

Virtual Reality as Collaborative Design Pedagogy on 3 Continents

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In the context of a challenging year for face to face education and more specifically for courses such as design studios, this paper proposes to discuss how a pedagogy based on immersive virtual environments can be conducive to a more collaborative approach in architecture studio. As we are currently teaching design studios with a combination of remote and face to face modalities it seems an opportune moment to explore how Virtual Reality can affect the design and learning process.

This paper presents a collaborative design exercise organized between three schools of architecture in Germany, the US, and Mauritius and involved the design of rooftop additions in different urban context on three continents. Students used the Spatial App with Virtual Reality headsets, Conceptboard, Slack, WhatsApp and Zoom to communicate, collaborate, design and formally present their work.

The three sites for the rooftop projects matched the school locations in Hamburg, Mauritius and Florida. Each group of students was assigned a site in a location they were unfamiliar with so it would create a challenge in terms of physical and cultural environment. Mauritian students were asked to design a signature commercial building in a US downtown whereas students in Florida planned a subsidized housing project in Hamburg. The German students, on the other hand created Airbnbs in Port Louis, Mauritius. Each rooftop project responded to the specific needs of its context and therefore exposed students to a set of unfamiliar circumstances.

The student teams onsite were responsible for providing site and context information to the offsite design teams. Then following a predetermined set of criteria, each student team periodically reviewed the work of the students designing in their location. The projects were initiated by a collaborative process where students exchanged information about site and context. Progress and final presentations were conducted using the Spatial App with either the Oculus Quest headsets, iPads or laptops. Students also used Conceptboard and Zoom

as supplemental presentation tools. They also used Slack and WhatsApp to communicate during the overall duration of the project.

We postulate that the collaborative process discussed in this paper has value as it introduces different sets of connections between students along with a new sense of community and familiarity through immersive virtual environments and other digital formats. This project focused on emerging technologies as they offer new means for students to connect, problem solve and get exposure to diverse architecture pedagogies and design cultures.

INTRODUCTION

In the past 18 months, the Covid pandemic has driven a number of societal changes and has forced us to rethink many things we took for granted as a large portion of our social and professional interactions have shifted to a remote format. At the onset of the pandemic and broadly speaking in the field of education, we have had to pivot from a traditional face-to-face model to a complete remote modality. In that context it became clear that certain course formats such as lectures could easily be converted to an online setting while others such as labs or studios may prove more challenging. As one of the cornerstones of architecture education, the studio blends an apprenticeship format with active learning and provides a unique learner-teacher interaction. The recent shift in teaching format driven by the pandemic very much created a challenge in terms of delivering a studio experience that would continue to benefit students on a variety of different levels and remain instrumental in their overall training.

This recent shift in course format was not only driven by unexpected events but it was also facilitated by a range of emerging technologies including virtual reality and other digital tools. Just as the pandemic has alienated us from our immediate social and physical environment it has focused our attention on newly available technology and allowed us to connect with people much further away. The question of how can technology impact the architecture studio and design thinking in general is especially interesting because the studio format as we know it today has remained largely unchanged for over 100 years. As a variety of new digital environments including virtual reality

have become widely available they can introduce new learning modalities within the studio and contribute to enriching the design process by means of creating dynamic social communities. Our hypothesis is that immersive virtual environments can create a new and different kind of proximity among students and faculty, which could not only allow remote interactions but also enhance the overall studio experience. As these new modalities introduce new ways to communicate and experience space we hope they can be a means to connect for people with different backgrounds and cultures and may enrich the studio experience and therefore positively affect design thinking.

In the summer of 2020, the School of Architecture and Engineering Technology (SAET) offered a combination of remote and face to face studio options and it seemed an opportune time to reach out to some of our international academic partners and engage them with our recently acquired remote capacities. We identified two partners for an experimental studio exercise, the School of Architecture at the Hafen City University (HCU) in Hamburg, Germany and the Ecole Nationale Supérieure d'Architecture in Mauritius. Students from the three schools respectively located in the US, Europe and Africa were asked to design a rooftop addition in an urban environment unfamiliar to them and conform with the requirements and challenges of sites abroad. The goal was to stimulate and engage students by having them interact with their peers from different geographic locations and cultural backgrounds. We introduced specific digital tools and immersive environments to allow students to better communicate but we hoped that the discovery of these modalities would impact the overall design process.

PROJECT DESCRIPTION AND METHODOLOGY

The SAET only offers a couple studios in the summer along with a few lecture classes. The studios are intensive and allow students to complete an entire year of studio curriculum in just 12 weeks. Students already feel somewhat isolated in the summer as only a few course sections are typically present in the building and last year's pandemic context certainly added to that sense of disconnect. Students abroad had actually experienced more severe isolations due to repeated lockdowns in their respective locations in Hamburg and Mauritius. The idea of offering a joint design exercise for schools on three different continents seem promising on the variety of levels. It would allow 3rd year architecture students from different design cultures to interact and use communication tools unfamiliar to them such as immersive environments and virtual reality. One of the objectives of the overall experience was to evaluate the impact of immersive environments on the particularly challenging context of this project and determine if it would affect design thinking. We hoped the virtual reality format would create a different kind of social space and studio environment that would be conducive to enhanced communication and a richer design process.

As previously mentioned, the project itself consisted in designing rooftop additions in three different geographic locations and



Figure 1. Introductory presentation (Chamel)

contexts. The reason behind the rooftop addition typology was suggested by the School of Architecture at HCU in Hamburg as it was a design strategy they were familiar with. Under the leadership of the school's faculty the city of Hamburg has developed a public housing strategy based on rooftop units for the past 10 years. This type of project narrative presented several benefits. Because students were asked to design a structure on top of an existing building it encouraged them to clearly understand the nature of the existing urban fabric on site as well as building structure and architecture typology. Students also had to familiarize themselves with the local culture, climate patterns and construction industry. Their design proposals needed to acknowledge specific challenges associated with geography, sustainability and cost feasibility within a specific market. Each geographic location presented unique needs in terms of program, construction process and climate. In Hamburg for example, the rooftop additions were designed as subsidized public housing units whereas in Mauritius, projects were planned as Airbnb apartments. On the other hand, the rooftop projects located in Florida had a commercial use. Due to local market needs and public housing policy each site presented an opportunity for students to articulate a specific design response adapted to that context.

Overall, the project spanned a 4-week period and therefore was conceived mostly as a schematic design exercise though structure and materials needed to be addressed at least conceptually. Prior to the start of the design phase each team of students gathered and created a series of documents including models and drawings as part of the project database for the offsite design teams. Each site and project context was then introduced to every team in a zoom style presentation. Following



Figure 2. 3D models in Spatial (Chamel)

the presentations students were able to visit their site using the Spatial App in an immersive environment. These presentations kicked-off the design phase as students were asked to articulate a specific design strategy and develop a parti for their project. They continued to communicate with the on-site student team to get clarification and gather additional materials. At the two-week mark, project teams presented their architectural concepts using a combination of zoom and immersive virtual environments. This progress presentation experienced technical issues as zoom and the Spatial App did not work well together. The size of the 3D models uploaded in Spatial also proved problematic but overall, everyone was able to communicate their work. The final project presentations occurred over two days and were conducted entirely in an immersive environment.

IMMERSIVE VIRTUAL ENVIRONMENTS: OPPORTUNITIES AND CHALLENGES

Initially, the idea of introducing an immersive environment within a studio project was driven by the desire to help students better understand their site context and provide an overall more engaging format for student interaction and project review. Virtual reality, we hoped would help bridge the divide between students of different cultural background and create a different kind of proximity in a digital environment.

As was just stated, virtual reality was used for a variety of purposes. The first immersive environment created by students consisted in a 3D model of their urban site. As the project requirements and site locations were introduced to them, students

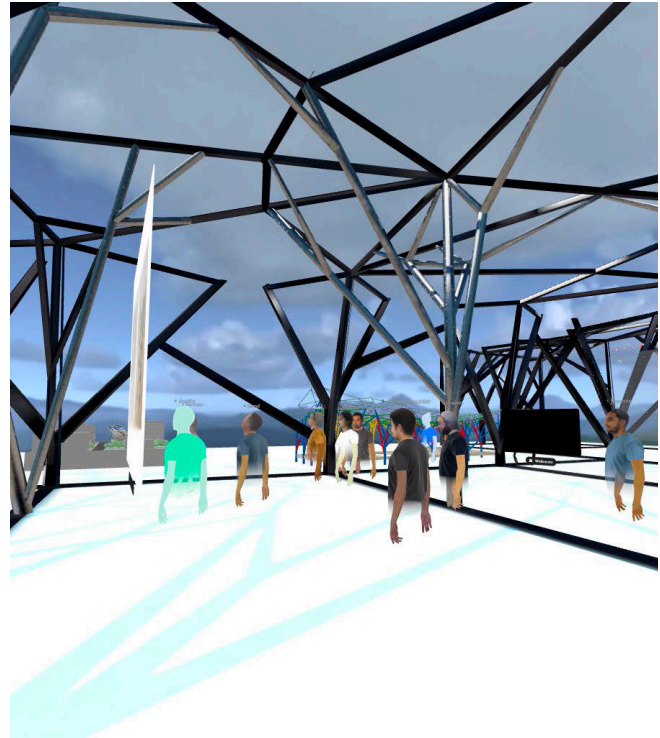


Figure 3. Structural system walk-through (Chamel)

were able to explore them using virtual reality goggles in the presence of the group who created the 3D model. The immersive urban 3D models proved to be effective for students to get a sense of scale, proportion and helped them grasp the overall size and quality of their architectural intervention. The immersive model effectively complemented other documents available to students such as aerial photographs, topographic maps or Google Street views especially at it related to context and scale. Though all students used avatars modeled after themselves in the immersive virtual environment it did not seem to foster more engaging social interactions. The second student experience in an immersive virtual environment occurred during a progress presentation at the end of the project's second week. Students then presented their conceptual ideas using a 3D schematic model of the project in its urban context with the Spatial App. The final project presentation was conducted entirely in an immersive virtual environment using the same App. Students ultimately created their own customized presentation where they were able to run a slideshow of project drawings along with an immersive 3D model of their project within its urban environment.

The first immersive session was helpful and beneficial as an introductory experience and to provide context. The second one, which was the project progress presentation proved more challenging as some students did not quite embrace an immersive 3D format but rather focused on the slideshow within the Spatial App. The third and final presentation though showcased an interesting combination of different formats including 2D



Figure 4. Slideshow format (Chamel)

drawings and details along with 3D interactive models. The immersive 3D models were instrumental in communicating the tectonic qualities of projects in relation to the urban context and adjacent existing building. Students created their own virtual spatial environment, which was inspired from their design strategy and customized to their project needs in terms of presentation. The final project deliverables were noteworthy because they allowed viewers to discover the design from a number of different perspectives. As a part of their presentation format, a 2D slideshow projected on a wall in the virtual room described the project narrative along with the traditional drawings and technical details. While students presented, viewers in the virtual room had the ability to explore the 3D model and move around in the urban context of the existing site. This innovative environment made for a dynamic and multi-layered experience as a synchronous presentation with graphic support was complemented with immersive 3D models. The various components of the presentations made for an engaging and stimulating event where the reviewers were actively involved. There was also a sense of a virtual community by the presence of everyone's avatars. A number of students went as far as reshaping the virtual space provided by the App and created a unique spatial experience based on their project concept or a specific component they decided to emphasize. In other words, the conception of the presentation space itself became a part of the overall design process.

The way in which students organized their showroom and designed space very much contributed to the way the project was

perceived. The level of sophistication and details in the presentation set up matched the quality and sophistication of the architectural proposals. And the presentation spaces, in some instances, could be considered as an architectural creation in its own right. One of the more surprising and meaningful takeaways of this project experiment was that students invested significant thoughts and efforts into the staging of their project. This kind of scenography became a vehicle to not only contextualize and present their work but also to help define it. Through the vehicle of a multi-layered presentation format, viewers were able to listen to a narrative, understand building structure, see construction details and appreciate the spatial qualities of a virtual space within its context. The students were able to convincingly display the complexity of their project in large part because of the opportunities offered by customized and immersive virtual environments

VIRTUAL REALITY AND LEARNING OUTCOMES

Interestingly, virtual reality did not seem to facilitate a socially more engaging environment when compared to other virtual platforms such as zoom or other teleconferencing tools. We found that the presence of avatars though helpful in a virtual space did not help foster connections amongst students in a synchronous format. Avatars did give a sense of a social group but did not help foster closer interactions.

In addition to virtual reality, students relied on other digital tools such as Zoom, ConceptBoard, WhatsApp and GroupMe to exchange information throughout the project. Overall the different means of communications allowed students to gain a fairly good understanding of the project requirements, challenges and deliverables in a geographic location completely foreign to them. As a result, students from Mauritius designed a project in Tallahassee, Florida where a commonly used material is brick veneer. As a testament to the students ability to understand local circumstances their design proposal showcased a deconstructed brick veneer facade as a conceptual statement about this material. The façade also worked as a rain screen to address the climatic context of Florida. Similarly students from HCU developed a project proposal using locally sourced bamboo and focused their design approach on passive sustainability and creative building details for the Mauritian site. Students from the SAET proposed rooftop additions in Hamburg as contemporary architectural statements with references to the historical urban fabric and typology.

To a certain extent, students were able to share important aspects of their culture and some of the challenges they were facing locally through the variety of digital tools at their disposal. For instance, the rooftop projects in Hamburg were designed as subsidize housing units using a prefabricated construction system. In that case the focus was on building envelope quality and energy efficiency. The project problematic in Mauritius was different and emphasized private ownership of rental units for the tourism industry and construction with locally

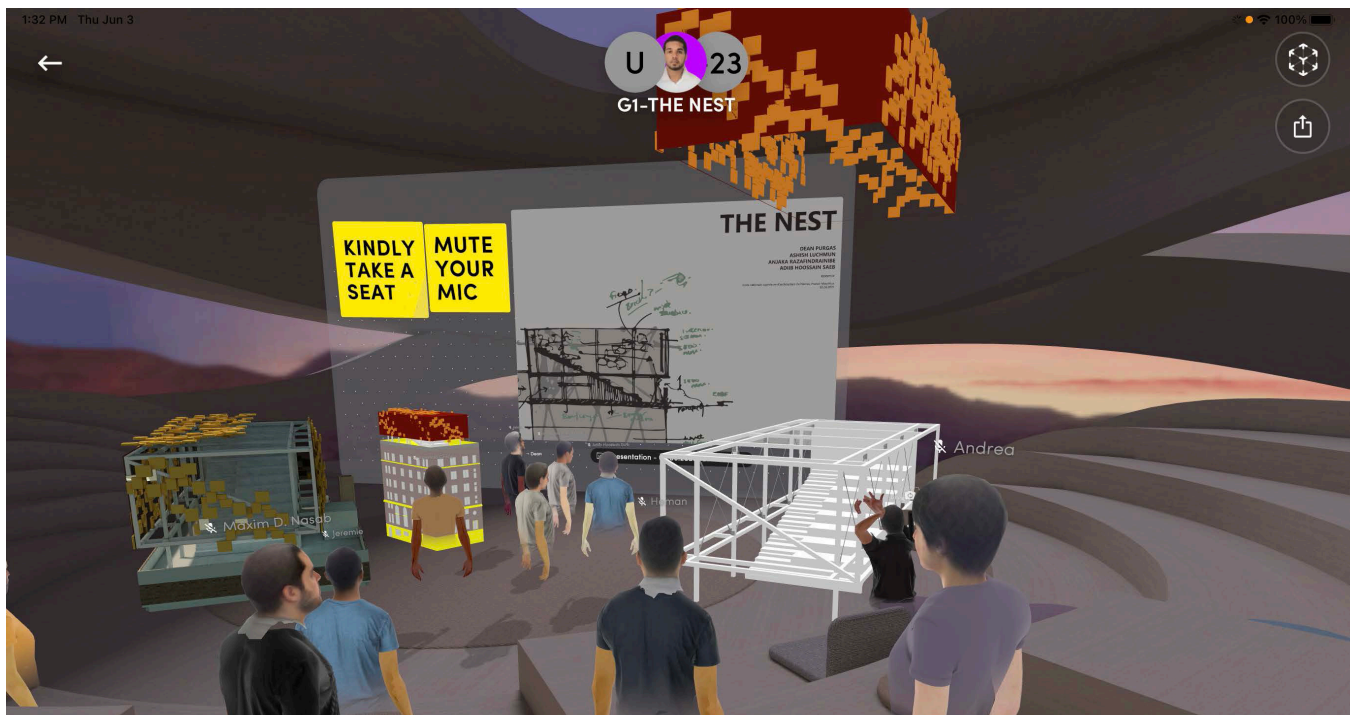


Figure 5. Multi-format final presentation (Chamel)

sourced materials with low-tech sustainable strategies. In the end student design teams demonstrated the ability to understand local circumstances and articulate appropriate architectural responses. At the same time, it was interesting to see how they did so within their own educational background and design culture. Students from ENSA Mauritius developed a design process that was more conceptual and focused on important ideas for the project to convey. The approach of the student group from HCU Hamburg emphasize materials and construction technique using bamboo in order to produce a very detailed architectural proposal. Students from Florida proposed designs as a balance between a conceptual approach and the resolution of practical concerns or program, structure and project identity. Each school offered an approach consistent with their pedagogical goals and design culture and also sensitive to the specific challenges of each project location.

In that regard this overall project experiment was successful and the various digital tools allowed students to understand a number of issues foreign to them and articulate an appropriate Architectural proposal. Similarly we were able to make some observations about the impact of immersive virtual environments on design thinking and the ideation process in general. Previous research work on the nature of the design process in studio have outlined a number of core development activities, which are essential to a creative process. These activities have been labeled as convergence, divergence and interrelation. Convergent thinking describes a process where ideas and comments are presented in order to make a complex problem converge towards a single solution. Divergent thinking on the other hand can be

described as a process that creates many possible solutions to a particular problem or question. Brainstorming for example is a form of divergent thinking. Interrelation is a development activity where designers compare a number of unresolved solutions that are related to one another as possible options to a single design problem. All of these different type of activities contribute to a successful design process, alternating phases of creative thinking, problem-solving and comparative analysis. In the context of our project we have noticed that immersive virtual environments seem to contribute more significantly to convergent thinking. In fact the format of the virtual project reviews encouraged comments from reviewers and peers and seemed to be more conducive to problem-solving and to the refinement of a specific design solution. Interestingly the immersive environment appeared to encourage students to provide constructive criticism to their peers more so than when compared to a traditional face-to-face format. This aspect of the overall design process was positive and contributed to students' ability to articulate sensitive architectural solutions in response to comments from their peers and professors.

CONCLUDING THOUGHTS

Initially the use of immersive virtual environments for the project described in this paper was motivated by the need to effectively communicate and present work remotely. As we evaluated and analyzed the work produced by students it became obvious that immersive environments had a significant impact on project outcomes and design thinking. Students in fact created innovative architectural compositions and displays within a virtual space they appropriated for themselves. These architectural interventions were conceived as a vehicle of discovery for the project and for the public. In addition, virtual spaces created a

positive environment conducive to comments from peers and faculty, which was instrumental in the quality of the final projects. Interactions in virtual reality very much helped students articulate thoughtful and appropriate architectural solutions to the site and context. This experimental project showed how immersive environments can positively impact design thinking and the design process in general. It would seem that even in a traditional studio environment virtual reality may have a place to foster a specific kind of interaction and creative expression. Immersive environments may be a positive complement to the standard studio experience especially as that course format evolves and integrates a more hybrid form with a mix of remote and on site participants.

In that sense virtual reality promoted a different kind of proximity among students, which in turn invited feedback and exchange and helped them understand a perspective foreign to them. This idea of foreignness that students had to grapple with appeared as a challenge at first but actually turned into an opportunity to discover and understand others. The awareness about the other, the other social group, culture, urban context, and problematic became a powerful driver for students to develop an innovative design solution. This kind of triangular design approach where teams are respectively addressing challenges foreign to them foster a process of discovery where participants including students and faculty were enriched. This exposure to ways and methods of thinking and designing that are different to our own is extremely valuable and keeps us fascinated by the results produced in an unfamiliar environment. In this era of globalization, this kind of design exercise also creates an opportunity to meaningfully connect with other cultures and begin to understand their issues and challenges. This is especially important as the concept of globalization tends to promote a mostly Western oriented culture and does not always invite cultural discovery and diversity.

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