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Breaking boundaries with VR: Enhancing learning experiences for fine arts students

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Abstract:

This paper presents the results of a pilot project implemented in the winter of 2023, when the Concordia University Library built customized access to a VR immersive experience for students in two Fine Arts courses. The pilot project explored the academic library's integral role in making VR works accessible to students for applied integration in the classroom in consideration of learning outcomes. Through user experience surveys, valuable information was gathered to assess the project's effectiveness in enhancing learning outcomes. It was found that the pilot facilitated learning experiences by:

- *Enhancing student engagement with course content (connecting VR activity to class readings/lectures and promoting active learning by exploring new mediums and building memorable experiences)*
- *Generating discussion among students (exchanges on form/content, shared experiences, processing emotions emerging from the VR experience, and VR's potential as an artistic medium)*

Survey results illustrated how opportunities, challenges, and risks were impacted by factors such as accessibility, space, equipment, and emotional/physiological responses. This paper presents insights related to technical installation, training, documentation, and the importance of having dedicated staff to assist users.

Keywords: Virtual reality, experiential learning, student engagement, academic libraries, course reserves.

Introduction

Virtual reality and augmented reality (VR/AR) technologies have attracted significant interest since their emergence. The technological breakthroughs in the creation and development of virtual spaces, and the possibilities these have conjured, have generated interest and debate, although they do not enjoy the same reach or rate of adoption as personal computers or mobile technologies. Notably, they have been embraced by higher education institutions, where researchers and educators have engaged in creative experimentation with VR technology and VR-enhanced content. A recent systematic review of the uses of VR technology in higher education institutions revealed that VR has been explored and employed to enhance learning in a wide range of fields: health sciences, engineering, manufacturing, transportation, and the arts.[1] Despite the prohibitive cost of the VR equipment and the significant learning curve involved in deploying it, educators and librarians quickly recognized the potential benefits of including VR and AR technologies into their practice and services to enhance learning outcomes and enrich user experience.

In 2021, authors David Greene and Michael Groenendyk published an environmental scan of virtual reality and augmented reality services in academic libraries in Canada and the United States. In their review of institutional members of the Association of Research Libraries,[2] the authors found that 42 percent of libraries offer VR or AR services at their institution. They also noted that VR and AR services were becoming common library resources. In line with this trend, Concordia Library provides its community with access to VR technology through two technologically enhanced spaces: the Visualization Studio and the Technology Sandbox.

The UNESCO International Bureau of Education defines holistic learning as "an approach that seeks to fully activate all aspects of the learner's personality (intellect, emotions, imagination, body) for more effective and comprehensive learning." VR can assist in the learning process as it can be used as an educational technology tool. VR-based learning has significant advantages for student learning, including increased retention, engagement, interaction, and critical thinking.[3]

As we move toward new ways of teaching and learning in universities, including experiential and deeply connected learning, this paper seeks to provide insights on the potential role that VR can play in these evolving educational models, and how the Library can play an active role in making this experience inclusive and equitable for all in line with UN Sustainable Development Goals.[4] To do so, this paper presents the results of a user-experience survey gathered in the context of a pilot project aimed at improving services at Concordia University Library.

The Request

The initial request for the pilot project study was received during the fall of 2022, from a Film Studies professor teaching the History of Film Animation class (an eighty-student undergraduate-level class), to be held during the Winter 2023 semester. The pilot was extended to include the students of a PhD-

[1] Jaziar Radianti, Tim A Majchrzak, Jennifer Fromm, and Isabell Wohlgenannt, "A Systematic Review of Immersive Virtual Reality Applications for Higher Education: Design Elements, Lessons Learned, and Research Agenda," *Computers & Education* 147 (2020): 103778, https://doi.org/10.1016/j.compedu.2019.103778.
[2] David Greene and Michael Groenendyk, "An Environmental Scan of Virtual and Augmented Reality Services in Academic Libraries," *Library Hi Tech* 39, no. 1 (2021): 33–47, https://doi.org/10.1108/lht-08-2019-0166.
[3] Muhammad Mujtaba Asad, Aisha Naz, Prathamesh Churi, and Mohammad Mehdi Tahanzadeh, "Virtual Reality as Pedagogical Tool to Enhance Experiential Learning: A Systematic Literature Review," *Education Research International* 4 (November 2021): 4. https://doi.org/10.1155/2021/7061623.
[4] United Nations, "Goal 4: Quality Education," in *The Sustainable Development Goals Report* (New York: United Nations Department of Social and Economic Affairs, 2017), https://unstats.un.org/sdgs/report/2017/goal-04/.

level seminar titled Critical Genealogies of Immersion (eight students), also held during the Winter 2023 semester.

Although this request represented a service offering beyond the Library's current offerings in VR equipment,[5] it presented an opportunity to evaluate the Library's readiness to make this technology available to students through the framework of course reserves. A pilot project was approved by Library administration and was deployed with the following objectives:

- Make the requested VR work available to students during the Winter 2023 semester
- Gather user-experience information from students and professors on accessing VR resources offered by the Library
- Evaluate the Library's current capabilities to offer student access to VR resources
- Identify key aspects that would need to be considered should the Library decide to scale up the project

The pilot project was designed as an opportunity to reflect on the technology spaces available within the Library and their articulation with the Library's collection, university curricula, and research requirements.

Pilot Implementation

A multidisciplinary team was formed to respond to the various elements required to deploy such a project. The team included the Digital Media and Visual Resources Librarian (project lead), the Teaching and Research Librarian for Social Sciences and Acting Manager of the Technology Sandbox, the Lead, Immersive Technology Systems, as well as the Manager, Information Systems and Technology. This team was responsible for designing, implementing, and reporting on the pilot project. Implementation also involved librarians and staff from the Information Systems and Technology team, as well as the Information Services team.

The pilot project used existing equipment and spaces within the framework of course reserves. The aim was for students to be as autonomous as possible, both in booking time and in accessing the work. By using existing solutions and technology at the Library, the team was able to evaluate the Library's current capacity to offer and support this service, verify the robustness of existing software and equipment, and evaluate gaps or obstacles to extending the offering across all faculties.

The Work

The work presented is *The Book of Distance*,[6] a twenty-five-minute narrative film written and created by filmmaker Randall Okita and made available free of charge by the National Film Board of Canada on a platform called Steam. The film recounts the story of the artist's grandfather, who immigrated to Canada in the 1930s and was imprisoned in internment camps during the Second World War because of his Japanese descent.

[5] The Library currently offers access to virtual reality headsets through its two technological spaces: the Visualization Studio and the Technology Sandbox. These spaces are community driven and occasionally integrated into the curriculum. Headsets are available onsite at the Sandbox (2) and the Visualization Studio (2), while six more are available to students on a one-week loan.

[6] Randall Okita, *The Book of Distance: A Virtual Reality Experience by Randall Okita* (National Film Board of Canada, 2020), https://www.nfb.ca/interactive/the_book_of_distance/.

The Book of Distance requires viewers to stand for the full duration of the work, walking around the space and interacting with virtual objects for the story to progress. The VR work does not include chapters; thus, if the experience is stopped midway, the work may be restarted only from the beginning.

VR Equipment

An HTC Vive VR headset was used during the pilot. Purchased in 2017, it belongs to the equipment collection used in the Visualization Studio. The headset was tethered to a computer with a four-metre cable. Although, in an ideal setting, the cable would have been suspended from the ceiling, in this scenario it was allowed to fall to the floor. Participants needed to hold two hand controllers to interact with the story. In addition to the headset and controllers, two sensors were needed to detect the viewer's movements in the space and help delineate the virtual space's boundaries. For this temporary configuration, the two sensors were placed on tripods (in a permanent installation, these would be mounted on the walls).

Space

A presentation practice room was repurposed for the project's duration (see fig. 1). One week was allocated for the installation and beta-testing the equipment. The two subsequent weeks were dedicated to giving students access to the space and the VR experience. The room measures 4.26 by 4.87 metres, with the boundary of the film's VR space measuring roughly 2.1 metres square. The room includes one computer in a locked presentation podium cabinet, one wall-mounted television monitor, and a few rolling office chairs. To prevent damage, theft, or misuse of the space during the pilot, the door was kept locked. The room was opened and closed by staff when there was a booking.

Figure 1. The dedicated VR room.

Booking System

Building on the existing LibCal (Springshare) platform, a special booking schedule was available to students enrolled in the two participating classes. The fact that students already used this software for general room bookings at the Library ensured that students would have some familiarity with this aspect of the experience. Six one-hour appointments per day, for teams of two students, were available on weekdays, with thirty-minute buffer periods built into the schedule to account for late arrivals and troubleshooting. The students on each team would alternate as viewer and spotter, the latter providing assistance to the viewer as a safety measure.

Student Support

The lead librarian was invited to give an in-class presentation that included a brief description of the VR film, the space in which the VR film would be experienced, and the booking calendar. Students were provided with an informational package in a digital format; this included step-by-step instructions on using the VR equipment in the room as well as information on how to use the booking calendar to reserve a session (made available on the course Moodle site). A printed version of the step-by-step guide was also made available in the dedicated VR room.

Due to the dedicated VR room's location, the need to keep the booking schedule on track, and to ensure ease of access to the room, a schedule was also created for on-call user/technical support. A team of ten members took turns providing user or technical support throughout the pilot project. This schedule ensured that an informed and trained staff member (or project team member) was available to confirm booking sessions, help students locate the room, provide a brief introduction to the space, and guide students through the preparatory steps before engaging with the experience. Students were instructed on whom to contact and how to proceed if problems occurred. Depending on the student's prior experience, this introduction typically took between two and five minutes.

Student Experience Survey Results

Over the duration of the pilot project, 37 bookings were received, totalling approximately 70–75 students.

Post-implementation, the lead librarian visited students in person during class time to distribute printed copies of a survey to gather feedback on their experience. The survey focused on technical installation, support and documentation, comfort and accessibility, immersiveness, and learning experience. Overall, 45 students responded to the survey, representing a 64% response rate. The selected survey results, presented below, illustrate how the project's various challenges, opportunities, and risks were affected by factors such as accessibility, space, equipment, and emotional/physiological responses.

Prior Experience

Among the undergraduate students surveyed, 58% had already used VR, while 42% said it was their first VR experience (see fig. 2). In the graduate student course, 75% had previously tried VR, while 25% indicated that it was their first experience. Of those with prior experience, 81% had used VR one to three times.

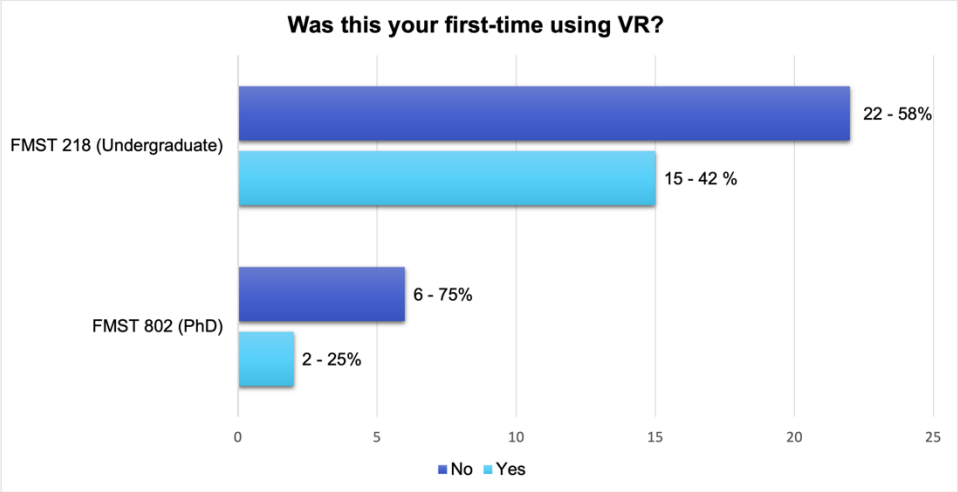

Figure 2. Comparing the percentage of undergraduate and graduate students' first-time VR use.

Technical Installation

The layout of the room was well received by students: 96% of respondents said the room layout worked well for the VR experience (see fig. 3).

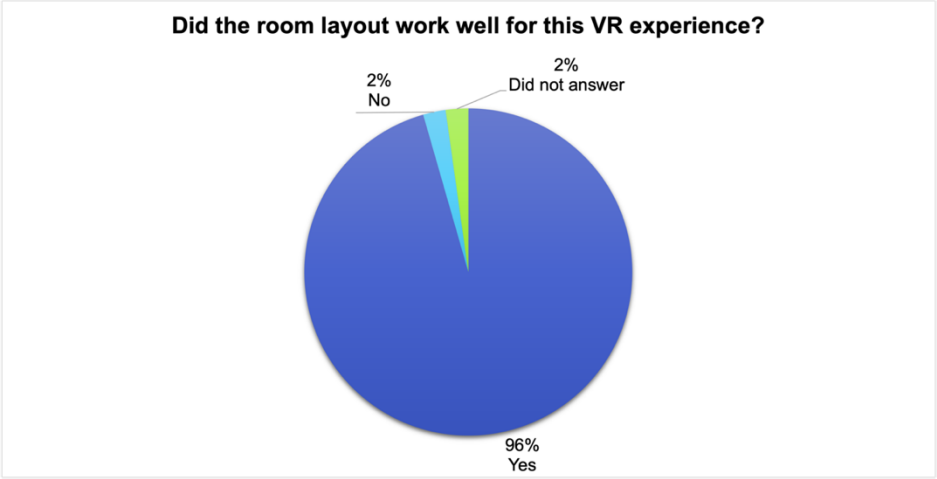

Figure 3. Room layout of VR experience.

When asked if they would change anything about the room to make the experience more comfortable, students recommended:

- Improved cable management
- A larger room
- Removal of the presentation podium cabinet
- Project film onto a large screen for spectators
- Mark off VR space boundaries
- Curtains for room windows

During the implementation phase, we were alerted by students to some technical issues that required troubleshooting. To attain a better understanding of what had occurred, students were asked in the survey if they experienced any other issues (see fig. 4). The most frequently reported issue (by ten students) was blurry vision due to their inability to wear glasses with the headset. Some students reported a frozen screen, glitches, delays, or prompts not responding to controller clicks, which may

have been related to the film's technical development or to the computer used to run the experience. In the event of a frozen screen or major glitch, it was necessary to restart the film from the beginning as no chapter breaks had been integrated into the design of the story.

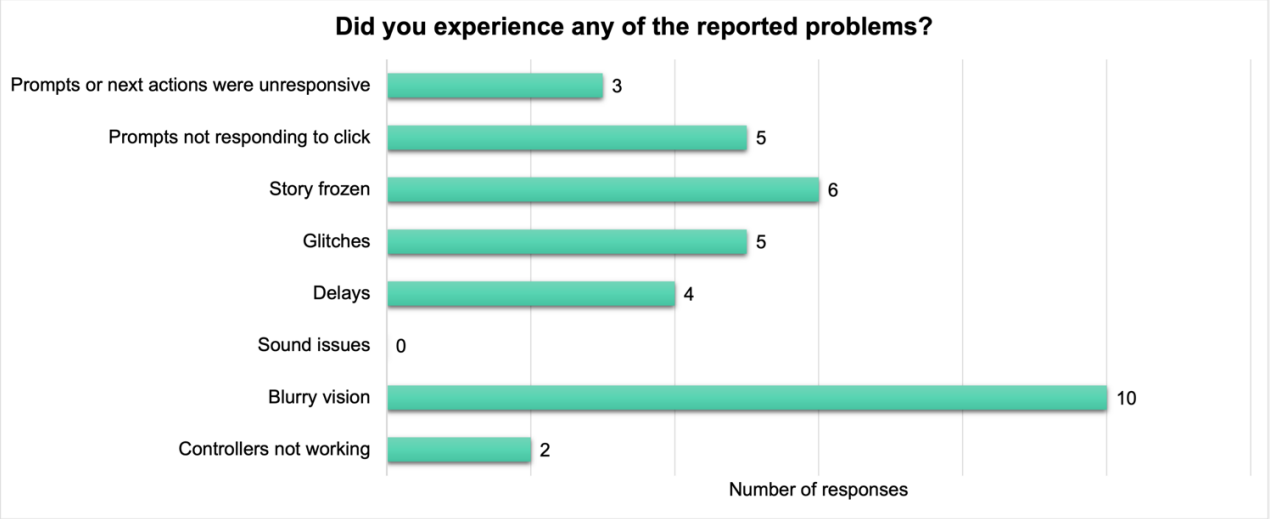

Figure 4. Types of problems reported during VR experience.

When asked if the VR film functions responded quickly to the input controls/actions, 78% of respondents answered "yes" (see fig. 5). Some 20% of students replied "sometimes (I occasionally experienced input problems)," while only 2% replied that the controls did not respond to input and that they encountered many problems.

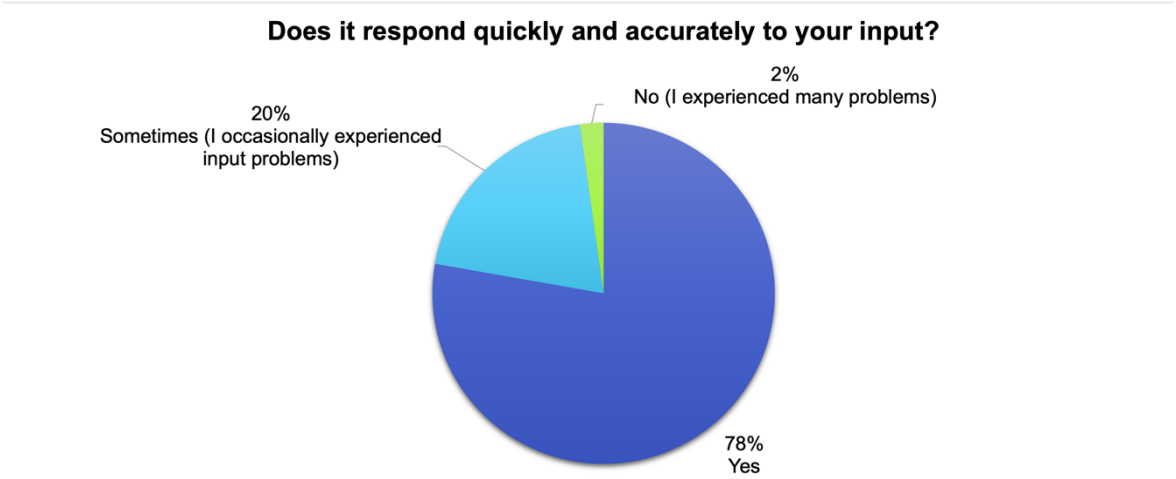

Figure 5. Students' perception of VR film response to input.

Support and Documentation

Students were asked to provide feedback on their experiences with the level of support they received during the VR session, their perception of the relative usefulness of the assistance received, and the documentation made available to them. In fig. 6, students evaluated the effectiveness of the support they received: 89% reported that the instructions provided by staff members were helpful. Students were also asked for their feedback on the usefulness of the documentation available for consultation. In fig. 7, the student feedback on the desired support type reveals a marked preference for in-person staff support compared to the documentation provided.

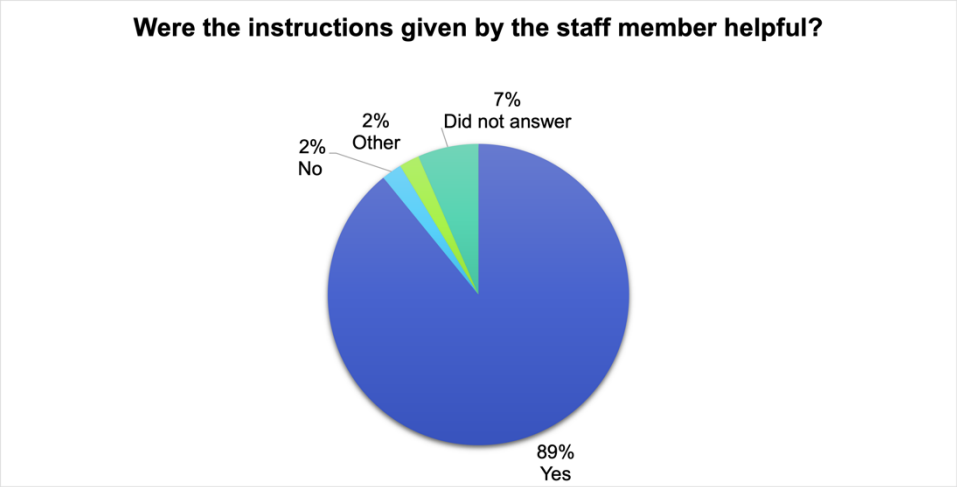

Figure 6. Student perception of staff support effectiveness.

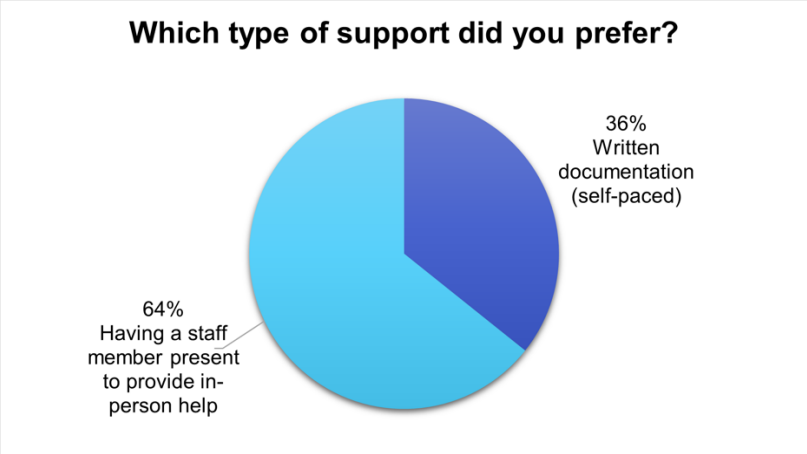

Figure 7. Student feedback on preferred type of support.

Comfort and Accessibility

The interactive VR film chosen for this project involved many challenging aspects. With a viewing time of twenty-five minutes, it is considered a long VR experience. Furthermore, participants need to be standing for the duration.

Students were asked to provide feedback on any physical or emotional discomforts associated with the experience. In fig. 8, we see the results of the students' evaluation of their comfort level using a scale from 1 to 5, in which 1 means *not comfortable* and 5 means *very comfortable*. The average result for the group was 3.6, with 54% of respondents reporting a value between 4 and 5. Surprisingly, the average value for students with glasses was slightly higher (3.8) than for students without glasses (3.4).

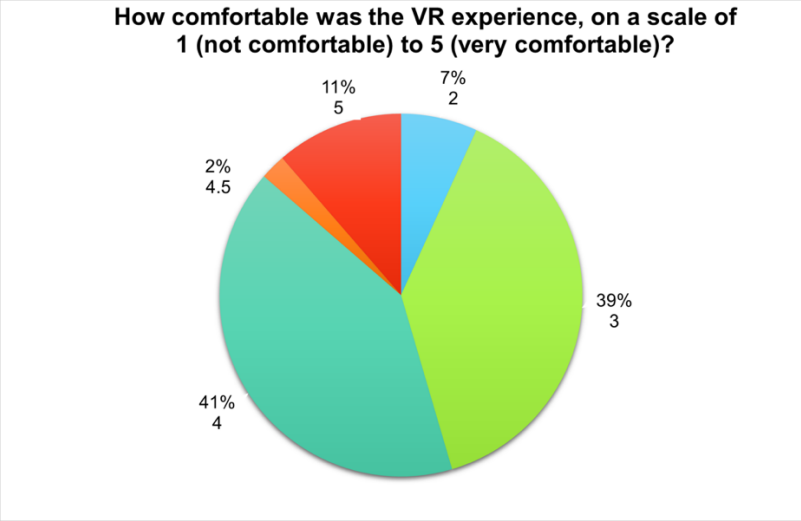

Figure 8. Level of comfort during the VR experience.

Of the 45 students who responded to the user experience survey, 55% wear glasses. Of these, 6 reported that they could not wear their glasses with the headset, and 7 students reported that their glasses made the experience uncomfortable with undesirable effects, including a feeling of tightness in the headset, with one participant even reporting a pressure-induced headache.

The survey also included a question on motion sickness and assessed its impact on the respondents' likelihood of completing the VR experience. In fig. 9, we see that 29% of respondents experienced mild to important motion sickness. However, only one participant reported stopping before the end of the film.

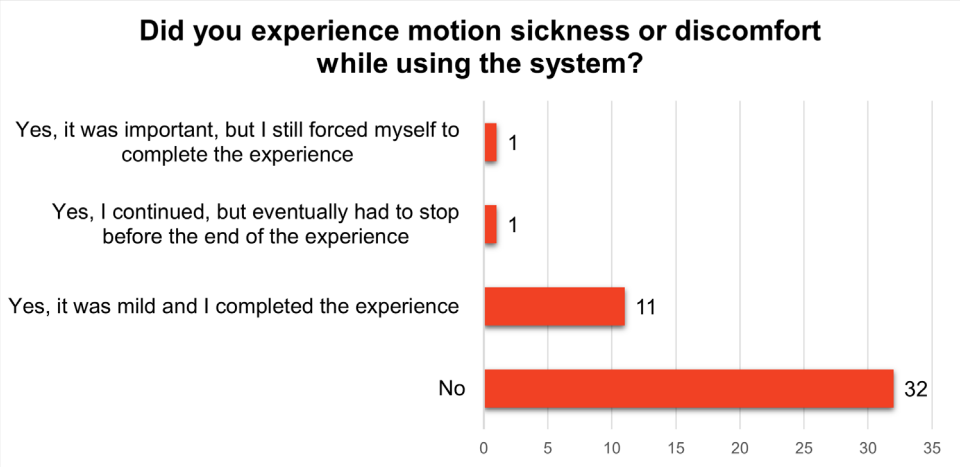

Figure 9. Motion sickness during the experience.

An open question on any other physical or emotional discomforts associated with the experience yielded interesting responses, including discomfort due to:

- Heaviness of headset
- Blurred vision
- Duration of the work
- Standing
- Being unsettled by the story's characters
- Emotional responses to the content (crying, feeling sad, difficult topic)
- Feeling the tugging of the computer cable

Although many students expressed discomfort-related issues in the user-experience surveys, for the great majority the experience was enjoyable. As we see in fig. 10, 84% of students rated the level of enjoyment at either a 4 or a 5.

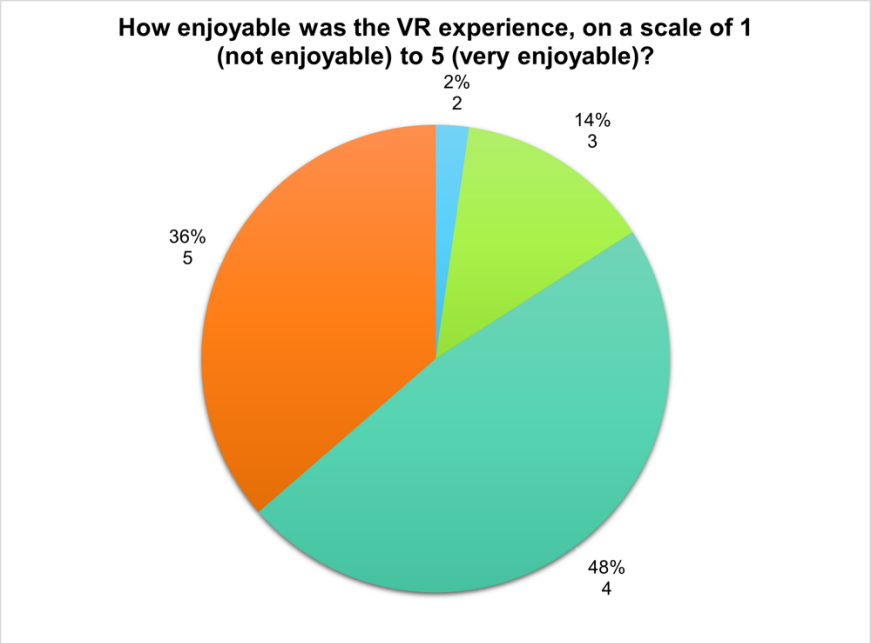

Figure 10. Evaluation of enjoyment.

Immersiveness

More than 61% of respondents thought that overall the experience was somewhat or highly immersive, while 31% expressed a neutral opinion and less than 6% thought it was somewhat not immersive or not at all immersive (see fig. 11).

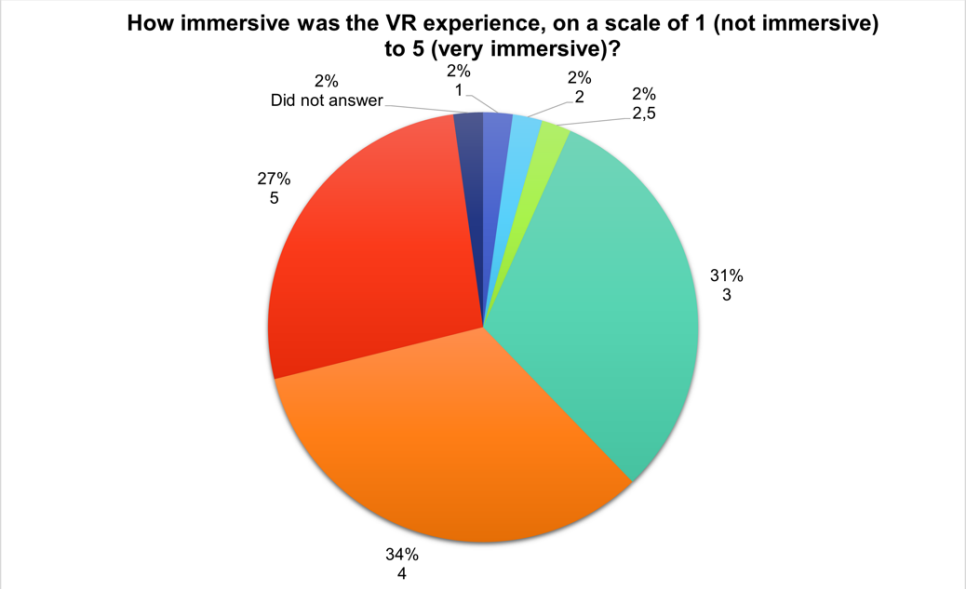

Figure 11. Immersiveness of VR experience.

Of the respondents, 87% said they were able to engage fully with the experience (see fig. 12). Of those (11%) who replied that they were not able to engage fully, some explained, in the open-ended responses, that technical glitches in the film hindered their ability to engage fully with the experience, while others

said discomfort owing to blurry vision and headset problems affected their experience. One student reported that their spotter had hindered their experience, while another mentioned that standing for the duration of a twenty-five-minute film posed a problem.

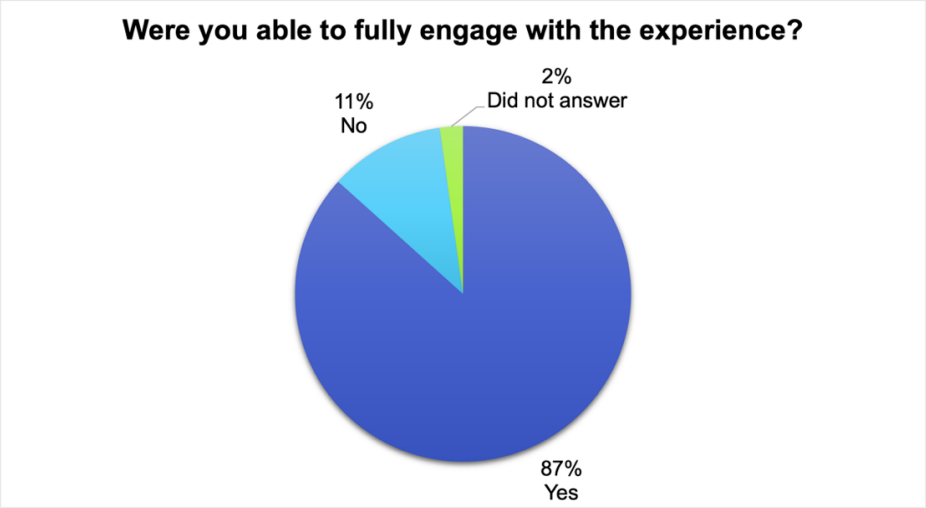

Figure 12. Respondents' engagement with the VR experience.

An important aspect of this VR experience was its impact on student emotions or mood. Of the respondents, 67% reported a positive reaction and 2% a negative one, while 31% indicated "other" (see fig. 13). Those who responded with "other" reported experiencing feelings of indifference, neutrality, ambiguousness, emotionality, and a sobering critical experience.

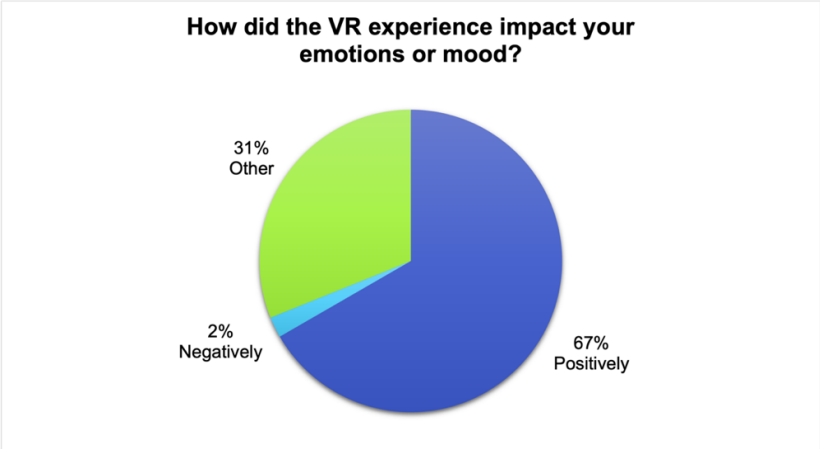

Figure 13. VR experience impact on emotions and mood.

Students experienced multiple emotional responses to the VR experience (see fig. 14). Most experienced sadness due to the story's content, but many also felt excitement and a few felt fear. Others felt intrigued, interested, or disoriented.

Figure 14. Specific emotional responses elicited through the VR experience (word cloud).

Learning Experience

For our team, gaining insight into students' overall learning experiences relating to the integration of VR into their courses was essential (see fig. 15). Overall, 84% of student respondents reported that the VR experience helped to facilitate their learning experience. Students described the VR experience as having been engaging, involved, invested, insightful, immersive, experiential, and memorable. They felt in control and liked exploring new mediums.

The VR film exposed students to new and unique ways of experiencing film and storytelling: 77% reported that it helped them form better connections to the course work. Two students indicated specific ways in which they could connect the film to their class readings and lectures. Some students explained that this VR experience made them appreciate their class even more, as they had never before taken a course which incorporated VR. Students were able to put VR theory into practice and explore the potential of VR for animated storytelling. Others found it captivating and felt closer to the filmmaker (who was a guest speaker in the undergraduate course).

It was found that 80% of respondents agreed that the VR experience had helped to promote discussion among their classmates and had allowed for a new, *shared* experience among students in the participating classes. Students indicated that they were able to exchange ideas on:

- The form and content of the film
- Possibilities of VR and animation
- Technical issues
- Feelings and emotions
- Accessibility
- Uniqueness of the experience

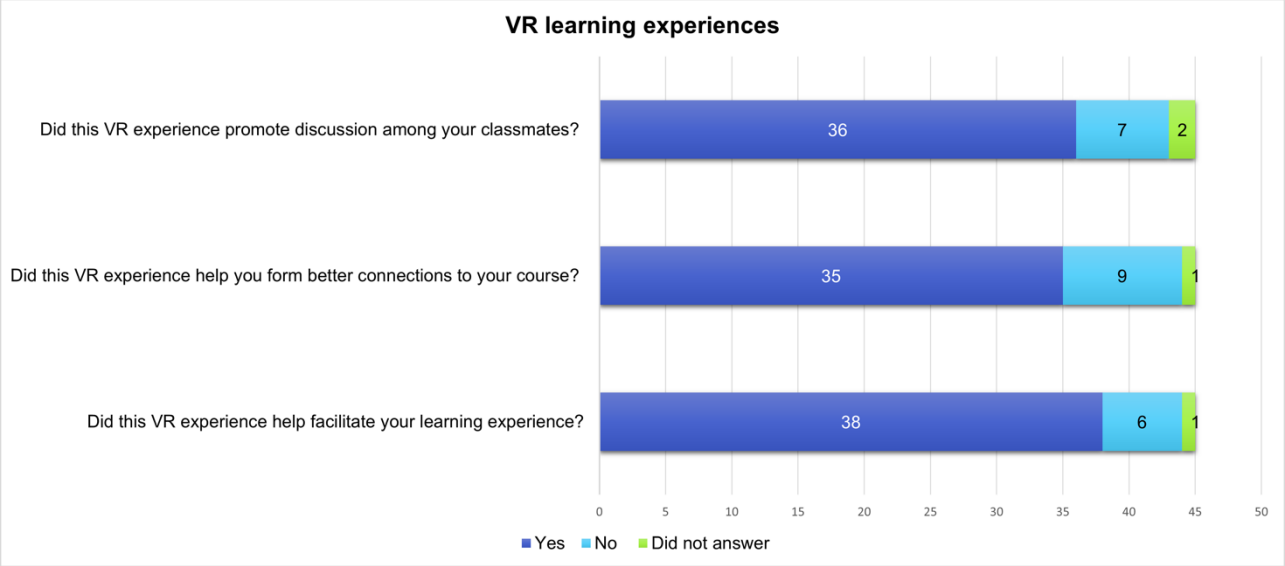

Figure 151. Learning experiences of VR.

As seen in fig. 16, when asked if this VR experience had helped them learn more effectively than they would have in a traditional, non-VR environment, 83% of students responded in the affirmative, either fully or partially. Many students reported that the experience was engaging and provided firsthand experience. One student explained that they easily become bored in traditional learning environments; in contrast, experiences such as this one offer a fascinating approach to learning. The interactivity of VR allows for an immersive learning experience. For some students, the provision of access to VR resulted in a unique and even exceptional learning experience, which might not have been easily accessible otherwise.

Figure 16. Effectiveness of VR experience compared to traditional, non-VR environments.

To gain insight into the impact of a course-integrated VR experience, we asked students if they were more likely to use VR after this experience: 65% answered yes, 30% maybe, and only 5% no (see fig. 17).

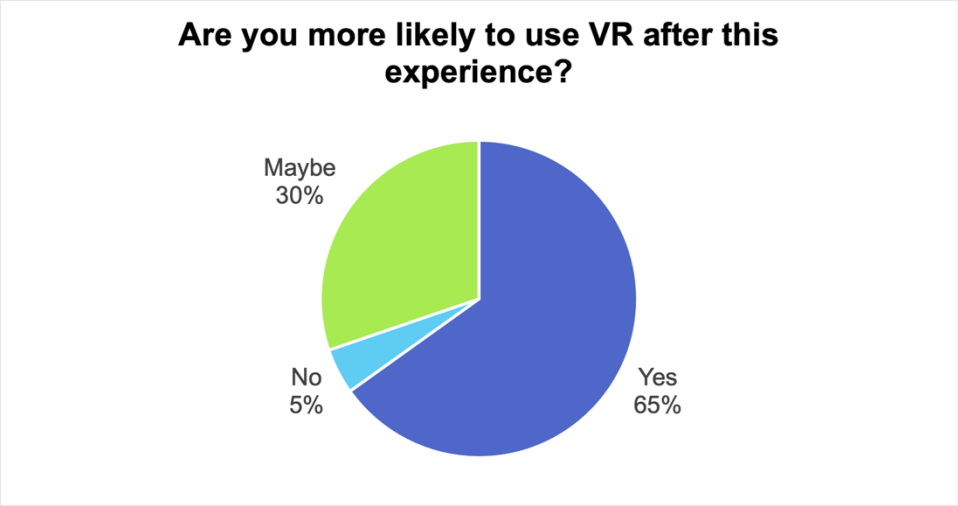

Figure 17. Likelihood of using VR after the class-related experience.

These results support the assertion that providing accessible VR through course integration can help contribute to one of the key UN Sustainable Development Goals: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."[7]

Future Implications and Focus Areas

Student Perspective on Future Developments

As seen in the results of this study, the VR initiative was broadly appreciated by students: 77% said they would like more VR content to be integrated into their classes. When asked how they would like to see the Library develop, the students' responses can be grouped into three themes:

- Offer a permanent, dedicated space for viewing VR resources
- Collection development: make available narrative-driven and story-focused artworks
- Offer similar VR activities/lessons/learning experiences

Transferability of Results

Both classes involved in the pilot were Faculty of Fine Arts classes. Professors from these classes reported that the VR experience facilitated student learning. One professor said of the VR experience that "it added such a crucial element to our theoretical, abstract readings. The experience also became a bit of a touchstone for the rest of our conversations that year. Students would often bring it up in conversation about many of the texts [they] read." In what might otherwise have been a traditional learning environment, access to the VR experience introduced an experiential component that enabled deeper engagement and understanding of the theoretical components, and remained in play throughout the semester.

Professors also reported that the VR experience facilitated class discussion. However, it should be noted that in both cases, students were expected to critique and discuss the experience itself as well as the artwork. For further analysis, it would be interesting to experiment with classes in other faculties, to determine whether including a VR experience as recommended class material might also positively impact learning experiences and outcomes in those environments.

Next Steps for the Pilot Project: Key Considerations

[7] United Nations, "Goal 4: Quality Education."

The pilot project aligned with the Library's desire to transform library services in parallel with the community's changing needs and explore new possibilities for supporting learning, teaching, and research. The request from faculty afforded us the opportunity to explore these possibilities using a hands-on experimental approach. It also allowed us to evaluate the library's readiness to offer VR works as course reserves.

Some of the lessons learned from this first deployment include:

- When introducing new technologies, successful adoption requires identifying and mitigating the technological barriers intrinsic to the technology.
- An adapted space for the technology is essential (adequate size, privacy, permanent equipment installation, and security parameters).
- Technical support needs to be available during access periods.
- Public-facing staff play an important role in ensuring that students have a successful learning experience, by facilitating timely access to the space and reporting issues to be designated for technical support on the students' behalf as necessary.

We identified several questions that require further exploration:

- Are course reserves the right means by which to connect the Library's expertise with professors in supporting curriculum?
- Should there be a course reserves room specifically for VR?
- How could the Library scale up or down from one semester to the next?
- How might this potential service compete for Library resources, space, and staff?

Upon reflection, we question whether the creation of a best practices guide focused on integrating VR content as course reserves or mandatory course content will be suitable for faculty. Professors should be aware of the possible adverse reactions to a VR experience. Such a guide could include information on how to select the most suitable VR content (length, presence of chapter breaks, preferred technology/platform, etc.) as well as consider other accessibility factors in relation to the VR resource and students' needs.

A review of the data will be presented to the library administration to inform decision making on whether the pursuit of VR, in support of teaching, could be a sustainable future project for the Library.

Acknowledgments

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