of a class attended either with headset or desktop. To reduce order effects, 5 of the 13 students rated headset viewing first (second week) and desktop later (fifth week). The other students experienced reversed order. The unequal split did not favor headset viewing: 4 of 5 students who reported high sickness with headsets are in the later group and tended to give low headset ratings.

3 RESULTS

Fig. 2 summarizes responses for main questionnaire items (many based on [7]). Headset and desktop viewing both received majority-positive ratings for several items, but variation was substantial. Headset viewing provided higher presence than desktop (Wilcoxon Signed-Ranks Test on the combined presence subscale: Z=2.103, p=.035), based on SUS-style presence questions [18].

Notable sickness was reported by 5 students for headsets and by 1 student for desktop (here, notable means average rating was 2 or higher across the following 5 symptoms, each rated from 1 to 4: general discomfort, fatigue, eye strain, difficulty focusing, headache). For headset viewing only, we found strong negative correlations between these SSQ-inspired [9] symptoms and various ratings: usability (Spearman r_s=-.830, p=.000), perceived message understanding (r_s=-.801, p=.001), overall experience (r_s=-.792, p=.001), SUS presence (r_s=-.719, p=.006) and co-presence (r_s=-.623, p=.023). Based on these correlations and on additional inspection, comfortable users tended to give higher scores to headset viewing. Several items received no negative headset ratings from the 8 low-sickness students (e.g., overall experience, usability, co-presence items).

4 CONCLUSION AND FUTURE WORK

Results suggest a benefit of headset VR for comfortable students, and increased overall presence, but simulator sickness remains an obstacle for remote delivery of courses to homes. We expect future VR technology to improve with more stable and comfortable visuals. In the meantime, desktop viewing appears to be a suitable alternative for students having problems with headsets.

Some additional questionnaire data conveys that most students prefer to attend a VR-based remote class using a mix of headset and desktop viewing. This provides good motivation to further explore these methods for attending remote classes and to study their tradeoffs with respect to different class topics and activities.

Elsewhere, we present more detail on the headset condition [21], including student and teacher comments. Future work will consider additional questionnaire details and end-of-course evaluation.

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