Checkup XR: Revisualizing spaces of care through a multidisciplinary immersion experience

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This paper discusses the use of extended realities as a format to support transdisciplinary teaching and learning. This pedagogical experiment, engaged students and faculty from the School of Nursing and Taubman College of Architecture and Urban Planning at the University of Michigan.The two courses taught in parallel focused on the design of healthcare spaces by taking a critical look on their relationship to the caregiver as opposed to the patient. The courses, a combination of residential and remote students, found a common ground and language through the use of extended realities. This paper discusses the methodology and outcome of the use of extended reality in the classroom as a platform for communication and co-creativity for the assessment and re-conceptualization of three spaces that are often part of the healthcare environment. These spaces are: wellness/ break area for the staff, hospital patient care room and an outpatient exam room.

INTRODUCTION

Extended Realities or XR has become a staple field of interest over the last decade. It has infiltrated our homes, businesses and has become an everyday component of education at many different levels. While there is still a lot of skepticism around the value of this technology, curiosity by many has allowed for different disciplines to embrace it. Its novelty has instigated new questions, spawned new methods of engagement, and has forced anyone working with it to move beyond the safety of tacit knowledge and find new answers through broader collaborations. Within education, universities across the globe are rapidly integrating extended reality in their curriculum. New XR labs are being formed to provide the necessary infrastructure to instigate new conversations and provide spaces for experimentation. Projects are being incentivized through startup funding and grants. Students are requesting that it be part of their course work. With all this euphoria, the field of XR is ripe to put pressure on the "idols and icon" of architecture and establish new methods for collaboration and the production of collective experiences. This paper will discuss the methodology and outcomes that resulted from an experimental collaboration between two graduate level seminars. The first course is an experimental research seminar led by Jonathan Rule, a faculty member from architecture. The course teaches digital skill building while interrogating the affordances of XR by focusing on virtual and mixed reality as tools to study and improve how spaces are designed. The second course, led by Dr. Michelle Aebersold, a faculty member from nursing, is a foundational course in the leadership, analytics and innovation masters degree in nursing. The course focuses on quality science and performance analytics and teaches students how to use continuous improvement, process flow and decision analytics to improve patient care delivery. Many of the students in this course are currently practicing in leadership roles, bringing some real world experience to this engagement. The co-creative endeavor has productively established a space for teaching and learning beyond the boundaries of architecture and nursing while still deeply engaging core values of their respective disciplines.

WHAT IS XR AND HOW CAN IT BE USED IN A SCHOOL OF ARCHITECTURE AND OTHER DISCIPLINES?

Extended reality (XR) is a term used to describe a fusion of all the realities, which are "… technology-mediated experiences enabled via a wide spectrum of hardware and software, including sensory interfaces, applications, and infrastructure".[1] XR includes virtual, augmented and mixed reality as defined by Milgram et. al, 1994[2] in which he describes a continuum between the real world and the completely virtual world. Progression along the continuum incorporates more digital content overlying the real environment until you reach the point where it is entirely digital. Each of these technologies has its own unique use in both education and real world applications. In healthcare XR is used as a way to educate learners and provide simulated patient care through the use of virtual simulated experiences nurse can learn how to manage a patient care situation or perform a procedure (Aebersold, 2022). Frameworks to guide the use of XR in teaching include both educational frameworks (mastery learning or experiential learning) and user-centered design.[3] It is a technology that also affords new possibilities for collaboration, co-design/ co-creation. XR in architecture is used in many ways in a professional capacity, including the design of spaces and new methods of fabrication through human-computer interaction (HCI). In

Figure 1. Hospital patient care room and Outpatient exam room. Rule/Abersold

addition, as a visual field it is also being used to educate future architects. The intersection of these two fields through the use of XR presents new possibilities for collaboration, co-design and co-creation to speculate on how spatial/environment designs impact the way we deliver healthcare and support the nurses who provide that care. Nurses and architects need to collaborate together in the real world to design safe and effective healthcare spaces, however they often don't understand how each side approaches this task. Terminology can also be specific to different disciplines and further complicates the ability to work seamlessly together.

THE METHODOLOGY OF A CO-CREATIVE PROCESS

Education should not occur in a silo and should embrace co-creative opportunities and methods whenever possible. In architecture it should not only be about improving design and final product but about teaching students how to communicate and collaborate with others in different fields. Funded through the Art+ Curriculum grant at the University of Michigan, the work in the two courses seeks to illuminate and expand human connections and inspire collaborative creativity.[4]

This co-creative project recognized that there was a critical issue missing in health care spaces that in part is a result of the lack of thought in caring for the health care provider.. "Previously, designing clinical spaces for well-being was focused primarily on the patient. Now, taking care of patients is table stakes; caring for the people who serve them is crucial to creating and maintaining a high-performing hospital system."[5] The traditional exam room has not changed since the 1950's even though healthcare has changed significantly.[6] In-patient care has increased in complexity and the use of digital medical records and smart technology is present in most in-patient rooms. To study this, students from a nursing and architecture seminar, utilized XR, building design, patient safety and nursing work to assess and re-conceptualize three spaces that are often part of the healthcare environment. These spaces are: wellness/break area for the staff, hospital patient care room and an outpatient exam room. Each of these spaces has a unique function and unique challenges.

The co-creative process relied on extended realities as a common ground for communication throughout the design process. These tools have enabled new opportunities for communication between remote or collocated individuals immersed in a multisensory shared spatial experience. Through realtime verbal communication and avatars that capture body, gaze and facial expressions allow for an environment with features that most closely simulate face-to-face communication and collaboration. In addition the physical distances between campuses as well as students taking the course remotely became irrelevant through XR. Colleagues from both disciplines and from anywhere around the country were able to converge in a virtual environment enabling real time prototyping through a virtual environment. These factors contributed to a workflow that enhanced mutual understanding of the different disciplines working together for a common goal.

As a point of departure for this project, it was important to help each group of students understand the unique nature of their respective areas of expertise. This was done using XR experiences that are unique to each group. Nursing students utilized Augmented Tectonics (Rule, 2022) to learn about architecture and architecture students used Under the Skin (Aebersold, 2021) to learn about patient care delivered in two different environments. In addition to learning about the other discipline, this was also an opportunity for students not familiar with virtual reality to explore it prior to using it as a tool for design and testing. Following this initial encounter, each course was structured

so that the students would work together through a series of XR tools that would help foster communication for the design of the spaces. These tools consisted of prebuilt apps including Gravity Sketch, Arkio and the Unity game engine. For hardware the course implemented a combination of Meta Quest virtual reality headsets (Quest 2 and pro). These headsets required various capabilities such as full virtual reality as well as mixed reality provided by Metas “passthrough” option.

In parallel to becoming adept to the technologies that the students would use, the seminars developed base knowledge through initial research into the design of these spaces through documentation, inventory assessment, process flows, performance analytics and first hand experience with professionals. Following this analysis the courses implemented a PDSA cycle (plan, do, study, act) which was broken down into three stages: prototype development (plan/do), virtual playtesting (study), and prototype adjustment/re-test (act). During prototype development students from both disciplines worked in tandem to establish criteria that would be studied. The nursing students focused on generating a high level Project Charter to guide the work. This included definition of scope, assessment and training protocols as well as requirements for data collection and analysis. The architecture student worked through these initial goals and focused on the assessment of the spaces to generate a virtual database of visual information to analyze. This included visibility of objects in the room from the nursing perspective (monitoring equipment), patient safety features, layout and organization, functionality and spatial flows, lighting and visual reception of the environment. For these studies Gravity Sketch was used because of its capabilities to provide a mixed reality experience for multiple colocated people. Taking inspiration from Alexander Kleins 1928 diagrams for frictionless living, the students were asked to develop their own embodied spatial mapping techniques using the immersive drawing and modeling capabilities of Gravity Sketch. Unlike Klein’s two dimensional diagrams, the mixed reality environment elevates the body to act as a measuring and annotational device with a one to one relationship to the activity and space. Through this process the students were able to understand workflows and patterns as it related to space through visual and quantifiable means as it relates to the body. While the virtual diagrams remained as abstract annotations of space and activity, they included an enhanced level of information by registering the third dimension in addition to the affordance of being embodied. The resulting diagrams in conjunction with the initial research and project charter compiled by the two groups of students highlighted areas in the different rooms where iterative testing through design could yield potential improvements to the space and workflow for the nurses.

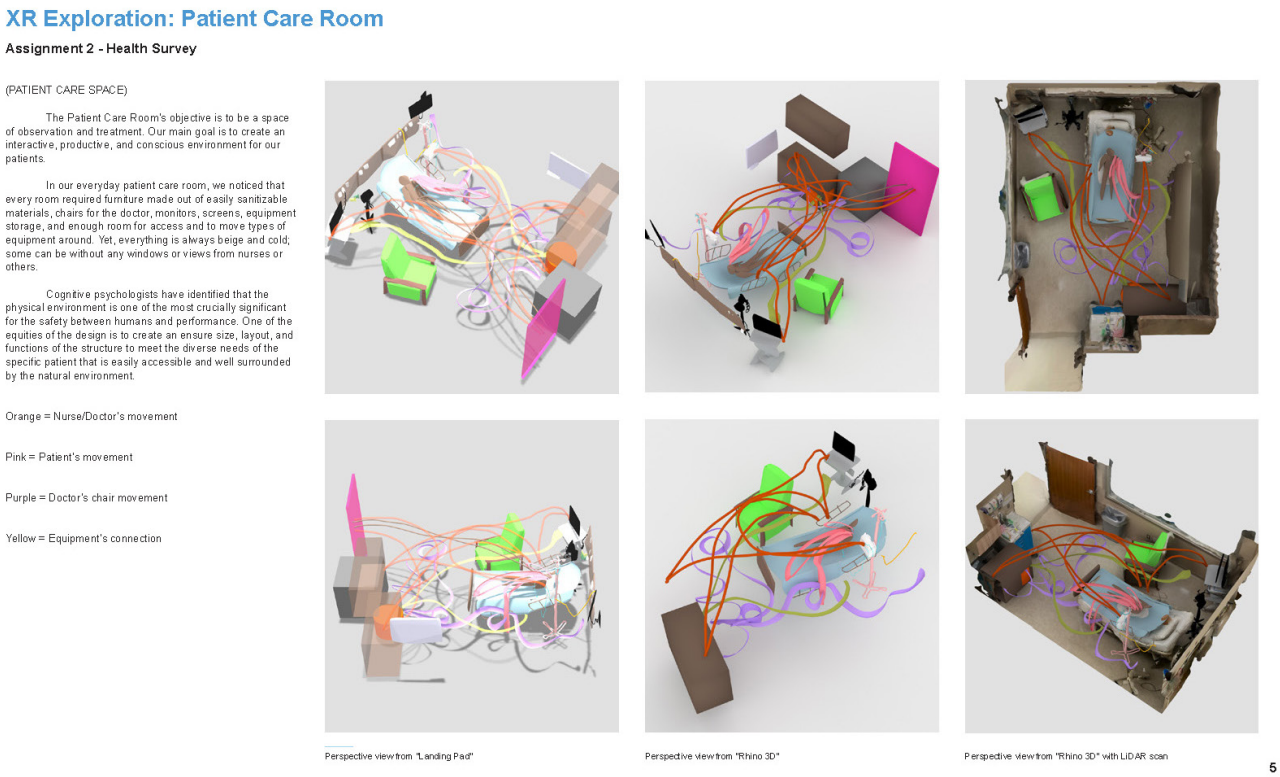

Figure 2. VR mapping Patient care room. Hua/Porter/Puribhat.

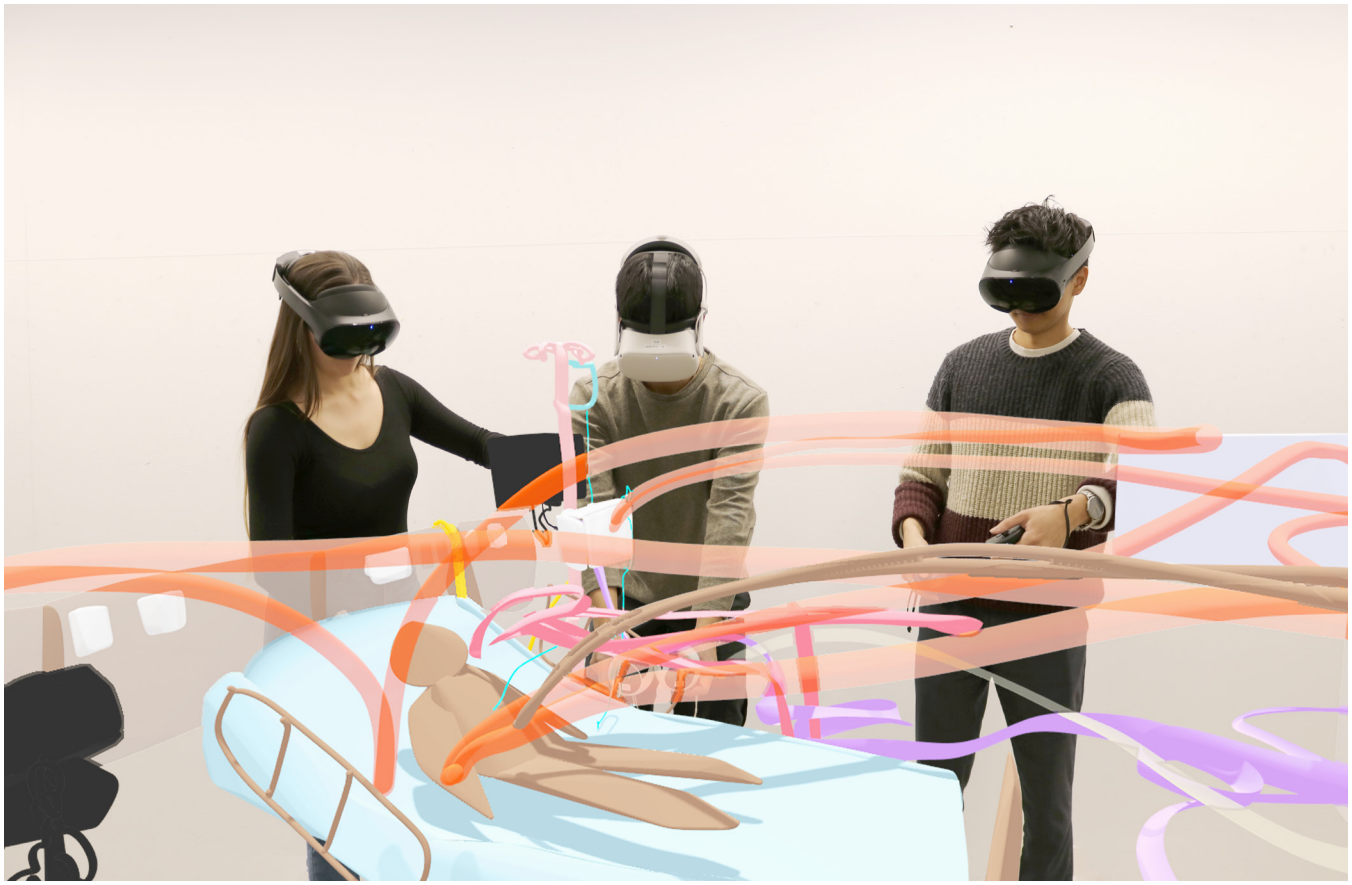

Figure 3. VR mapping Patient care room. . Hua/Porter/Puribhat.

During the design phase of the seminar, nursing and architecture students worked collaboratively through design charrettes and reviews. To facilitate these encounters the course leveraged the collaborative virtual reality capabilities of Arkio. Through a simple interface, students and faculty were able to meet in the virtual spaces through virtual reality headsets, their computers or mobile devices. The platform workflow allowed for seamless communication between a variety of design softwares used by architecture students. It allowed for models to be shared and marked up or modified in real time as well as exported back into the original software, eliminating the need to translate changes from these design sessions. This intuitive tool allowed for extended reality to serve as common ground that removed the requirement for nurses to read plans or see the work through selected views of static renderings. Instead everyone was able to roam the designs freely which elevated the ability to engage the design work for non-architects and helped facilitate conversation about the space that otherwise might not happen.

Following the initial design phase, the architecture students began to develop stand alone experiences through the Unity game engine and the Meta Quest virtual reality headset. These experiences focused less on extended reality tools for design exploration but more on testing and training through a singular design solution. Refined designs of the various rooms were imported into Unity where they were enhanced through the application of interactivity. This allowed the models to be used for more than a passive visualization. Instead, the embedded interactivity allowed the students to test the functionality of the design in addition to feedback about the visual experience of the space. The embedded interactivity focused on roomscale navigation and two methods of interaction. To achieve room scale navigation the virtual experiences were ported to the headset for a stand alone experience. This allowed for six degrees of freedom for movement without the need to be tethered to a computer or use teleporting. This method of working allows for a deeper immersive experience by removing physical elements that break the immersion. In developing interactivity for the experience, the students tested two methods: controllers based and hand tracking. The first experience used the quest controllers for interaction. This allowed for the ability to move objects, turn on and off lights, or change between different design options. The second experience was designed to allow for a more intuitive interaction experience within the virtual space. Leveraging the inside out tracking on the virtual reality headsets and the Oculus Platform SDK allowed for interactions through hand gestures. The use of hands instead of controllers resulted in a reduced learning curve when it came to navigating and using the virtual spaces during the testing phase. Controllers required a memorization of button locations and trigger inputs, while hand

Figure 4.Immersive and inperson collaborative working sessions. Rule/Abersold.

tracking simulated the way we interact naturally with real world objects and space. When comparing the two methods, the use of controllers revealed a limitation in that students would only navigate and talk about the space. On the other hand, using native hand gestures as controllers and literally walking around to navigate, encouraged an intuitive exploration giving participants the ability to reach out and "touch" the virtual environment

After the initial design iterations were complete, a testing phase was initiated. While quantitative feedback has yet to be integrated in the testing, the students were able to ascertain qualitative feedback on the spaces by way of direct observation and survey. These observations and surveys adapted strategies for VR playtesting to help better understand the nurses response to the designed environment. These moderated in-person sessions adapted the suggested methods established by Meta for VR playtest facilitation and results reporting.[7] Even

Figure 5. Testing and analysis of designed spaces. Rule/Abersold.

though these environments were not games with a specific objective, the methodology for analysis of the embodied experience through playtesting was a helpful way to guide students through understanding one anothers spatial experience. In parallel to the playtesting session, students presented their designs to practicing healthcare professionals and experts in extended reality development for additional independent feedback. The co-creative student experience was evaluated and found to be beneficial. For the nursing students the use of XR has been focused more on the training aspects of helping them to learn the skills unique to their profession. This experience provided an opportunity to engage in an interdisciplinary experience which highlighted how XR technologies can be used to improve the work environment in which they deliver patient care.

CONCLUSION

The use of virtually embodied environments for co-creative exploration is not new but has been garnering use as a result of necessity, COVID-19 pandemic, as well as improvements in the technology available. While there is still room for improvement ,the benefits of designing, iterating and collaborating with peers in a virtual space is becoming more evident. With advances in XR technology it has become clear that in both education and practice, working through this medium has become more collaborative. XR as an emerging tool for co-creativity, offers the potential to improve the design process, especially when that process takes on a multidisciplinary approach. The work completed between these two seminars was largely successful; however, it is also possible to highlight moments where future research into XR supported co-creativity is required. The future of healthcare is important for everyone both the recipients of care and those that deliver care. Creating optimal space for healthcare delivery will require a co-creative approach through student/professional exchange and innovative uses of new technologies. The focus on both the patient care experience and the health professional experience of healthcare can provide a way to improve both, through more optimal space design.

ENDNOTES

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