Immersive Empathy: Developing Interactive 360-Degree Video Projects in a Cylindrical Space for Social Awareness in a College Digital Art Class

Jinsil Hwaryoung Seo, Michael Bruner, John Alberse

Soft Interaction Lab, School of Performance, Visualization & Fine Arts, TEXAS A&M UNIVERSITY
College Station, TEXAS, USA
hwaryoung@tamu.edu, michaelbruner@tamu.edu, johnalberse@tamu.edu

Abstract

This paper explores the integration of immersive 360-degree video technology within the realm of art and design education, particularly highlighting its implementation in a college-level digital art class. Emphasizing the immersive nature of 360-degree videos projected in a cylindrical environment, the study investigates how such technologies redefine user experience by enhancing presence, engagement, and empathy. Unlike traditional videos, 360-degree videos envelop viewers in a spherical visual experience, creating a more profound connection to the content. The paper discusses the pivotal role of immersive experiences in art education, particularly in fostering a nuanced understanding of social issues and contexts. It demonstrates how such technology not only enhances the educational experience in art but also empowers creators and audiences to explore and understand complex social issues, opening new avenues for empathetic and socially conscious art creation. The experiences and outcomes of the students' projects illustrate the impact of immersive technology on both creators and audiences, suggesting a rich space for further research and development.

Keywords

360 video, immersive experience, interactive experience, social awareness, embodied interaction, art education

Introduction

In the evolving landscape of art and design education, the intersection of immersive aesthetics with interactive technology has emerged as an effective method to create art projects to raise the public's social awareness. We focus on the immersive nature of 360-degree video projected into a cylindrical environment and the user's embodied interaction through the "Interactive Virtual Environment" course. The 360 environments have significantly redefined the boundaries of user experience by offering a heightened sense of presence and engagement. Unlike traditional video, 360-degree videos envelop viewers in a spherical visual experience, providing a panoramic view that responds to the viewer's direction. This immersive quality creates a compelling illusion of being physically present in the depicted environment, thereby intensifying the user's emotional and cognitive connection to the content.

It is known that this immersive aspect of 360-degree videos has been used to transform the learning experience. It allows students to not only observe but to inhabit different environments and perspectives virtually. This immersive experience is pivotal in art and design education, where understanding and empathy are crucial to creating impactful works. 360-degree videos in the immersive environment foster a deeper level of engagement with the subject matter, encouraging a more nuanced understanding of social issues and contexts.

Moreover, the use of interactive elements within these 360-degree environments further enriches the experience. Interactive features such as clickable hotspots, branching narratives, and integrated multimedia content allow users to actively participate in their journey. This interactivity not only makes the experience more engaging but also empowers users to explore and understand complex social issues in a more comprehensive and personal manner.

This paper delves into how art students in the interactive virtual environment course have harnessed these technologies. It examines students' design processes and the technical development of the projects, showcasing how these immersive and interactive elements have been utilized to create powerful and socially aware artistic works. Through this, the paper aims to illuminate the transformative potential of 360-degree video technology in art education, particularly in its ability to foster a deeper understanding of social issues.

Background and Prior Works

This project has a strong conceptual and technical background. Conceptually, we focus on raising awareness of various social and personal challenges. In art creation, we use the relative lens, "put yourself in other's shoes." Regarding technology, we explore the benefits of the immersive 360-degree environment.

Put yourself in others' shoes through Art Creation

Art creation experience can significantly support the concept of "putting yourself in others' shoes," which is fundamental in developing empathy [1, 2, 3, 4]. Here are several ways in which art facilitates this process:

- *Perspective-Taking:* Art often requires the creator to delve into perspectives different from their own. Whether it's painting, sculpture, literature, or performance, artists frequently explore and represent the emotions, experiences, and viewpoints of others. This act of perspective-taking is a key component of empathy, as it involves understanding and sharing the feelings and thoughts of another individual.
- *Emotional Exploration:* Art allows for the exploration of a wide range of emotions, some of which might be unfamiliar or uncomfortable. By engaging with these emotions through art, individuals can gain insight into the experiences and feelings of others, fostering a deeper emotional connection and understanding.
- *Storytelling:* Many forms of art tell stories. These narratives, whether based on real-life events or fictional scenarios, enable viewers or creators to experience lives and situations different from their own. This storytelling aspect of art can evoke empathy by immersing the audience in the experiences of the characters, prompting them to feel what others might be going through.
- *Cultural and Social Exploration:* Art often reflects cultural, social, and historical contexts. Engaging with art can expose individuals to different cultural and social experiences, encouraging them to appreciate and understand diverse perspectives. This exposure is essential in developing a more inclusive worldview and empathy towards people from different backgrounds.
- *Reflective Practice*: Creating or experiencing art encourages reflection. This reflective practice can lead to a greater understanding of the human condition and the various challenges people face. Through reflection, individuals can develop a more empathetic approach to understanding others' experiences and emotions.
- *Safe Space for Experimentation*: Art provides a safe space to explore sensitive or challenging topics. This environment allows individuals to experiment with and understand complex emotions and situations in a controlled and thoughtful way, which can be crucial in developing empathy and emotional intelligence.

Immersive 360 Video for Evoking Empathy

Immersive 360-degree video technology has emerged as a powerful tool in empathy education [5, 6]. By immersing students in environments and perspectives vastly different from their own, this technology provides an experiential understanding that goes beyond traditional learning methods.

Immersive experiences, including VR and 360-degree videos, can enhance emotional empathy, although they may not significantly impact cognitive empathy [7]. This suggests that while immersive technologies are effective in evoking feelings of compassion, their role in fostering a deeper cognitive understanding of others' perspectives may be limited.

Embodied Interaction

Embodied interaction refers to the integration of physical movement and perception with digital experiences, enhancing the learning process by making it more engaging and memorable [8]. This approach is particularly relevant in immersive environments, where the user's physical actions directly influence their interaction with the digital content.

Lee-Cultura & Giannakos (2020) highlighted the importance of embodied interaction in developing spatial skills, a key component of successful cognitive task management [9]. In educational settings, embodied interaction within immersive technologies like 360-degree videos can amplify students' engagement and connection with the content, leading to a more profound understanding and retention of material, especially when addressing complex social issues.

Prior Works

Here are some examples of immersive interactive 360-degree video works that exemplify social awareness.

Clouds Over Sidra: This groundbreaking 360-degree documentary takes viewers into the life of a 12-year-old girl named Sidra living in the Za'atari Refugee Camp in Jordan. The immersive experience allows viewers to experience the daily life of a refugee, fostering a deep sense of empathy and understanding for their situation [10]

The Displaced - The New York Times: This 360-degree video tells the stories of three children displaced by war in South Sudan, eastern Ukraine, and Syria. The immersive experience puts viewers in the middle of their worlds, showing the impact of conflict on children and giving a firsthand look at the challenges they face. [11]

Traveling While Black: This VR documentary confronts the way African Americans have experienced restricted movement in the United States and the impact of these restrictions. It's a poignant exploration of the challenges faced by Black travelers, past and present. [12]

Design Task in Class

In the "Interactive Virtual Environments" course at Texas A&M University, students were presented with a design challenge: to craft an immersive, interactive 360-degree video experience. The core objective was to transport users into the lives of individuals from diverse cultural, social, or personal backgrounds, thus cultivating a deeper sense of empathy and understanding. Students were encouraged to delve into their personal interests and experiences, focusing

on socially relevant issues and challenges. To facilitate this, the university provided a state-of-the-art cylindrical environment equipped with six projectors, enabling the creation of captivating 360-degree video projections. Within this space, users are not merely observers but active participants, encouraged to physically navigate and mentally engage with the interactive narratives. This setup was designed to create a truly immersive experience, where users can not only see but also feel and understand the stories being told from a first-person perspective.

Immersive 360 Space

The Igloo System

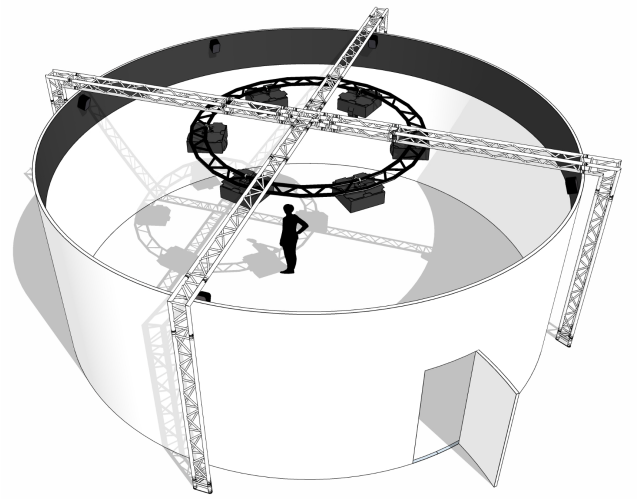

Figure 1. The Igloo System

The class used the Igloo system (Figure 1), which is made by Igloo Vision [13]. We used a cylindrical model that consists of a large projection screen suspended by a steel frame. A set of six Epson 8K ultra-short throw projectors is suspended from the center of the space, with their projections overlapping. The environment was operated by the Igloo Core Engine (ICE) software. It handles warping and gamma correction of those projectors to create a seamless blend across all six projectors, essentially providing a unified 360-degree display. The ICE software also provides a content management system for receiving input from NDI, Spout, and other sources, as well as layering and positioning those inputs.

Additionally, the company offers specialized plug-ins for both Unity and Unreal Engine, designed to integrate projects created in these engines with the Igloo display system. While the primary function of these plug-ins is to facilitate the playback of 360-degree videos, they initially offered limited scope for user interaction. Recognizing this limitation, the course's instructional team developed an advanced interactive system. This innovative system enables users to actively navigate within the 360-degree projection environment, offering a more dynamic and engaging experience. Through this enhanced interactivity, users can explore various narrative paths, making choices that lead them through different storylines. This development significantly elevates the user experience, transforming passive viewing into an immersive journey where selections directly influence the unfolding of emergent narratives.

Interactive System Development in the Igloo

We created a digital twin of the Igloo within Unity with an array of virtual cameras at its center. The virtual Igloo was created with the same dimensions as the physical Igloo. The main interactive system utilized the HTC VIVE system, which consists of base stations, a head-mounted display (HMD), and controllers [14]. We added four base stations for tracking VR controllers in the Igloo space. The controllers are tracked with a 1:1 correlation between the physical and virtual spaces; a ray is cast from the virtual controller for interaction with UI elements and to display a cursor (Figure 2).

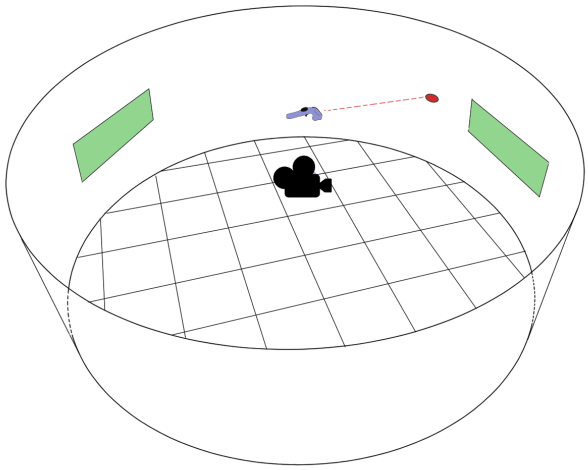

Figure 2. The virtual Igloo configuration

The virtual Igloo was assigned a material with a render texture for its diffuse and emissive texture maps. Unity's VideoPlayer component has an option to render to a target texture; we set this to the virtual Igloo's render texture. When the video player was activated, the 360 video would display on the virtual Igloo.

The camera array in the virtual scene consists of 4 cameras which together capture a full 360-degree view of the space. They capture the virtual Igloo, including the video being displayed on it. The cameras also capture objects in the scene that lay between the cameras and the virtual Igloo. UI elements, text, and special effects can be added to the scene in this manner. This is how the interactable buttons in the original template worked. Objects that shouldn't be captured by the cameras, such as the virtual controller model

and interaction ray, can either be hidden in the scene or excluded via render layers.

The output of the cameras is remapped onto a texture with a resolution matching the Igloo's display resolution. That texture is then sent via Spout to the Igloo ICE software to be projected onto the physical Igloo.

Students were provided with a basic interaction model template. The template managed a set of "clips," each of which contained a 360 video and a set of buttons. Each button had a "target clip" associated with it. When the button was clicked, the target clip would be made active and begin playing on the Igloo material, which was then projected. The previous clip's buttons would also be disabled and hidden, and the target clip's buttons would be made active and visible within the scene. This system allowed students to construct a narrative flow by dragging and dropping clips and buttons within the template (Figure 3). Each clip has a set of buttons (represented by arrows), which, when pressed, start another clip and make its buttons visible and active.

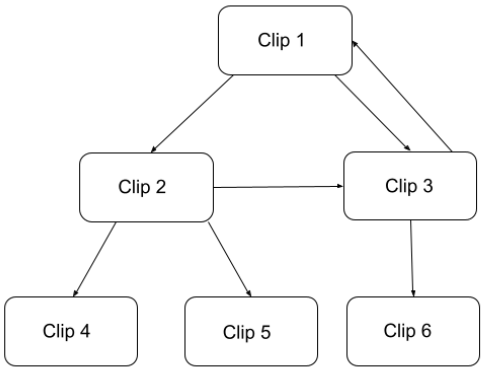

Figure 3. An example of interactive narrative flow

Students could expand on this template to improve on the interaction model. For example, some groups created a "spotlight" effect around the cursor, obscuring the video in darkness wherever the user was not pointing.

Interactive Design Process

In this project, the students followed a typical interactive design process that begins with thorough **research and concept development**, where students choose a subject they are passionate about, conduct interviews, and gather stories to deeply understand the chosen topic. Following this, students worked on the **concept development** through storyboarding their narrative, carefully planning out scenes and interactions to ensure a compelling and coherent experience. In the **design phase**, students worked on the interaction flow, mood board, color scheme, and visual design. The **production (prototyping) phase** involves capturing 360-degree footage, where students will need to consider the unique aspects of VR filming, such as camera movement and viewer engagement. A critical component of this task is the integration of interactive elements, like clickable hotspots or branching narratives, to enhance viewer engagement and deepen the understanding of the subject matter. The **editing and post-production process** will involve combining visual and audio elements using 360 video-specific tools to create a seamless experience compatible with 360 video platforms. After developing a prototype, students conducted **user testing** to gather feedback, which is crucial for refining and improving their projects. User testing for this project involved informal feedback between students and instructors. Notes on clarity, structure, user interface and overall presentation were given to each team to improve their final presentation. The culmination of the task is a **final presentation** where students will showcase their interactive 360-degree video, discussing their creative process, design rationale, intended impact, challenges faced, and insights gained. This comprehensive task not only encourages students to harness their creativity and empathy but also provides them with valuable experience in utilizing advanced technology for socially impactful storytelling.

Students' Projects

In this class, nine student projects were created, and we presented two example projects here.

Project 1: Choose Your Own Imagination

Concept Overview: "Choose Your Own Imagination" is an interactive 360 video that shows the point of view of an artist's process of remembering what to draw. This project was intended to support viewers "put [themselves] in other's shoes" by showing the perspective of varying degrees of aphantasia. Aphantasia is the inability to form mental images of objects that are not present. The viewer can look into their imagination to see what they are supposed to be drawing and make a decision based on what they see. As the decisions progress, the viewer's imagination depicts varying degrees of aphantasia by making the picture harder to understand [15]. At the end, there is no picture, and the viewer has to guess, which brings them to the final video that explains aphantasia.

Target User Group: This piece's target audience is artists, young adults, and people who are interested in experiencing a new perspective.

Interactive Experience: The interactive elements lie in the viewer's ability to choose what they "remember." This project is a series of short videos that are linked at the end of each video in the form of choices. For example, if the viewer sees an apple in their "imagination," then they can choose between drawing an apple or a pear with links at the end of the introductory video. As the viewer makes these

decisions, the clarity in which they can "imagine" will diminish, creating a contrast between the varying degrees of severity in aphantasia. The team depicts this using a flashlight function that allows viewers to "spot the fruit" within their own imagination, each choice increasing the difficulty.

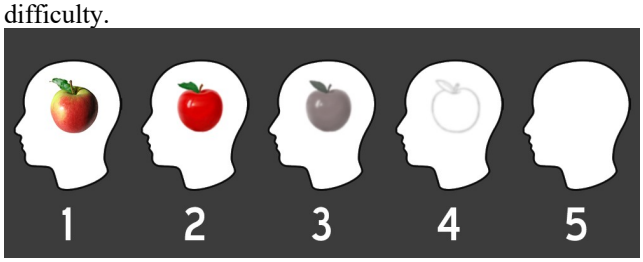

Figure 4. Visual Design

They focus on the visual aspect of aphantasia because this is a multisensory condition, meaning that some people could lack the ability to imagine touch, smell, sound, and taste as well.

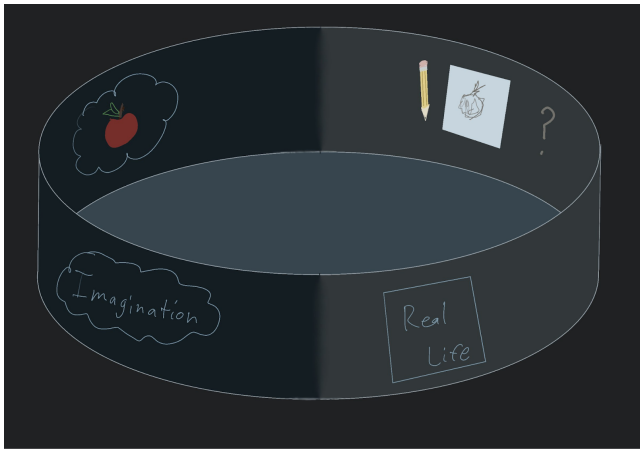

Figure 5. Concept of two worlds

Final Outcome/Presentation: The project was well executed by providing two sides: reality and imagination. In the project, audience members were fully engaged with the 360 projection screen and the interaction flow. Here are two sides of the project.

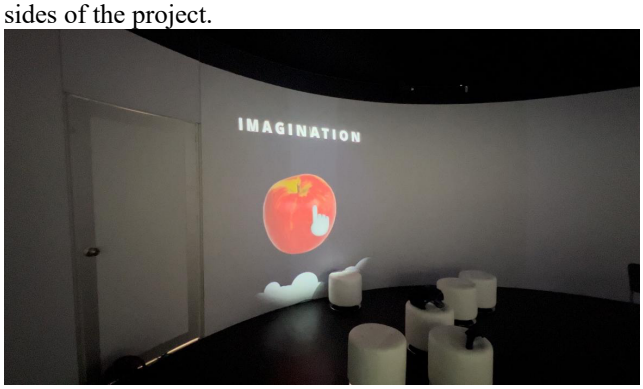

Figure 6. The imagination side of the project

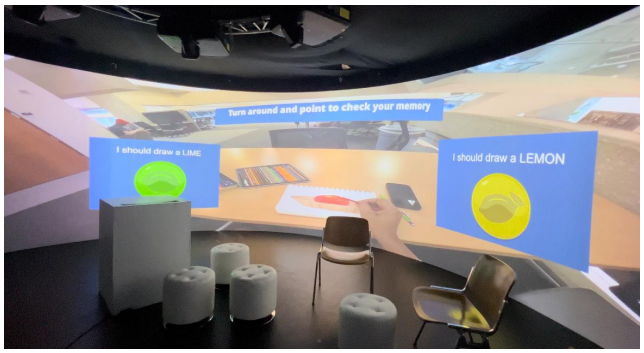

Figure 7. The reality side: artist's drawing

Users had to search their imaginations with the flashlight effect to find the correct answer. This process simulated how a person with aphantasia might experience the world. Additionally, the immersive environment, combined with a first-person perspective and inner imagination world, further personalized the experience.

Students' Experiences: Throughout the interactive design process, the students adeptly crafted an immersive environment that delves into the life of an individual with aphantasia. This endeavor involved conducting thorough research and deeply immersing themselves in the issue, embodying the experience to enhance their understanding and empathy. The students placed a strong emphasis on both the immersive quality and the interactive aspects of the environment. Their journey through this creative process yielded insightful experiences, some of which are highlighted in the following excerpts.

"Our final demo was really good, and got great reception and feedback from the class. We did update our UI based on the feedback we've got."

"After demoing the project to the class and having others test the experience, we discovered that the split we created between reality and imagination was an effective method of demonstrating aphantasia."

"We felt that this immersive environment is good for telling the story of an artist with Aphantasia. We hope that this project has been useful in helping others better understand Aphantasia, whether they experience it themselves or are unaffected by it."

Project 2: 360 Panic Experience

Concept Overview: This project explores the concept of stepping into the shoes of someone experiencing a panic attack through an immersive 360 video. The user chooses where to go during an anxiety attack, providing an understanding of their overwhelming nature and raising awareness for those who haven't experienced it. This project strives to illuminate the challenges of someone who

experiences panic attacks and provide the tools necessary to help oneself or others.

Target user group: The target user groups for this piece are Mental Health Educators, family, and friends of those with anxiety disorders, and educational institutions.

Interactive Experience: A user walks into the on-campus crowded Starbucks, surrounded by very loud noise and multitudes of people seemingly staring at the user, leading to a panic attack forming within. As discomfort creeps in, the user's heart rate starts to quicken and they can hear the pounding of their heartbeat. The user's surroundings start to tunnel in, and the field of view gets tight. Breathing becomes difficult and the air feels thin as if the walls are closing in on the user. They become hyper aware of every sensation in the user's body, chest tightening and feeling strained, as if a heavy weight is pressing down on their chest. People passing by seem to judge the user as it is hard to comprehend what they are saying or where they are looking. The user is sweating and shaking, flight or flight response is in full effect, even if there is no visible danger. The user has the choice to leave the area to the library, then are given choices of what to do next, like drinking some water or leaving the building. Some choices will be blurred out at first to increase the feeling of panic and not being able to think clearly. The intensity starts to die down, and things return to 'normal.' By the end of the simulation, the user is left with insight on this seemingly invisible experience (Figure 8).

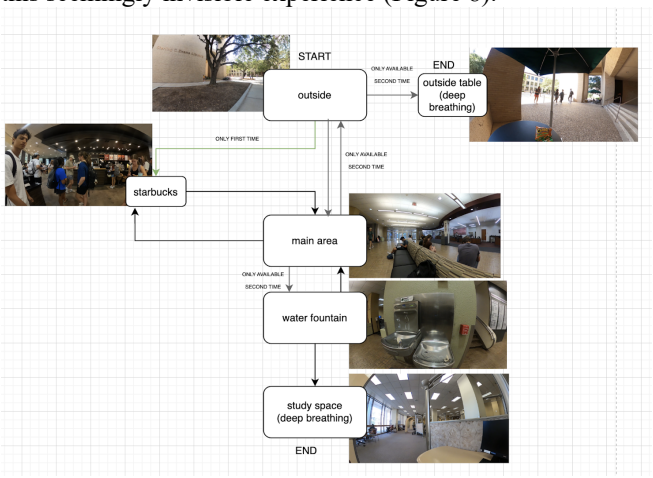

Figure 8. Interaction flow

Final Outcome/Presentation: The videos were shot all in or around the Library Building. This mostly went smoothly apart from the public recording concerns. The editing was done in Premiere Pro, and the video effects used were lighting brightness, wave warp, camera blur, static, and edge pinning. Adobe After Effects was used to make the title and ending screens as well as edit the final videos. Students added in more user flow between the spaces so that the path isn't so linear, but instead hopefully incites a feeling of confusion and disorientation to heighten the intensity of the experience. Their final updated Unity file has more intense effects added, and the scale has been fixed as well.
Figure 9 is the 360-degree video, and Figure 10 shows the user interacting with the projected images in the Igloo system.

Figure 9. 360 Video of Pain Experience


Figure 10. User experience in Igloo

Students' Experiences: As the students navigated through the interactive design process, the students encountered various challenges and learning opportunities, particularly in their project exploring a person's life. Here are some reports from the students.

"The 360 Igloo environment provided an effective space for special exploration of visual elements, such as a jumble of words across the screen, to convey complex thoughts and emotions."

"We liked to explore the concept (pain attack) that many students experience daily."

"After testing our project with users, we identified some main areas for improvement. One area is to enhance the visualization of panic attacks. Although we incorporated audio and visual effects in the 360 videos, we could have pushed these effects further to better portray the experience of having a panic attack. As our initial venture into this medium, we consider it successful."
"With more time and refinement, it has the potential to become a valuable tool for mental health educators."

These reflections highlight the complexities of creating immersive interactive environments and the valuable lessons learned by the students in the process of developing their projects.

Discussion & Conclusion

The endeavor to integrate immersive 360-degree video technology in a college digital art class, as detailed in this paper, has demonstrated the potential to enhance educational experiences, particularly in the realm of fostering social awareness and empathy. The projects undertaken by students, including the exploration of aphantasia and the simulation of a panic attack, serve as exemplary instances of how immersive technology can be leveraged to create impactful and socially aware artistic works.

The experiences of students facing technical setbacks and learning from the iterative design process highlight the real-world challenges and resilience required in such innovative endeavors. These projects not only succeeded in providing users with an immersive experience but also in educating them about complex conditions like aphantasia and panic attacks. The ability of these projects to put users in the shoes of someone else, to let them experience a slice of another's reality, is a powerful testament to the potential of immersive technology in education.

Furthermore, the development of an interactive system within the Igloo environment, enhancing user engagement and narrative exploration, represents an advancement in the field of interactive design. Future work can compare the impact of the Igloo environment to other media, such as HMDs and flat screens, and explore the impact of these various mediums. One major benefit we see is that the Igloo enables multiple participants to be immersed simultaneously and share a communal experience. In contrast to most VR and AR experiences which isolate the participant from other physically co-present participants, this system allowed students to push the boundaries of traditional storytelling, creating narratives that were not only immersive but also responsive to user interactions.

In conclusion, the integration of immersive 360-degree video technology into art education has opened new avenues for empathetic and socially conscious art creation. The experiences and outcomes of the students' projects illustrate the impact that such technology can have on both the creators and the audience. As technology continues to evolve, it will undoubtedly provide even more opportunities for educators and students to explore and express complex social issues, thereby enriching the educational landscape with innovative and impactful learning experiences.

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