Media Architecture in Architecture Studio Education capturing dynamics in the process

Exploring how architecture students design with virtual design environments tools

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ABSTRACT

Virtual design environment tools such as virtual reality can refine the methods of existing Media Architecture design processes. Architecture has the potential to become dynamic and adapt rather than providing static characteristics. Media Architecture can be understood as materials or objects with dynamic properties, such as interactive sources of light or moving elements, which embody the physical space on an architectonic scale. In the higher education context, virtual design environment tools can be a driving influence in expanding traditional teaching approaches while discovering new ways of designing and creating design solutions in architecture schools. These visual communication technology tools allow architects to engage more effectively with stakeholders to create a connection that goes beyond the planning process. This research focuses on the use of immersive technologies in the design of Media Architecture in architecture schools in Australia and Germany. Based on a literature review of architectural education, Media Architecture, and virtual design environment tools, a recommendation for a design studio was presented, implemented, and evaluated in an architectural design studio setting. The most common approach in architectural education, how to learn to design, is a project-based approach called “design studio”. In a “design studio”, future architects explore ideas and concepts, create and evaluate alternatives, and decide and act. This research emphasizes on architecture students’ learning experience, who have been exposed to the emerging discipline of Media Architecture and the state-of-the-art technology approach to design Media Architecture with virtual reality. We conducted three case studies with advanced undergraduate architecture students in their third year and masters in Australia and Germany. Within these case studies, we developed educational content for designing Media Architecture while using virtual design environment tools in a higher education context. In order to motivate and evaluate students’ experiences in these scenarios, Keller’s motivation design model ARCS (Attention, Relevance, Confidence, Satisfaction) was utilized in the design studio context to design Media Architecture with virtual design environment tools. A response of the students to the new studio content and approaches in the educational environment was evaluated through surveys, interviews, and observations. We are in progress of reviewing the collected data at this stage. The results of the case studies will allow us to explore educational Media Architecture approaches further, such as simplifying content delivery and eliminating issues. The outcome of this study are preliminary recommendations for teaching architecture students the use of virtual design environment tools in the design process of Media Architecture.

CCS CONCEPTS • Human-centered computing → Interaction design  
Empirical studies in interaction design

KEYWORDS

Design Education, Design Studio, Immersive Design Environment, Media Architecture

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1 INTRODUCTION

This paper explores virtual design environments tools to design Media Architecture in a higher education context. Virtual design environment tools such as immersive technology can refine the methods of existing Media Architecture design processes [11, 16].
In higher education, such tools have the potential to refine traditional teaching approaches while discovering new ways of design thinking and creating design solutions [15, 31]. The potential of immersive technologies of virtual design environment tools for design education and design processing must be researched to discover the ideal use for both educators and students. As smart technologies become more prominent in cities and private homes, it is necessary to explore interactive tools [9, 13, 32]. Architecture can be interactive and temporary and capable of shifting in a short time to address different problems or needs by incorporating media into architectural structures [17]. Media Architecture can be understood as materials or objects with dynamic properties, such as interactive sources of light or moving elements, which embody the physical space on an architectonic scale. Dynamic properties can be physical elements that make it possible to create spatial situations with a variety of purposes [6]. There is insufficient research in learning & teaching of Media Architecture and what kind of tools can be employed to examine the design process. We propose a recommendation for how the architecture design studio design should emerge. More research is required to explore how these technologies can be embedded in an educational context [17]. This research explored three case studies with undergraduate and master architecture students on how to learn about Media Architecture at Queensland University of Technology (QUT) and Bochum University of Applied Sciences (HSBO). We utilized a studio pedagogy approach to evaluate students learning experience since studio education in architecture school is considered to be the core of architectural education [30, 33, 39, 40]. The operating conditions such as the institutional context of studio and lecture learning settings, curriculum structure, nature of stakeholders (i.e. students, tutors and unit coordinators), number of face to face contact hours and utility of online learning resources of other University studio models have been explored to guide this research [5, 28, 39]. The data sets were part of an architectural design course in which students need to develop a residential building or similar type of building. Students were introduced to the concept of Media Architecture and visual virtual design environment tools to explore design solutions and create media architectural experiences.

2 BACKGROUND

It is fundamental to start developing strategies and approaches for new design tools and educating students for dynamic design tasks such as Media Architecture, and understanding tools for an iterative process of designing Media Architecture. [17, 23]. Historically architecture has been a hybrid, or bimodal profession of art and social function [33]. New domains of science and technology apply nearly every day in the discipline of architecture [34]. Architects act as designers of buildings, but they also have responsibilities to the society they design for [12, 24, 33, 34]. Architecture students need to be exposed to these new possibilities and topics such as Media Architecture and virtual design environment tools to give them relevant technological understanding and show them career pathways. Technology as a tool is a part of the education program in almost every architectural university [1, 16, 27]. The rapid implementation of computers in design education makes it necessary for universities to develop a more specific pedagogy for a digital technology application to keep on track with technology developments [1, 16, 27, 36]. Media Architecture needs dynamic tools in the design process, such as technologies that allow designers to show and simulate dynamic behaviour [6, 11, 17]. We define Media Architecture as media structures are integrated into Buildings, urban spaces or general structures on an architectural scale [6, 8]. Understanding the process of designing Media Architecture is significant for this research. It is also vital to consider how design thinking is taught in architecture schools, because Media Architecture is a multidisciplinary discipline and requires additional strategies [17]. While researchers such as Jenney et al. focus on interdisciplinary collaborative prototyping, this research explores immersive technologies [20]. The purpose and function cannot be developed with traditional architecture due to the fact that new and advanced technology solutions need different ways to teach. New methods are required in a more straightforward way as Media Architecture is made up of highly dynamic elements [1, 29, 31]. By immersing the user in a virtual reality environment, immersive technologies are able to capture and simulate the dynamic aspects of Media Architecture. In Immersive experiences, users are entirely immersed in a digital world either based on a real or completely fabricated model [7]. There is a potential to reduce mock-up and scale models cost in saving material and in shifting the physical iteration process into a digital space [22]. In architectural design, technologies tend to be used as visualization tools in the design process rather than as an iterative tool to explore architectural qualities such as spatial qualities [26].

3 OBJECTIVES AND GOALS

This research explored how students can be educated to master virtual design environment tools to empower their ideas in the design process of Media Architecture. The goal is to explore how technologies such as virtual design environment tools can improve learning outcomes, collaborations and design decisions. There is limited research that focuses on educating architecture students on the theme of Media Architecture while using immersive technologies. Most of the literature focuses on how to implement software in a traditional design studio context. [14–16, 25, 31]. The discipline of Media Architecture needs dynamic tools in the design process, such as technologies that show and simulate dynamic properties [17]. It is necessary to introduce learning architectural design techniques that allow students to engage with these dynamic qualities.

With this research, we are in the process of developing a verified framework representing a basis for making a contemporary learning model in architectural design education.

3.1 RESEARCH QUESTIONS

R1: How do architecture students use virtual design environment tools to communicate their design ideas?

This question targets explicitly the possible design solutions used by architecture students to discover new ways of designing within virtual design environments.

R2: How can virtual design environment tools be employed in architectural education to design Media Architecture effectively?

This question examines the opportunities a virtual design environment can provide to architecture students to discover different design solutions within the emerging communication and immersive software tools.
4 METHODS

In order to design engaging technology interventions and to investigate their impact on the architectural education process, we conducted three case studies:

Case 1: Queensland University of Technology (QUT), Australia
July 2019 to November 2019

Case 2: Bochum University of Applied Sciences (HSBO), Germany
Nov 2019 to Jan 2020

Case 3: Queensland University of Technology (QUT), Australia
July 2020 to November 2020

The principal researcher has been employed as an educator to teach architecture students about Media Architecture and immersive technologies in a design studio set-up. Eighteen in-depth, semi-structured interviews were conducted by the principal researcher across three case studies. In addition, participating students had the opportunity to contribute to this research via an online survey (n=30). Two case studies have been conducted at QUT and one at HSBO [18, 19]. Universities have different resources and can be very complex in organising these, and in addition to that, students have various backgrounds and knowledge levels. We decided that a flexible structure is needed so that the result can be applied at different institutions. Both QUT and HSBO indicated their availability to be part of this research. Therefore, we had access to these sites as teaching staff, but cross-cultural differences have not been a topic of investigation, but they might warrant further investigation.

The qualitative data (observations, interviews, surveys) has been analysed employing thematic analysis to uncover patterns in the data [4], [2, 3, 10]. Discovering patterns further allowed the researchers to improve teaching content from one case at QUT to the other case at HSBO [2]. Ethical clearance was approved from QUT Human Research Ethics Committee and complied with the requirements for a negligible or low risk application (approval number: 1900000811). We followed a qualitative research approach to understand the student experience and show evidence of learning success by employing Keller’s ARCS Model [21]. Keller’s ARCS motivational model explores the attention, relevance, confidence and satisfaction that students experience [21]. During the interviews, the principal researcher carefully communicated to students that critical responses and evaluations were welcome and that the purpose of the study was to improve the design studio.

Students were introduced to a detailed design brief. For the data collection process, the case studies were set-up in design studio context, which is common in architectural education [29, 33, 38]. The design studio education model provided a theoretical framework to inform the thematic analysis. In design studios, participants solve a design brief while creating prototypes and “learn by doing” under the guidance of experienced tutors, who are usually experienced in the practice of architecture [28, 33]. The brief mostly is based on a realistic intervention like designing a residential building for example, but in this research, we asked students to design a Media Architecture intervention. This included developing a series of prototypes to create new knowledge about the design. Within every variation of these prototypes, the existing knowledge grows.

Research through design is not limited to problem-solving but also includes understanding interactional, aesthetic and experiential characteristics in designing interactive products [35, 38]. It has been found that studio-based learning methods can foster creativity; with the support of immersive technologies, they can be less time, energy and resource-consuming [16, 37]. In all case studies, students were introduced to concepts such as Media Architecture and immersive technologies to foster the design process of Media Architecture. The principal researcher has been employed as part of the teaching team in all three cases studies and given a lecture and tutorials. Within these design studios, students were exposed to virtual design environments to engage them in a range of tasks. These tasks, such as conception, perception, testing and exploring scale and dynamic properties, have been adjusted after each case study for the following one. We introduced two virtual environment tools to architecture students to complete a design brief. Students modelled their design ideas with the CAD Software and animated their design in real-time software. All students in every case study had the opportunity to explore their designs with a virtual reality headset Oculus Rift and Oculus S, which were made available during class. Due to the limited number of devices and COVID 19 restrictions, only a few students used this opportunity.

This section covers the Virtual design environment tools used in the design task, Oculus Rift DK2. The Oculus Rift tool is an immersive VE tool that enabled the participants to feel present in the VR space, where they could create virtual objects and move freely around them. The participants were able to create, interact...
with the virtual objects and walk around their design by using the wireless controllers held in both hands.

As a pilot study, the first case to test general set-up within a unit analysed using inductive thematic analysis. The study was "Architectural Design 6" at QUT. Students were asked to design a high rise building with a focus on elderly people. In cooperation with the unit coordinator, we developed an activity in the semester to support students in designing a static building and engaging with Media Architecture structure and their proposed architectural concept. This studio's outcomes suggest that the studio design content needed to focus on a design task strongly connect to the general assignment. Based on these findings, we developed a brief for a compact design course at HSBO. The second case study was conducted in a workshop design-intensive format. The design brief in the course "CAD-Advance-Class" was strictly focused on the virtual design environment tool and an abstract design task. Within a physical workshop setting, students had to design a Media Architecture structure. We compared the studios' results with the previous studio set-up to further develop the following content. The third case study was conducted at QUT. The research was allocated in the Master’s unit "Brisbane studio: urban commons". We asked students to design an architectural intervention for marginalized groups with an interactive intervention. We are currently in the process of finalizing the analysis for the third case study.

5 RESULTS

We are in the process of concluding all results by analysing them through the lens of Keller’s ARCS Model [21]. Therefore, the following section provides only a general idea of the core results but is not fully completed yet. Our results suggest that immersive technology does have potential to help students understand and design Media Architecture. Students had a better understanding of the definition of Media Architecture once there were able to employ virtual design environment tools to create immersive experiences. A primary evolving theme of the data collection was the significant interest in immersive technologies in general. Students described the advantage of the perception of the space experiences their design proposal and how it allowed them to make design decisions. Students reported that immersive experiences were engaging and supported the design process. Participants enjoyed using immersive reality tools, but some expressed scepticism over whether these technologies are necessary for the design process. Through the three case studies, data showed that designing in a virtual design environment impacts design decisions. Most participants agreed that the developed skills would impact future design courses.

Employing immersive technologies was seen more as an addition to visualisation than as something to test dynamic properties such as changing light sources and moving elements. Participants explained that they experienced a limitation in investigating their design ideas because of their limited knowledge of virtual design environment tools. The data showed the definition of Media Architecture and virtual design environments have to be more distinct to make sure that students understand these concepts. Students reported that they are confident to employ the skills they have gained and learned in the workshop for their future architectural design work. The studio approach encouraged a collaborative culture. Students reported great learning success and were satisfied with their design. Students could prove their concept with the new tools and did not get frustrated because of their limitation in employing the tools.

6 DISCUSSION

The results indicate the importance of technical knowledge for architecture students to stay motivated during the design process in an architecture design studio. The study demonstrates a correlation between the relevance of dynamic design tools to make more sophisticated design decisions. The studies provide new insights into the relationship between the impact of virtual design environments tools captures dynamics of Media Architecture. These results should be taken into account when considering how to teach architecture students about architecture with dynamic elements. The data contributes to a clearer understanding of the learning process.
of architecture students. While previous research such as Wei et al., (2015), Salman et al., (2008) or Mathews (2010) has focused on the effects of technologies in education, these results demonstrate that immersive virtual design environments are beneficial to understand the dynamics of Media Architecture. The number of available hardware devices constrained the methodological choices during the studio classes.

7 CONCLUSION AND FUTURE WORK

Students indicated an interest in the discipline of Media Architecture and described the relevance of immersive technologies. However, participants stated that there is a need to explore Media Architecture and virtual design environments more. Participants of the second case study had trouble defining Media Architecture and described the relevance of immersive technologies. However, participants stated that there is a need to explore Media Architecture and virtual design environments in general. Students of the third case study were more experienced, and studio content had been adjusted to a more realistic scenario. Therefore, students were more confident in their responses in the interviews and surveys. We propose that virtual design environment tools have to be explored more in a university context as technology is rapidly evolving but education content is only slowly adapting.

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