The Implementation and Impact of the Surrogate Avatar Experience (SuAvE) on Interrelationships Within Higher Education

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Abstract

Higher education learning environments rapidly reshape traditional notions of learning, stemming from digital environments predominantly utilized during the COVID-19 pandemic. As digital technologies increasingly become more utilized within curriculum and learning spaces, examining pedagogy, technology, and the configurations of these spaces requires further exploration and examination. This paper discusses the implementation and impact of the Surrogate Avatar Experience (SuAvE) on the interrelationships within higher education learning spaces. SuAvE navigates the intersection of digital technologies, bridging them to the physical realm of learning to provide physical embodiment within the hybridization of educational spaces. Four case environments where implementations of SuAvE are analyzed to understand the interrelationship in the four defined dimensions of connected, embodied, relational, and socio-material space. Through methodology and results, this paper seeks to contribute to the ongoing discourse surrounding the transformation of learning spaces. It offers an innovative approach to combat the limitations of physical embodiment within current hybrid-learning practices. This multidimensional lens evaluates SuAvE's impact on higher education, recognizing its role as both a catalyst and a canvas for innovation and transformation.

Keywords: physical embodiment, surrogate avatar, remote participant, hybrid learning, higher education, socio-material space

1. Introduction

1.1 The Project Positionality Within Hybrid Learning

Hybrid learning, a pedagogical approach that combines traditional face-to-face instruction with online learning components, has gained prominence in recent years, particularly in response to the increasing demand for flexible education models. This method allows students to engage with course materials through various modalities, fostering accessibility and personalized learning experiences. By blending in-person interactions with digital resources, hybrid learning aims to cater to diverse learning styles and needs, ultimately enhancing educational outcomes.

The benefits of hybrid learning are numerous. First, it provides flexibility, allowing students to tailor their learning experiences to fit their schedules and personal circumstances. This adaptability is particularly valuable for non-traditional students, such as working professionals or those with familial responsibilities.

Despite its advantages, current hybrid learning technologies face significant challenges that can hinder their effectiveness. One of the primary issues is the need for embodiment within these digital frameworks. Many platforms must facilitate the physical presence and sensory engagement necessary for deeper learning. Students who participate in hybrid learning using stationary digital screens that lack movement from the professor’s viewpoint, may experience disembodiment, leading to feelings of isolation and detachment from their learning environment. This disconnect can negatively affect motivation, engagement, and overall academic performance. In addressing this lack of embodiment, it is essential to consider its impact on the connected, embodied, relational, and socio-material spaces of learning environments. The ability of an environment to provide interactions between students and educators in a physical location through technology allows for developing interpersonal relations for collaboration and open communication.

As such, hybrid learning technologies require adjustment to reflect on the gaps associated with current hybrid education models, as they play a vital role in navigating the physical and virtual environments. By incorporating features that enhance connectivity, promote embodiment, and foster relational and socio-material dynamics, hybrid learning technologies can help bridge the missing aspects of traditional hybrid learning approaches. Integrating a system to overcome the shortcomings of these challenges can ensure that all students thrive in the dynamic educational landscape.

1.2 Approaching Previous Literature and Experimental Studies

The increase of hybridization in higher education is transforming methodologies related to teaching and learning. As educators and students navigate this evolving terrain, a need to critically engage with the emerging learning landscape exists. The hybridization of learning, also commonly referred to as blended learning, has multiple definitions framed around the "mixed mode of instruction, formally combining traditional face-to-face instruction and pure online learning" (Olapiriyakul & Scher, 2006).

In a post-pandemic context, where classrooms began resuming in-person facilitations, the continuation of hybrid learning was demanded by students for its accommodating nature (Krishnan & Nagaratnam, 2023). Undergraduate and postgraduate learners prefer the method of hybridization in learning as it enables them to more easily balance academic, professional, financial and social environments while satisfying educational requirements (Ali, 2019; Snart, 2010). Alongside this, higher education faculty members generally support hybrid learning methods as they achieve greater accessibility for students in higher education but recognize that the quality of education has an impact from the lack of face-to-face interactions in the learning environment (Abdelrahman & Irby, 2016). Furthermore, the implications of hybrid-learning within education rely heavily on educators to utilize digital tools and modify traditional course material and assessments, which has been an adjustment to faculties, educators, and learners alike (Dikilitas & Rambla, 2022).

While there has been an understanding of the benefits of hybrid-learning methods, such as the flexibility that provides students with accommodations, there is the suggestion that the teaching-learning process requires physical embodiment within higher education (Raes et al., 2020; Rodríguez-Jiménez & García-Merino, 2017) In a study regarding physical embodied experiences, a study was conducted with fourth-year University students, comparing in-person classmates to their strictly remote counterparts to understand the difference in the hybrid-learning realm (Foo et al., 2021). In the identified areas of proficiency, participation, communication, preparation, critical thinking, and group skills, the students with physical embodied learning had a higher observed performance. The conclusion suggested that having a sense of belonging in a learning environment increased motivation and satisfaction for students. Studies comparing online learning and in-person learning were also conducted, where the observation entailed that there was a significant positive relationship between authentic learning and social presence; the conclusion was that online courses need an aspect of social presence to increase interest and engagement (Stankovska et al., 2021). Lastly, in specific STEM-related courses, it was determined that there is a need for embodied experiences to grasp educational concepts fully (Weisberg & Newcombe, 2017).

This physical embodiment is a vital missing component in current hybrid learning implementations, creating a need for more engagement in online educational spaces (Raes et al., 2020). As such, higher educational environments have been considering different methodological approaches to bridge this gap in experience for remote students.

Introducing secondary avatars to navigate physical environments has been facilitated to address the lack of physical embodiment observed in many higher education environments. In the case of "avatars", it signifies any object or person that acts as a stand-in for another person within a physical environment and can be controlled or given a direction on behalf of a person. The implementation differs between studies conducted. Robots are an example of these physical avatars that assist with mobility and teleconferencing abilities. Specifically, in a case used for senior citizens, the robots were programmed to engage in social environments through gestures, speech, and facial expressions (McGinn et al., 2020). However, this research project showed that there are still barriers to social interactions connecting with robot avatars in human-robot interaction. Similarly, most applications of robotic avatars in different workplace settings are associated with high costs and require specific programming for each environment, which makes it challenging to implement in higher education. As such, cases of interactions between human avatars have also been studied, where the human surrogates are objects. Specifically for collaboration and education in smart cities, human surrogates and avatars are implemented to complete tasks that are dangerous or physically demanding, and aid in the development of the city (Hughes, 2014). However, when implementation into social settings occurs, the presence and connection of human-surrogate becomes a vital aspect of how students learn and the capacity to integrate into the environment. Social presence and awareness are factored into integration, prompting questions

regarding the connection between humans and co-presence in how humans feel when they are co-located with their surrogate avatar (Kim et al., 2017).

1.3 Objective of SuAvE

The Surrogate Avatar Experience (SuAvE) aims to provide embodied experiences in hybrid environments for remote participants through a surrogate avatar volunteer for implementation within higher education learning environments to address the existing lack of embodiment. Compared to hybrid learning, or robotic avatars, SuAvE enforces connection, bridging the gap between remote learners and their peers. This innovative approach makes SuAvE the first of its kind to specifically tackle the challenges of enhancing embodiment in remote learning by leveraging human-volunteer surrogate avatars to provide new interactive educational experiences.

2. Method

The materials and methods for SuAvE were developed using grounded theory to conduct research related to generating theories and concepts rather than previous hypotheses (Chun Tie et al., 2019). The comprehensive nature of the Surrogate Avatar Experience is best conducted through this approach to build theories directly from observations and experiences of the interactions of surrogate avatars and their remote participants related to societal implementations. Implementing SuAvE in the following and predominantly free-form studies allows for exploring diverse perspectives and experiences within the given context of higher education adaptations. Furthermore, the iterative approach of grounded theory allows for the continuous refinement of SuAvE implementations. Amongst all trials, consent was obtained, and the participants remained anonymous.

2.1 Materials and Methods

This study employed open and anonymous interviews as the primary instrument for data collection. Participants included students and faculty members from the University of Ottawa, all of whom volunteered to participate in the project through word-of-mouth or graphic promotions. An ethics approval was obtained before conducting the experience to ensure the study adhered to ethical standards and protected participant confidentiality. This approach gathered authentic qualitative data and allowed in-depth exploration of participants' experiences and perspectives regarding the surrogate avatar and remote participant interactions with the environment.

2.2 General Integration of SuAvE

The Surrogate Avatar Experience is a socio-technical approach to academia that enables individuals to interact with physical learning environments from a remote virtual environment. Volunteers are asked to take on the role of either the surrogate avatar or the remote participant, where a connection between the physical and virtual planes of learning is then organized. The surrogate avatar assumes the responsibility of physically representing a remote participant who attends virtually and requires physical embodiment.

Different approaches exist to recruit volunteers, including developing posters, emailing student groups, and implementing SuAvE in the classroom. Informed and voluntary consent is obtained from all participants in SuAvE through an initial orientation call that explains the purpose of explaining SuAvE, the roles of participants, key terms, and the potential use of observations in a thesis research paper. Surrogate avatars and their remote participants are connected through a provided Microsoft Teams link after being matched based on volunteers' availability and obtaining consent to participate.

With the current implementation iterations, people interact with this experience from different technological standpoints, leaving many slight adjustments to the set-up of SuAvE that will be addressed in their independent subsections.

At its base, the materials involved include: a device with videoconferencing capacities, a microphone, and a harness. Other alternatives include headsets or a neck harness, depending on the execution of SuAvE in a certain environment. Sample schematics are depicted in Figure 2.

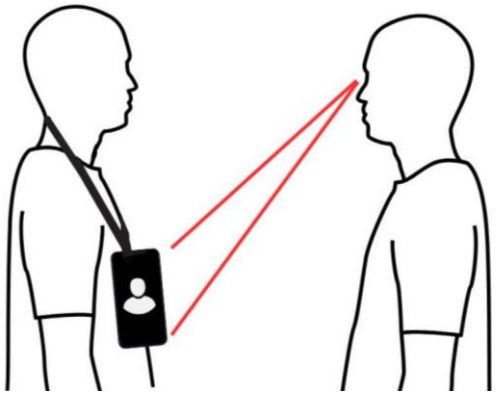

Figure 1. The Surrogate Avatar Experience Overview

Description: The person on the left side of the image is the surrogate avatar, who is attending a physical environment on behalf of the remote participant, who is located on the device screen that is being worn. The person on the right side of the image is the third-party observer interacting with the remote participant through the contact area, signified by the red line.

Figure 2. First-person perspective of a third-party participant of SuAvE showcasing the surrogate avatar and the remote participant on the device screen.

Description: The left schematic depicts a harness used alongside a headset, allowing the surrogate avatar to communicate directly with the remote participant and maneuver in the physical environment. In the right schematic, the surrogate avatar utilizes a lanyard for the personal electronic device that the remote participant is in attendance with.

Four implementations of the SuAvE were studied, as detailed in the following sections.

2.3 Integration in Shared Learning and Presentations Environment

In Fall 2023, SuAvE was implemented to undergo a tour of Design Day for a remote international attendee. Design Day is a highly anticipated research event on a university campus that is dynamic and involves communicating and listening to students in a large, crowded space. The set-up of Design Day can entail over 40 projects being showcased between 9am-2pm, with 3-4 presenters per project. Attendance between judges, presenters, and other viewers can reach a capacity of well over 500 participants in a 2-story building. Due to this chaotic environment, hybrid sessions can rarely occur, limiting the research presentation to the local audience.

Using Microsoft Teams as the web-conferencing platform, the surrogate avatar and the remote participant connected at an agreed-upon time to account for time-zone differences. The surrogate avatar, situated on campus at Design Day, then walked around to the different presentation booths, explaining that they represented a remote participant from a different country to the student presenters. The attention was then directed to the remote participant. Without discrete instructions from the surrogate avatar volunteers to the booth speakers, there were a variety of reactions possible to occur. In some cases, the booth speakers would directly control the device the surrogate avatar was using. In other

cases, the surrogate avatar would move the device based on their perception of the booth or under the direction of the virtual participant. In this case, no hardware was particularly controlled, and this interaction demonstrates the perception of how people interact with SuAvE without formal directions or instructions.

2.4 Integration in the Classroom for Students

In the Fall of 2023, SuAvE was implemented in a graduate course for an international student who needed help physically attending project-based class. In conjunction with an institutional policy regarding classroom attendance and participation, graduate students are required to be present in the classroom. SuAvE was offered as a method of satisfying and accommodating to the remote participant's attendance policies in the curriculum.

The remote participant and surrogate avatar were presented with the same Zoom link to connect. Before connecting, they had an opportunity to meet briefly, so that introductions would not impede the experience. The surrogate avatar utilized a personal cellular device, a pair of Bluetooth headphones, and a harness to conduct the experience, similar to that in Figure 2(a).

2.5 Integrations in the Classroom for Professors

An implementation of SuAvE in the Fall 2022 semester was conducted, where students from a mixed graduate and undergraduate class were instructed to attend different buildings on campus to participate in public presentations to their peers related to course work. Upon set-up, one person from each group was selected as the surrogate avatar participant for the professor, who acted as a remote participant. The remote participant could then evaluate the students' presentation skills and delivery of materials to the public, alongside guiding the students to improve their presentation experience. With 10 groups in 10 different locations, Zoom was used as a videoconferencing platform for its capacity to manage breakout rooms so that the remote professor could move between different physical spaces without physically being on the site of the presentations. This integration allowed for groups to present simultaneously to upkeep class-time productivity. The professor would not be present with every group at once but would be free to join the conversation to observe as needed. This schematic is depicted in Figure 3.

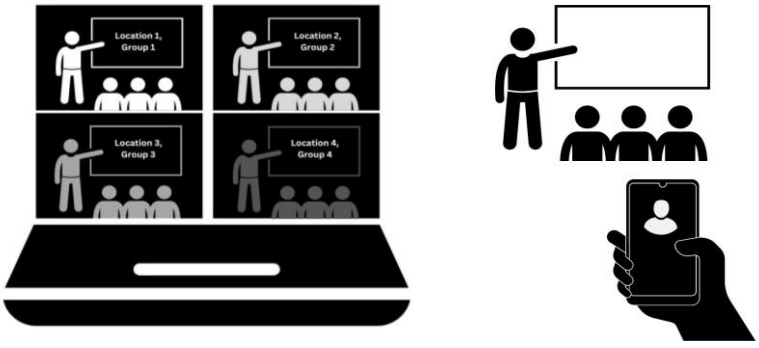

Figure 3. Integrations where one remote participant can be represented by multiple surrogate avatars.

Description: The left schematic depicts the perspective of the remote participant and the ability to navigate many different physical environments with differing representations. Only one video feed was active at a time, as facilitated by the 'Breakout Rooms' feature on the Zoom platform. The right schematic depicts the perspective of the surrogate avatar, utilizing a personal device to showcase the environment to the remote participant for navigation purposes.

2.6 Integrations in Project-Based Studies

In Fall 2023, a series of implementations of SuAvE were conducted to accommodate a group of engineering students working on their independent final capstone project. The capstone project is imperative to completing an undergraduate degree in the Faculty of Engineering, where capstone groups are required to have clients that interact with different iterations of their project and provide feedback to the group and their professor. Scheduling conflicts between the client and group members were consistent, where the client of the capstone group or the group members themselves could not always physically attend meetings. SuAvE was utilized to accommodate this challenge and not impact the capstone group's requirements. The overall intention in this utilization was to understand different conditions of SuAvE within the same environment with the same participants' group and alternating roles.

This capstone study was conducted over a 4-session period, where 4-instances were trialed using SuAvE. The first

three weeks of this SuAvE implementation entailed the client being the remote participant, attending through a surrogate avatar volunteer who was a group member. The fourth week entailed a study where multiple surrogate avatars represented multiple remote participants; the remote participants were the client and one of the group members. This study attempts to create similar conditions with the same participants to draw conclusions about interactions of SuAvE in learning spaces and understand the perspectives of third-party observers in the experience.

Specifically, in this trial, a neck harness was used as the accessory to prop the personal electronic device on, as depicted in Figure 4.

Figure 4. SuAvE Design utilizing a neck harness as the accessory for holding the personal electronic device.

Description: The neck harness is worn by the surrogate avatar, and the remote participant is prompted on the neck harness device. Although difficult to illustrate, the video feed was externally facing from the Surrogate Avatar's viewpoint.

2.7 Overview of Data Collection Methods in Each Case

A summary of the key details related to each implementation methodology is described in Table 1.

Table 1. Key details related to the differences or similarities in materials and methodology between the 4-explored implementations of SuAvE.

	Integrations in Shared Learning and Presentation Environments	Integrations in the Classroom for Students	Integrations in the Classroom for Professors	Integrations in Project-Based Studies
Surrogate Avatar	Student	Student	Student	Student
Remote Participant	Student	Student	Professor	Client
Surrogate Avatars	1	1	10	1-2
Physical Group Size	100-500	30	100	5
Duration of Experience	1 hour, 1 session	3 hours, 1 session	1 hour, 1 session	45 min, 4 sessions
Device	Cellphone	Cellphone	Cellphone	Cellphone
Accessory Utilized	None	Body Harness	None	Neck Harness

3. Results

The results from the SuAvE implementations are depicted in greater detail for their respective sections.

3.1 Integration in Shared Learning and Presentations Environment

The freedom of movement within SuAvE in a physical environment for a remote participant was the most notable observation of this implementation. Since the physical environment was loud and busy, having no stringent expectations for the remote participant or the surrogate avatar allowed for different interactions with SuAvE that were not previously observed. In some interactions, the booth speakers at Design Day felt more comfortable using

the cellular device to interact with the virtual participant, as it improved auditory concerns since both sides could hear each other better. For projects with a physical component that could be interacted with, presenters familiar with their project physically demonstrated the work to the remote participant. Interactions with the remote participant were authentic and well-received based on anonymous interview responses collected in the aftermath of SuAvE. However, it is to be noted that the surrogate avatar and the remote participant were treated as separate identities.

Intertwined with the surrogate avatar and the remote participant being treated as separate identities, this perception of the surrogate avatar and the remote participant being separate was observed through understanding the difference in these participants and their interactions with the environment surrounding language and communication. As Design Day occurred at a bilingual institution, many presentation groups preferred presenting in the French language. In this case, the surrogate avatar did not speak French. However, the remote participant did – so at times, the agency was given to the group presenters to interact with the remote participant directly rather than through the surrogate avatar due to this language barrier. Since the surrogate avatar did not interact with the environment much in these instances, when presentation groups could present in English, the surrogate avatar then interacted with the projects independently from the remote participant instead of for the remote participant. This experience further enforced the participants' behaviour as separate identities. For this reason, it was observed that the surrogate avatar acted as more of a mobility aid rather than a physical replacement for the remote participant. With that being identified, most presentation groups remarked that this was a more dynamic and fluid approach to presentations in the remote plane as there was agency in interactions directly with the project. The remote participant also explained that the ability to direct the surrogate avatar to interact with projects requiring in-person demonstration from a first-person rather than a third-person perspective provided a greater comprehension of project technicalities.

3.2 Integration in the Classroom for Students

When utilizing SuAvE in practice for this graduate classroom, key observations involved the interaction with the physical space and its respective technological approach as measured through interviews with both the surrogate avatar and the remote participant. In the in-class experience, the remote participant participated in team discussions in the physical plane of learning related to group work and project assessments through the direction of the surrogate avatar. Furthermore, the remote participant could also ask direct questions about course content with the professor. The remote participant would turn their camera on and interact with others around them when there was the opportunity but predominantly had their camera off otherwise. This interaction remained true when a break occurred in the lecture, as the remote participant would leave to assume their break. This disconnect left the surrogate avatar in an "idle state" – a term coined to define the inactivity of utilizing a surrogate avatar, but where the surrogate avatar is still a physical representation of someone else. This idle state causes the interaction between the surrogate avatar and the other participants in the physical space to overlap between representing another person and themselves. This state takes away some of aspects of physical embodiment, as after that initial point of idleness, the perceptions of others interacting with SuAvE recognize the avatar as being a separate entity from their virtual participant, which should not be the case.

Technologically, there were challenges for the surrogate avatar in navigating a private voice channel with the virtual participant to understand their instruction for physical embodiment and a public voice channel for the remote participant to interact with others around them. This mediation required the interaction of a third device that allowed the remote participant to send a private message about any modifications they would need without interrupting others around them in the public voice channel – which is not logistically ideal. The surrogate avatar is required to navigate two interfaces and two information streams promptly. If connectivity issues occur, resulting in delayed messages on the separate messaging interface, it will also cause a delay in information and activity direction. Furthermore, there were some challenges with the remote participant being able to consistently view slide content, such as the video-streaming capacity of the device, the placement of the device with the harness being too low, and general internet connectivity differences that affected the legibility of the screen. Content from the slide deck of the course was accessible to the student prior to the lecture in order for the remote user to follow along with better resolution at home, and changing attention from the screen to the classroom participants only was shifted halfway through the session to try to provide a more relatable and clear experience of physical embodiment.

Generally, the remote participant and surrogate avatar were content with the experience, both having acknowledged the previously mentioned technological and brief social challenges. The remote participant indicated that seeing other students in the classroom and communicating with project peers for classroom activities was a refreshing aspect of SuAvE. It was mentioned that the group would typically meet in-person to discuss project deliverables, with the remote participant obtaining a designated role following the role-distribution conducted in class without

their physical presence or participation in how the deliverables were subdivided. SuAvE allowed the remote participant to participate actively in these discussions and develop a more foundational relationship with their peers with whom they had not had the opportunity to interact in the missed sessions prior. The capacity to direct the surrogate avatar in the space, such as moving closer or farther from sources in the physical classroom or interacting with different peers in the classroom, also made SuAvE a more interactive experience than current hybrid learning methods.

3.3 Integrations in the Classroom for Professors

Student groups organized by the professor were provided to use SuAvE to conduct multiple simultaneous project presentations that the professor could remotely attend. The selected volunteer from each student group that would act as the surrogate avatar was directed to use their own personal device and conduct their roleplay to 'act as the professor' as they best saw fit. No other technological devices were utilized besides personal electronic devices with videoconferencing capabilities. Students were then provided with the Zoom link and a specific breakout room number to join and then departed to their desired presentation locations on campus.

Without prior notification, the remote professor would join breakout rooms to observe student presentations. The professor had the opportunity to participate in the physical environment in one of two ways. The first method was to observe how students interacted directly with their physical environment. The lack of notification or set-joining time increased the likelihood of the professor being able to authentically observe students in their presentation environments without the students specifically preparing for interactions with the professor. The second method was to watch the students directly present and ask questions. The remote participant could direct the surrogate avatar to move within the environment, either closer or farther, to students and their presentation material.

Although there was the benefit of navigation through multiple spaces for the remote professor, a few technological challenges were observed. From the perspective of the choice of personal device, the model of the device changed the audio-visual quality – causing some student groups to have a more significant technological capacity to focus on the presentation material and surrounding environment. Furthermore, the choice of personal lines of communication, which is directly between the surrogate avatar and the remote participant, compared to public lines of communication, which is between the remote participant and the direct environment, changed the quality of the audio and thus the integration of a first-person perspective for the remote professor. In general, students explained that it was a unique experience and found benefit in not having isolated times to present or a requirement to observe other student presentations. Meanwhile, the experience from the perspective of the remote professor was accessibility focused as there was no need for physically navigating multiple environments, and it could be completed through the virtual learning space.

Some students reported some resistance to the bystanders' participation in the experience as the crowd assumed that the streaming device was being used to record the experience. They did not want to be personally recorded. This observation could be attributed to the assumption that personal electronic devices are typically utilized for photo or video-capturing, compared to when a body-mounted accessory is used to place the electronic device.

3.4 Integrations in Project-Based Studies

An engineering student capstone group reached out to a graduate student from the University of Ottawa to inquire if this graduate student would be willing to be a client for their project. The client explained that they would be willing if remote accommodations were available, with SuAvE implemented to facilitate the interaction. A preliminary session explaining the context of SuAvE was conducted to obtain consent from all participants.

The first session was an opportunity to become familiar with SuAvE as a socio-technical tool for all future capstone project meetings. The surrogate avatar and remote participant utilized their Microsoft Teams meeting link to conduct the virtual connection. Based on feedback from the prior study, a neck phone holder was utilized to create a higher viewpoint for the remote participant, with only a public audio connection, entailing an open speaker and microphone in the public environment. For the first trial, the surrogate avatar and the remote participant were asked to interact with SuAvE as they saw best fit. In the first week, the preliminary design and implementation of the capstone project, the group did not have much to showcase in a physical environment, as their main tasks were to research background information about their project designs and begin preliminary sketches. The surrogate avatar explained that they interacted with the room environment as they thought would have been beneficial, including moving with the flow of conversation to show each person's perspective. The remote participant explained that it was beneficial to feel like they were having face-to-face interactions with each group member when brainstorming the outline of the project design, excluding the one acting as the surrogate avatar. There was an observed overlap in instances where they were

both speaking (the surrogate avatar and the remote participant), as this was the surrogate avatar's first experience with SuAvE, and they were adjusting to the differentiation of being a physical embodiment of their remote client. It was also noted that the observing participants, being the other group members, had to adjust to identifying the remote participant and the surrogate avatars as differing identities. This situation existed because observing participants would attempt to interact with the surrogate avatar as a separate person from the remote client – which is not the intention of SuAvE. It was explained that outside this initial perception difference, having a surrogate avatar for remote client interactions with other group members and themselves felt more dynamic and easier to manage as an observer, as they were not required to change viewpoints or manage any technical aspects themselves.

The second session built upon the observed results from the first session to allow another student in the capstone group to be the remote participant. In this case, the preliminary prototype was demonstrated. The remote participant directed the surrogate avatar to pick up the working parts of the prototype to interact with its design and understand the project's foundation. The ability to interact with the prototype design and inquire about certain connections made within the design from a first-person perspective allowed the remote client to present feedback on the preliminary prototype to the capstone team. The remote client indicated this was unique to other solely virtual methods of being a remote participant overseeing project designs as there was a more significant interaction with the environment. As the surrogate avatar had previous knowledge about the prototype design, they could be directed to interact with specific aspects without difficulty. The observing participants, being the other group members, identified that the experience was more accessible to navigate as the surrogate avatar aids in the remote participant's perception of the space and their physical interaction with the project. Conversations were enabled to flow more authentically with the remote participant. These observations remained the same in the third session as the process did not change, and the interactions with the developing prototype were coordinated similarly.

In the fourth session of the implementation of SuAvE for this capstone group, another team member was unable to attend the client meeting physically but still wanted to be present as it was the final session. As a result, this session utilized two surrogate avatars representing two remote participants: the client and another team member. This experience was the first instance of two SuAvE experiences ongoing in the same group with some observed challenges and a third-party indicator. It included delays due to the processing of different internet connections on the ends of the remote participants. Furthermore, considering the capstone team's dynamic in presenting their final working model, there were observed cases of surrogate avatars interacting with each other and the opposing remote participant – so there was a greater shared agency and collaboration rather than individual physical embodied experience. The remote participants explained that when this occurred, they were able to identify that they were not being directly addressed but mentioned it was an unfamiliar experience to be a first-person observer in a conversation. One additional group member acted as an observing participant, who mentioned that it was a bit overstimulating to navigate multiple surrogate avatars and their remote participants, especially in an environment where there was familiarity amongst all participants through multiple implementation sessions. Despite these circumstances of navigating multiple audio and video channels for communication, from an overall standpoint, they did emphasize that it was still more integrational than current hybrid practices and that it was beneficial, considering it was the final required client call for the course and project completion.

4. Discussion

Based on the implementations of SuAvE in differing higher education environments, SuAvE is an emerging method of providing a more dynamic experience to the increasing hybridization in learning and teaching. The analyses of the studies evaluated are in accordance with their respective sections under the themes of connected, embodied, relational, and socio-material spaces.

4.1 Connected Space

Connected space in higher education and the influence of hybrid learning as an adaptable, networked environment for learning to flourish in. The connected space merges physical and digital elements to promote inclusivity and cater to diverse learning preferences and needs. SuAvE connects a network of volunteers, where the surrogate avatar exists in the physical space. It bridges the physical environment to the remote participant through digital elements of videoconferencing platforms and technological devices. In general, SuAvE allows for adaptability in differing scenarios by offering first-person perspectives with interactions of different working parts. The connection between the digital and physical realms of learning is aided by directing the surrogate avatar to interact with the space. This one-on-one interaction provides flexibility, while stationary hybrid-learning methods are still developing.

In the (i) Integrations in Shared Learning and Presentations Environment implementation, this connected space was seen by the navigation and interaction of physical projects during design day for an interested remote participant. In

the (ii) Integrations in the Classroom for Students implementation, the connected space allowed for the remote participant to attend and interact with their classroom environment. In the (iii) Integrations in the Classroom for Professors implementation, the connected space allowed the professor to remotely visit student presentations in different physical environments. Lastly, in the (iv) Integrations in Project-Based Studies implementation, the connected space allowed the remote client to interact physically with the students' capstone project design.

Technological aspects of SuAvE are still being developed related to understanding internet connectivity, device capacities, and general audio connection differences that can impact the connected space. Furthermore, closed captioning will be considered in future implementations to aid with inclusion and accessibility in the connected space.

4.2 Embodied Space

Unlike purely digital spaces, embodied spaces provide a tangible dimension for students and educators to engage with the physical environment through actions and gestures in the first-person perspective. The primary purpose of SuAvE is to provide a method of physical embodiment for remote students, which is essential to learning and higher education. SuAvE allows remote participants to have an agency of interactions in the environment through the direction of the surrogate avatar, who is gives up their independent agency to provide an embodied experience for whom they represent. Through surrogate avatars, remote participants engage in immersive and three-dimensional experiences, interacting with peers and project materials in physical and digital environments.

In the (i) Integrations in Shared Learning and Presentations Environment implementation, this embodied space was observed by navigating the physical environment and projects through the direction of their surrogate avatar. In the (ii) Integrations in the Classroom for Students implementation, the embodied space allowed the remote participant to direct their surrogate avatar to interact with the professor and other group members. In the (iii) Integrations in the Classroom for Professors implementation, the embodied space allowed the professor to be directed in their environment to understand how students presented their projects in differing physical environments. Lastly, in the (iv) Integrations in Project-Based Studies implementation, the embodied space was observed when the remote client could interact with the project deliverables by directing the surrogate avatar to navigate the environment and the direct use of differing working parts.

Factors related to embodiment can influence the experience, as observed within the implementations of SuAvE. Aspects such as height, gender, race, and language can change first-person interactions depending on the people assuming the roles of surrogate avatars and remote participants, respectively. These direct implications in SuAvE and the embodied space are being further developed.

4.3 Relational Space

In hybrid learning, relational space refers to the quality of meaningful connections and interactions that foster a sense of belonging in learning environments. The importance of human connections in the learning process is emphasized, and their disconnection through current hybrid learning methodologies. SuAvE plays a vital role in reshaping the relational space by providing both the platform and the connection for interpersonal engagement and collaboration between surrogate avatars in the physical plane and the remote participants in the virtual plane of learning. Through the direction of surrogate avatars, the remote participants can interact with their peers and instructors to engage in discussions, group projects and collaborative activities regardless of geographic location and time-zone differences. The ability of surrogate avatars to facilitate real-time communication and interaction enables students to build relationships and share ideas in social-learning environment. As observed, SuAvE works best when integrated into social-learning environments that promote collaboration, communication, and interactions with the physical environment.

In the (i) Integrations in Shared Learning and Presentations Environment implementation, the relational space was identified through the capacity for the remote participant to interact and communicate with presenters directly, especially when they shared a different language than the surrogate avatar. In the (ii) Integrations in the Classroom for Students implementation, the relational space allowed the remote participant to participate in group discussions related to course deliverable work. In the (iii) Integrations in the Classroom for Professors implementation, the relational space was exhibited by observing students and their relational space with others from a remote and third-person perspective environment. Lastly, in the (iv) Integrations in Project-Based Studies implementation, the relational space was observed through the dynamic of interactions between the remote client and the engineering group student members throughout the course of the 4-session study and the physical project development.

One of the most prevalent observations with SuAvE is that participants will treat the surrogate avatar and the remote

participant as separate identities rather than viewing the surrogate avatar as a means of physical embodiment for the remote participant. This analysis is inherent because of the relational space and the human desire for connection between people in the physical environment. While imperative to the SuAvE experience, this relational space poses its challenges in implementation and is still to be further developed.

4.4 Socio-Material Space

Socio-material space encompasses the dynamic interplay between social interactions, material resources, and technological infrastructure. SuAvE is pivotal role in navigating the socio-material space by mediating interactions between professors, students, and peers in the digital and physical environments. The surrogate avatars facilitate the integration of devices with videoconferencing capabilities and additional physical equipment to enable actions that involve communication and collaboration with the physical environment on behalf of their remote participants. Surrogate avatars also embody socio-cultural nuances of the remote participants in their role of physical embodiment. SuAvE navigates the interplay of social, cultural, and technological factors in higher education. It is exhibited through all implementations of SuAvE through the principle of the interaction within the physical space from a remote environment through a surrogate avatar.

5. Conclusion

In conclusion, the Surrogate Avatar Experience (SuAvE) in higher education presents a promising methodology for providing physically embodied experiences for remote learners. The unique aspect of more significant interaction with the environment sets it apart from other virtual methods, contributing to a more immersive and engaging experience for remote clients. Furthermore, the implementations at this point conclude that SuAvE has more interactive benefits than solely virtual methods of being a remote participant. As SuAvE continues to evolve, incorporating surrogate avatars into higher education settings can redefine how learners and educators interact and collaborate on projects in remote environments, aiming to foster deeper connections and more meaningful interactions. Implementations of SuAvE are still in progress to refine the scope of further study, and collaborations are most welcome in this regard.

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