# Virtual Reality for Fashion Education

by

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A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Approved March 2023 by the
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ARIZONA STATE UNIVERSITY

May 2023

ABSTRACT

Both fashion design and education are areas where new technologies can have a significant impact. This dissertation examines the potential of virtual reality (VR) for fashion design education and focused on the profound affordances that virtual reality offers - immersion and agency. Using a phenomenological approach, the study combined arts-based research, observational field notes, and in-depth interviews to ascertain the potential value of adding VR to the fashion curriculum. A small group of 14 fashion design students participated in the study, engaging in passive viewing and active creating activities. The students reported their impressions and shared their designs. Results indicate that the use of VR in fashion design education can lead to deeper engagement, increased creativity, and enhanced learning experiences. The study found that students who used VR technology in their design and theory courses reported feeling more engaged. The data also revealed that students found the VR environment to be a valuable tool for exploring design ideas, enhancing creativity, and increasing confidence in their work. These findings have important implications for both design educators and industry professionals. The study concludes with recommendations for integrating VR technology into fashion design education and suggestions for future research.

## DEDICATION

I would like to dedicate this to my family, who supported me through this endeavor with patience and love. Thank you, Lily, Santi and Cole. I wouldn't have been able to accomplish this without your support. I am especially and forever grateful to my husband, Brian for his encouragement and for the sacrifices that have made it possible for me to achieve this dream of a lifetime.

ACKNOWLEDGMENTS

I would like to extend my gratitude to my committee for their wise advice and thoughtful support. Thank you to Professor Brian Nelson, my chair, who has always been positive and enthusiastic about my topic, and Professor Danah Henriksen who encouraged me from my very first semester at ASU and helped me to clarify my direction. Special thanks to Professor June Julian, without whom this wouldn't have happened – she has been a mentor, an inspiration, and a creative partner throughout my academic career.

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# CHAPTER 1

# INTRODUCTION

Designers are curious by nature. The very act of designing is an exploration of possibilities, an exercise in problem-solving and creativity that correlates positively with openness to new ideas and experiences (Prabhu, Sutton & Sauser, 2008). Fashion design, in particular, is about creating and celebrating the new (Bianchi, 2002). This interest in novelty is why there are twice-yearly fashion shows, "what's hot and what's not" lists, and the Pantone Color of the Year (Pantone, 2023). In the context of this interest in new ideas, I explored, through my dissertation study, a new technology--virtual reality--attempting to determine its potential utility for fashion design education.

## Statement of the Problem

There has been a growing interest in immersive virtual reality (IVR), both in education and in the fashion industry (Jacka, 2018), (Hamilton, McKechnie, Edgerton & Wilson, 2021), (Segran, 2020), (Smith, 2020). This trend had already been in motion when the COVID pandemic arrived, and the changes it has wrought have added urgency to the adoption of new technologies and processes. The challenge of social distancing in an industry that creates objects for people to wear on their bodies, combined with an ongoing recognition of the apparel industry's environmental impact, has made virtual and other extended reality (XR) technologies increasingly attractive.

While this may have begun in response to the pandemic, COVID only accelerated an existing impetus. The industry was already having an identity crisis before the pandemic began. Social media, internet influencers, and direct-to-consumer marketing were challenging the traditional gatekeepers (Fernandez, 2021). New technologies were emerging for design, production, and marketing (Ahmed et al., 2019), along with the tension between these innovations and an industry that can be surprisingly resistant to

change (Borrelli-Persson, 2020). For all its embrace of the latest styles, fashion is an industry that values tradition. However, the COVID pandemic amplified and accelerated the need for a radical reset in how fashion works, from design to production to retail. It became a clear imperative that the industry embraces sustainability - curbing the excesses of planet-destroying fast fashion - and recognize the need for greater inclusivity and diversity in this traditionally exclusive world (Barton, 2020).

As a result of these forces, the fashion world was beginning to embrace virtual, extended, and augmented reality (AR). In 2020 and 2021, with COVID raging, Fashion Weeks around the world showcased their lines in virtual-only shows. Augmented reality transformed the experience of trying on clothing and accessories for brands as diverse as Gucci and ASOS (Hackl, 2020). Virtual models were taking over the runways, and Instagram feeds of major labels (Marain & Trochu, 2019). In May 2019, a blockchain dress that existed only in digital space sold for nearly $10,000 (Hacki, 2020). Fashion brands began to create garments that were non-fungible tokens (NFTs) and were preparing to clothe the Metaverse (Zwieglinska, 2021). The fashion industry has been experimenting with XR and all its permutations.

In the past three years, luxury fashion houses Valentino, Gucci, and St. Laurent have shown entirely virtual fashion shows (Browchuck, 2020). Balenciaga's AW (Autumn/Winter) 2021 show was an actual playable video game (Balenciaga, 2021). Congolese design label Hanifa caused a viral sensation by creating their clothing through 3D modeling software and showing their line in a virtual reality setting (Segran, 2020). VR and 3D software were being rapidly adopted both by ready-to-wear, and luxury brands (Joundi, 2018), and courses in its use have been launched at most of the high-profile fashion design school programs: Parsons School of Art and Design, Fashion Institute of Technology and Drexel University among others (CLO3D, 2018).

In the years leading up to the pandemic, there had been increasing pressure on the industry to address sustainability issues in fashion design, production, and disposal. The entire business of fashion is one of the most significant polluters on the planet, second only to the petroleum industry (Morgan, 2015). While the COVID crisis accelerated a move toward virtual technologies for prototyping garment production and showcasing collections, these concerns had been building for decades. Ideating, prototyping, and creating virtually uses fewer natural resources in the design process and creates less waste in production. Increasingly, apparel employers were and are requesting job candidates that have 3D prototyping skills. Moving to a model wherein clothing lines are created virtually and made to order will help to create a more environmentally responsible industry.

Another potential benefit for the design process lies in virtual technologies' ability to create rapid prototypes. Several programs, such as Gravity Sketch and CLO3D, offer the potential to envision design ideas virtually in various fabrics with no waste. After creating a virtual design, a mouse click enables the user to see how it would perform on a virtual model in silk, cotton, wool, or any other fabric. The virtual model moves, walks, and stretches, and the textiles' behavior in the design is evident. This process eliminates the need for hours of draping, sewing, and testing and the cost and difficulty of obtaining a range of fabrics to try in the design process. Production samples can be transmitted visually instead of being physically produced and shipped across oceans. Developing skills in an immersive ideation to demonstrate potential fabric choices without the need to create mock-ups (often called muslins or toiles) physically will be game-changing for students entering the field. That the field is currently in the midst of a sea change leaning toward the virtual offers a potential competitive edge to students that understand the technology.

## Research Questions

The purpose of this dissertation study, building on findings from prior research cycles, was to explore approaches to utilizing virtual reality to enhance fashion design education. The study gathered the observations, impressions, and opinions of participating college students regarding the value of VR for enhancing engagement and assisting in design ideation. The primary research question was framed as a phenomenological exploration of "whatever appears, in the manner in which it appears…to the experiencer" (Moran, 2000. p. 4) and focused on the experiences and observations of the design student participants.

RQ: How do students view Virtual reality as an addition to the Fashion Design curriculum?

Sub-questions were:

How do students identify the role of agency in Virtual reality as a factor influencing their design ideation?

How do students identify the role of immersion in Virtual reality as a factor influencing their engagement in a history/theory course?

## Larger Context

Virtual reality has received a great deal of attention from the education community for over a decade. The ability to immerse students in settings that would otherwise be dangerous, prohibitively expensive, or outright impossible was exciting (Thomas, 2018). Through immersive VR, students could visit recreations of the past, travel to distant locations, and experience others' perspectives (Dede, 2009). Training can be accomplished in a virtual setting that would be much more difficult to achieve in a physical space (Pantelidis, 2009). Immersive virtual reality seems positioned as the next disruptive technology that changes how education is approached. Most previous studies

on virtual reality for educational purposes have been STEM-related (Luo et al., 2021). VR has been explored far less frequently in the context of design education (Radianti, Majchrzak, Fromm & Wohlgenannt, 2020). The study of virtual reality for fashion design education, in particular, is very limited.

**Local Context**

That new technologies are being swiftly adopted by the fashion industry, a business based on creating novelty, is not surprising. The Fashion Design and Merchandising programs at Harcum College, where I work, are dedicated to preparing students to enter this industry. I needed to consider how to incorporate these technologies into the fashion students' educational experience. Harcum College is a non-profit private school in Bryn Mawr, Pennsylvania, a suburb of Philadelphia. As an associate's degree-granting college, the school focuses on preparing students to either enter a career directly upon completion of a two-year degree or transfer to a four-year school (Martin, 2020). In the Fashion Design and Merchandising programs, these two imperatives are central to our continually evolving curriculum.

The fashion programs are relatively small, with thirty to fifty students in both years. Despite the college's location in an affluent leafy suburb, most of the students in the program come from Philadelphia, with a substantial minority from smaller cities in central Pennsylvania. Many of these students were underserved in their secondary schools and came from financially challenged backgrounds. These factors are always part of our considerations in creating an engaging and innovative program, ensuring that the fashion students at Harcum College have every advantage possible in supporting their professional success. As the Director of Fashion Programs, I wanted to explore the possibilities that virtual reality might offer our students for greater engagement, to assist in design ideation, and enhance their career prospects. My dissertation study

incorporated virtual reality experiences into the fashion design curriculum at Harcum College and investigated how the students viewed its impact on the curriculum.

I have always been an optimistic futurist. Although I acknowledge the potential for technology to bring us not to a utopia but deeper dysfunction (Curtis, 2011), I remain bullish. I have been fascinated by the idea of the Metaverse long before Mark Zuckerberg made his momentous announcement - changing the name and focus of Facebook, one of the largest tech companies in the world (Zuckerberg, 2021). Although I had not heard the term Metaverse before reading Snow Crash (Stephenson & Kodaj, 1992), I had always imagined that someday another technologically mediated world could exist next to our own - an alternate universe that expanded what was possible in ours. When I first tried a VR headset, it was a revelation. While the experience was not perfect - I developed a case of cyber-sickness pretty quickly - its potential was exciting. The mechanism of this potential became clearer in reading the research on the uses of virtual reality for education. Johnson-Glenberg's (2018) description of the two profound affordances, immersion and agency, pointed the way. I believed both could be particularly relevant to the study of fashion design. The process of design proceeds from a two-dimensional concept to a three-dimensional reality through a slow and painful process. What is VR but an instantaneous jump into three dimensions?

**Conceptual Framework**

In basing my dissertation study on these two affordances, I had to consider how each would be applied. The two avenues for exploration - agency and immersion - indicated incorporation into the curriculum of two different classes at Harcum. There seemed to be a straightforward way to apply the affordance of agency by utilizing applications that enable students to design in VR. The ability to effect change in the virtual environment, to build and create using virtual tools, seemed to offer a creative

opportunity for student designers. The sense of virtual agency could help them to develop and refine their design ideas without the lengthy process of actually constructing a garment. How to study the affordance of immersion was less clear-cut. Immersion, the sense of actually being in the virtual space, is not necessary for the process of creating fashion. While immersion is generally experienced in any successful VR app, it might not be the most critical element in a creative situation.

For the dissertation implementation, the study of the affordance of immersion was situated in a theory class, History of Fashion. Studies on using virtual reality for education that focus on the effects of immersion (Huang, Roscoe, Johnson-Glenberg & Craig, 2021) are more likely to explore the intensity of emotion produced and the potential for this emotion to enhance engagement. The History of Fashion class offered the opportunity to examine whether the depth of immersion could create a more profound sense of engagement with the material. The video/experiences suited to this part of the study were primarily passive, consisting of viewing a 360° movie, although one allowed some limited exploration of the environment (Forcefield, 2019). I believed that viewing the material in VR could create a more impactful and memorable learning experience.

**Background**

These two "profound affordances," immersion and agency (Johnson-Glenberg, 2018), set virtual reality apart from other multimedia experiences. These affordances guided my thinking in formulating the research questions for my study. The most immediate and notable of these affordances was immersion, the sense of presence that VR engenders. In the head-mounted display (HMD), the user feels that they are in a different space than their physical body is inhabiting. Immersion was a central attribute of many documentary virtual experiences available for VR, some of which explore

historic sites or events. VR has been called an "empathy machine" (Bailenson, 2019), and the potential for engagement seemed evident. Consequently, in this dissertation study, I explored VR's impact on students' perceived level of engagement in the History of Fashion through immersion.

Contextualizing themselves within the history of fashion is an essential part of the learning process for fashion students. The required fashion history classes at Harcum are often seen as the less exciting parts of the program. Some students have a hard time emotionally engaging with a long past time, making it difficult for them to understand the forces behind a previous era's fashion. While teaching a unit on fashion history in ancient Rome in the Spring of 2021, many students were less than excited by what they saw as "just more draping fabric around yourself." For the dissertation study, I introduced our Oculus Quest VR headsets to the class and pulled up an experience that placed the viewers into the Colosseum during the reenactment of a gladiatorial match. The students responded enthusiastically, reacting to the action around them and commenting on what the ancient Romans were wearing. Many wanted to repeat the experience immediately to see things they may have missed the first time. Using virtual reality to create a sense of connection with fashion's past had the potential to create a deeper engagement with material that is critical to students' contextualizing their own work within the scope of the practice.

My dissertation study also explored the affordance of agency for design ideation in the Fashion Design course. The traditional fashion design process begins with a concept - mood, silhouette, or inspiration - and is initially expressed via a sketch, drawing, or other two-dimensional renderings. The design is then evaluated, and construction is planned. The garment is rendered as a technical drawing with all construction details indicated. It is, in essence, the blueprint for the garment. At this

point, the student may begin making flat patterns or draping fabric to bring their concept into reality. It is frequently at this point that things go awry. Skirts that were supposed to be full and flowy are limp and flat. Fabrics that were expected to provide structure give way and sag. A deep cowl neck in the front of a gown combined with a deep V in the back means that the dress slides off the shoulders altogether to puddle on the ground.

Virtual reality had the potential to address this issue in several ways. Modeling programs like *Tilt Brush* (2019) and *Gravity Sketch* (2019) offered the opportunity to create virtually in three dimensions. These programs provided an environment, complete with a dress form, that allowed the users to construct virtual garments in a space that felt real. The hand gestures created various marks in the virtual space that reflected the garment's construction in a simulacrum of actual fabric. Instead of beginning the design process by drawing on a two-dimensional surface, I wondered if the sense of agency and embodiment offered by working virtually in three dimensions could improve students' ability to envision the final product. Would the design learning that evolved in this way prove helpful in bridging the 2D concept to the 3D garment divide? Research into the power of embodiment as a force for learning suggested that it might (Kwon, 2018).

One of the main hurdles for beginning fashion design students is learning to think three-dimensionally. Making the connection between the flat, paper doll-style drawings they begin with and a garment that works in three dimensions is difficult. A garment that fits the vagaries of a human body and is made out of textiles - each with unique characteristics and properties - is a tricky design challenge. VR and other 3D technologies could address this challenge. Using Tilt Brush (2019), an app that allows the user to design in a three-dimensional space with a dress form by painting with color, texture, and line, had the potential to help the students to understand the principles of design in a more profound and meaningful way. The dissertation study proceeded from

my belief that virtual reality had the potential to both increase engagement (Dede, 2009) and assist in design ideation (Joundi et al., 2018). The embodied, kinesthetic design process afforded by virtual reality could encourage students to ideate in the round, making the connection between design drawings and finished garments more immediate and explicit.

Assessing the value of VR in the context of the classes was a more complicated proposition. Upon consideration, it was clear that the benefits of the two affordances were not really quantifiable. One could examine design work before and after the VR experience. While design quality metrics could be applied, there would be no way to attribute increased quality directly to the VR experience. Similarly, the level of engagement due to immersion inherent in a 360° video is subjective. There are observable aspects - how the students acted when in the VR unit, for example, but this would be unreliable evidence. It seemed that the way to formulate the question properly was not to ask whether the affordances improved learning outcomes but to ask how the student participants perceived it. Consequently, I spent much time talking to the students in the study, asking for their opinions or to describe their experiences. At the conclusion of the semester, I finally asked them directly whether or not they had found value in using VR. I also asked their thoughts on potential future uses of VR in the fashion programs.

**Role of the Researcher**

As the researcher for this study, I was an insider, collaborating with the participants in a spirit of exploration. As Director of Fashion Programs at Harcum, I am responsible for designing the curriculum and mentoring faculty, and I teach several classes a semester. The study required the support of an additional faculty member, who received training in the use of VR, and who had previously (in an initial study I

conducted prior to this dissertation research) expressed enthusiasm for the project. As I will detail further in chapter 3, the faculty member and I were responsible for data gathering, using field notes to describe student affect during the VR use (Appendix C), and ensuring student comfort and safety while using VR (Appendix F).

The student participants reported upon their perception of virtual reality's effect on their design ideation and engagement with course material in discussion forums and through unstructured interviews (Appendix E). The faculty member and I recorded in-class observations, took videos and photographs, conducted post-experience interviews at the close of each semester, and discussed their design work. No aspect of the technology used was graded, and students were informed that participation in any virtual reality activities was strictly voluntary (Appendix A). I hoped they would enjoy exploring a novel technology, whether or not they found it valuable to their educational process.

**Definition of Relevant Terms*:***

Virtual reality has been studied as an educational tool for over 20 years. However, a truly established taxonomy has yet to be developed because of the novel and changing nature of the technology. When the term virtual reality is encountered in the early literature, it frequently refers to something functionally different from what is now available. In educational research, the term virtual reality had previously been used to describe virtual interactive learning environments and communities - for example, Second Life or OpenSim - accessed through a desktop computer interface. For clarity, these should properly be referred to as Virtual Worlds or Virtual Learning Environments instead of Virtual Reality. What is meant by the term Virtual reality as it has evolved generally connotes the use of a head-mounted display for 360° immersion.

**3D Modeling:** A technique that creates design renderings that appear three-dimensional.

**AR- Augmented Reality:** A technology that allows digital images to be transposed upon the actual physical space.

**Fashion/Apparel Design:** Fashion Design and Apparel Design are used interchangeably throughout this paper. Both terms refer to the act of designing and producing wearable garments. The programs at Harcum College have traditionally been called Fashion Design and Fashion Merchandising, but many other colleges refer to their programs as Apparel Design. Apparel is a more accurate and technical term.

**HMD - Head-Mounted Display:** Projection display devices that are mounted within a helmet or headset. The HMD is often used in conjunction with handsets that allow the user to interact with the virtual environment through physical gestures.

**IVR - Immersive Virtual Reality:** An environment accessed through a headset that gives the user the impression of existing in a created digital space.

**VR -Virtual Reality:** This term can refer to either a three-dimensional but desktop-mediated collaborative environment or an immersive experience, whether collaborative or experienced alone.

**VW/VLE - Virtual Worlds/Virtual Learning Environments***:* This term refers to a collaborative digital space that the user interacts with through a representation of themselves, an avatar. Despite the three-dimensional appearance of the environment, it is experienced through a two-dimensional medium, the computer screen.

**XR - Extended Reality:** A catch-all term for any digitally mediated experience, including augmented and virtual realities.

My dissertation study focused primarily on immersive virtual reality (IVR) with head-mounted displays (HMD) and hand sensors. The sense of immersion and ability to

manipulate the perceived environment that this kind of VR provides enabled me to examine both the affordances of immersion and agency for fashion design students.

**Organization of the Study**

The research took place in two parts over two semesters. Each semester's study focused on one of virtual reality's "profound affordances" (Johnson-Glenberg, 2018). The first semester's study, in Spring 2022, occurred during the History of Fashion course and explored the affordance of immersion. It examined qualities of engagement related to that affordance. The second semester's Fall 2023 study focused on the students' perceptions of the affordance of agency in VR. Embedded in the Fashion Design course, this part of the study examined virtual agency as a tool for design ideation within a conceptual framework of embodied cognition.

**Table 1**

*Timeline of activities*

| Date | Activity | Affordance | Data |
|---|---|---|---|
| March 3, 2022 | View *Lincoln in the Bardo* (NYT, 2018)<br><br>VR experience based upon the novel (Saunders, 2017) | *Immersion* | Observations<br>Discussion Forum<br>Interviews |
| April 24, 2022 | View *Anne Frank House* (Forcefield, 2018)<br><br>VR experience based upon The Diary of Anne Frank (Frank et al., 2015) | *Immersion* | Observations<br>Discussion Forum<br>Interviews |
| April 7, 2022 | View *Traveling While Black* (Williams, 2019)<br><br>VR experience based upon Jim Crow Era | *Immersion* | Observations<br>Discussion Forum<br>Interviews |

| | | | |
|---|---|---|---|
| September 2022 | Design with Tilt Brush (Google, 2019): Design project based upon elements and principles of design | *Agency* | Observations<br>Design Objects<br>Interviews |
| December 2022 | Design with Gravity Sketch (Gravity Sketch, 2019): Accessories design project | *Agency* | Observations<br>Design Objects<br>Interviews |

**Prior Cycles of Research**

My dissertation study was an Action Research study. Action Research builds on prior related research and is designed to collect data that could provide context and framing that help to answer the research questions. Action Research is a particular type of sociological research that is frequently used in educational settings (Mertler, 2011). While both Action and Traditional Research employ the scientific method, Action Research is conducted in the field by working practitioners. This form of inquiry allows the researcher to investigate their own practice - findings then inform future practice, creating a spiral of question, action, reflection, and repetition. Quantitative or Qualitative methods can be used (Mertler, 2017). I embedded my research within my practice as Director of Fashion Programs at Harcum College.

In preparation for my dissertation study, I conducted two cycles of initial research in order to establish the existing level of interest and support on the part of students and faculty and to begin exploring the possibilities for engagement. The first was conducted in the Fall of 2020. In Cycle 0, I was interested in discovering what the students and faculty see as particular difficulties in design education and whether there was a perceived need for an intervention at all. Students and faculty were interviewed to discover their views on VR's potential for design education (Cycle 0). As a follow-up to

Cycle 0, I wanted to know if a less immersive VR technology would increase interest or engagement in the context of the History of Fashion. In Spring 2021, a small study (Cycle 1), conducted virtually, examined the responses of student participants who volunteered to use a rudimentary virtual reality viewer, Google Cardboard, to watch and report on videos in the History of Fashion class (Cycle 1).

### *Exploratory research*

During the exploratory phase of the research prior to the dissertation study, it seemed important to establish some premises from which to proceed. In the first iteration of this action research (Cycle 0), I explored student and instructor perceptions surrounding virtual reality to establish any preexisting knowledge and interest level. Additional lines of inquiry included what a student or an instructor perceived as difficulty in translating design ideas into a three-dimensional form and how students experience their context within the broader fashion industry and the scope of fashion history.

One instructor and one senior student were interviewed for this phase of research. The student was a full-time student and a senior in Fashion Design. A 21-year-old male, he has been attending the program for three years. He was engaged in class and the broader fashion community, having participated in several local fashion shows. He had never used VR or 3D technology for fashion design. He expressed growing confidence in his abilities as a designer, although he had initially struggled in the program. Despite a stated preference for "Street Wear," his designs tend to be classic and often ambitious in relation to his skill level.

The instructor had twelve years of industry experience as a designer and three years of experience teaching at Harcum College as an adjunct instructor. She teaches construction classes and computer-aided design, primarily Adobe Illustrator, for

technical drawing. She is very comfortable with technology and has adapted remarkably well to the online delivery method instituted during the pandemic. In one of her previous positions, she had worked extensively with Optitex, a 3D modeling software for apparel production.

The student and the faculty member immediately identified converting design ideation into three-dimensional garments as critical difficulties for design students. Both also noted that this is a difficulty that is only alleviated by practice and over time. The instructor had used 3D prototyping in a previous job and was enthusiastic about its capabilities. The student had not heard of 3D modeling, but he was interested in its potential. While he had only used virtual reality for gaming, he had experienced great "hedonic pleasure" - the enjoyment of experiencing new technology (Lindgren, Tsholl, Wang & Johnson 2016) from the process and was eager to try it again.

As a senior, the student was comfortable with his abilities, allowing him to take a longer view of his growth as a designer. When asked about whether his garments turned out as he had envisioned, he reported that now they did, but in the beginning, he found the disparity between what he had planned and what he produced to be vast. He noted that this was a source of discouragement for many early designers - the gulf between their ideas and the reality of working with fabric on the form.

In the two interviews, both instructor and student expressed interest in and enthusiasm for exploring virtual reality and 3D modeling in the context of fashion design. The instructor laughed when asked whether her students' garments turned out as they had planned. She observed that it took a lot of time and practice for students to understand the relationship between lines on paper and seams on a human body. As the conversation turned to 3D modeling software, she was very supportive. It had been a

critical innovation at her last workplace and, despite a steep learning curve, had eventually saved a great deal of time.

### *Pilot Study*

Building on findings from my initial research, I conducted a second round (Cycle 1) of study in Spring 2021. One of VR's benefits is its ability to transport the user to places that would be otherwise impossible. Virtual field trips can elicit a high degree of engagement, and students frequently speak about the experience as though they had lived it (Thomas, 2018). Following a virtual field trip to a tomb in Ancient Egypt, high school students could recall vivid details and even complained about stepping over "rubbish" (Thomas, 2018, p. 68). With an increasing number of educational VR experiences being produced, this innovation can expand the students' understanding and create a more significant connection with the material in their classes.

The sense of presence, a feeling of being in the virtual space instead of the space that the body actually inhabits, is one of the most notable effects of immersive virtual reality (IMVR). This feeling is usually abrupt and immediate upon donning the head-mounted display and has been one of the more well-documented qualities of the technology. Recent studies have indicated that the quality of immersion creates enhanced engagement and an increased feeling of identification with the subjects of viewed material (Aitamurto et al., 2018), (Huang et al., 2020). As Johnson Glenberg states, "Immersive VR has the ability to immediately transport the user to a limbically heightened emotional space that can have positive effects on attention and engagement; this is one reason educators believe that learning will be positively affected" (2019, p.2).

Virtual reality has the potential to provide students with a deeper understanding of and emotional connection to the lives of people in past eras. In experiences that take students to historical reenactments, they can viscerally comprehend how it felt, for

example, to inhabit the space of Ancient Egyptians (Nichols, 2018) or sit on a bus in the Jim Crow era (Williams, 2019). While the value of such experiences has yet to be fully established (Bailenson, 2018), it was enlightening to hear how the students perceived its value. A recent study by Minocha et al. (2017) found that immersion fostered engagement and a state receptive to learning. This immersion encourages curiosity and an urge to explore (Johnson Glenberg, 2018), engagement, enjoyment, and motivation that facilitates learning (Flavin et al., 2019).

The Cycle 1 research centered on a pilot study that focused on the quality of immersion as an affordance: whether and to what extent it added value to the History of Fashion class in the student participants' eyes. Although the unique circumstances of the pandemic necessitated a change in the original research plan, perhaps it was a benefit. In a time of quarantine and remote learning, many students reported feeling isolated and trapped. Even if it was only virtual, the ability to experience an alternative reality might have helped to alleviate these feelings. While I had initially considered creating participating and control groups in the class, I decided against this. Because of the potential benefits students might derive from the experience; I gave all the students viewers. They had the opportunity to use them to engage in virtual experiences, even if they chose not to participate in the study.

**Pilot Study Participants**

There were thirteen students in the online History of Fashion course. The two VR experiences were embedded throughout the semester when relevant content was being discussed. While all the students in the class were given viewers and viewing the experiences was part of the course, there were no graded assignments associated with VR use. Only those who agreed to participate in the study completed the qualitative measurement tools. All thirteen students in the History of Fashion class received Google

Cardboard VR viewers, mailed to the student's home or dormitory addresses. Using their smartphones and the catalog of 360 history videos available on YouTube, the students had the opportunity to experience virtual reality as a learning tool.

Throughout the semester, the students were introduced to two different historical virtual reality experiences: exploring a recreation of the Titanic (Vicinity360, 2019) and experiencing what it was like to travel as a black person during the Jim Crow era (New York Times, 2019). Students participating in the study answered a survey when they received their Cardboard units to assess their previous level of interest in the topic: History of Fashion, and their learning preferences in theory classes like this one. Throughout the semester, students participated in a discussion forum responding to the experiences. At the end of the semester, participants were interviewed to evaluate their perceptions of how and to what extent the VR experiences enhanced their understanding of and engagement with the course material.

**Pilot Study Findings**

The most notable finding was the extent to which the use of the VR viewers seemed to encourage a heightened emotional response to the video's content and profound identification with the documentary subjects. While I had expected the immersion quality to enhance the experience, this emotional intensity was a side effect I had not anticipated. Four students who had used the VR viewer to watch *Traveling while black* (NY Times, 2019) agreed to be interviewed. Nine students who watched *Titanic* (Vicinity 360, 2019) and *Traveling while black* (NY Times, 2019) responded to a discussion thread about each video. All reported deep empathy with Sandra Butler-Truesdale, the first interview subject, and one student "Alice," who said it had made her cry. Each of the three students reported that it was a good use of class time, felt that they had learned something significant, and that the immersive effect had

enhanced this learning.

The subject matter of the third video, *Traveling while black* (NYTimes, 2019), seemed to elicit the most potent responses. There are probably several reasons for this. Indeed, it is the most well-produced of the VR offerings. It has a narrative flow that is designed for VR and film direction that is high quality. Of the student participants in the interviews, two are women of color. The subject is harrowing, and these students could probably relate to the fear of existing as a Black person in America. The viewing of this video also happened to coincide with the trial of Daryll Chauvin, the police officer accused of killing George Floyd, which was broadcast daily. The news coverage of additional cases of police brutality was ubiquitous during this semester.

Although all the participants expressed a sensation of "being there" and understanding the feelings of the documentary's subjects, one student, Neneh, expressed this most vividly:

> I remember when Tamir Rice's mother, she was talking about how she how she went into the... found out that her baby was, you know, her son got shot, and then they to go to the (at this point, the participant pauses, as she is tearing up) ambulance, and she said I wanted to go back there and, you know, comfort him and stuff like that. And they wouldn't allow her at all. And that is really sad. Like, you put out a basic right for, like, a mother at least to say goodbye to her son because that was the last time seeing them. And that really struck a chord with me because I'm just like, Okay... It got me in my feelings. And then... then it made me mad.

Several comments in the discussion thread indicated an increased identification with the subjects. This comment was from Alice, a girl who comes from a homogenous rural community:

> The emotions I felt when watching this was anger, sadness and a bit of rage. How dare you kidnap, murder, rape and enslave an entire group of people for 200 years, and in the last 150, you treat them like trash and take away basic advantages for them and their descendants? It's truly baffling to me. However, what I took from this is that throughout history, black people have been treated like they don't matter and has been viewed as everything except human beings.

Others commented on the profound sense of identification they felt with the subjects of the documentaries when using the virtual reality viewer. One student found that the experience allowed her to view a familiar story from a perspective that she had not considered: "I have heard of the story before - Tamir Rice -. It's just that I never got the mother's perspective on it. And after hearing about that, yeah, (I was upset)."

According to all the participants, the sense of immersion was more pronounced than an ordinary video would have been. In the words of one student, "I feel more so...like, not even at a movie. It's just like...I just felt like I was actually there. Like, I was just actually there."

The immersion helped some students to gain a greater insight into a previous era, expressed by Jada, "I believe the change from like the past to like the present day...you could definitely tell it was like two different time periods."

**Implications for Further Study**

Several factors created obstacles for the first two cycles of this study but provided insight into more effective methods for future study. The lack of in-person instruction made it difficult to gain buy-in from many students, and the fact that no grade was attached to the experiences meant that students did not feel obligated to participate. This lack of interest is part of a larger pattern of Zoom burnout that I had observed as the

semesters progressed. Students, increasingly tired of the virtual interface, checked out - symbolized literally by their cameras turning off and decreasing interaction within the course. The lower-quality viewers that they were sent were less exciting and engaging than a full head-mounted display would have been. Frankly, after a year of online education, I believe they were sick of being on screens of any kind. The lack of any reward for engaging with the technology meant diminished motivation to try it and fewer students willing to provide feedback.

However, there was positive feedback from those who used the viewers. From the straightforward enjoyment of using new technology to the incredible sense of immersion, most students reported that it was a pleasurable experience that they would be eager to repeat. The feeling of immersion enhanced the students' emotional connection to the material, creating impressions that were reportedly more memorable. This empathetic connection to the subjects of the documentaries was evident. The link was more pronounced in response to the emotionally charged *Traveling while black* (Williams, 2019) but still evident even in the emotionally neutral walkthrough of the *Titanic* (Vicinity360, 2019): As one student noted: "It feels sad but peaceful."

The biggest obstacle to studying this innovation was that the technology central to its affordances was unavailable to the students. The HMD would have allowed a deeper dive into the two profound affordances of immersion and agency. As a result of this situation, one of my questions - the potential utility of VR for design ideation - had to be set aside. There was a forced pivot from VR as a design tool to VR as support for related theory classes. Despite this direction change, the students' voices were loud and clear. Most of the students that decided to engage found it a worthwhile experience and were eager to repeat it. As a result, I intended to incorporate VR experiences into the curriculum for all history/theory courses.

The initial studies, particularly the pilot, provided an opportunity to learn what parts of the initial research design would be successful and which would prove less so. The initial survey could have been more helpful than the interactions with students - the interviews afterward and the discussion boards being the most revealing. Authentic student voices became an essential part of understanding how they perceived the value of the innovation (Gregory et al., 2018). In the final dissertation study, additional rich qualitative data was gathered - including the design pieces created (Leavy, 2009) and videos from within the virtual world. Observational notes provided greater context to the student experience. Creating more open-ended questions for the interviews produced more meaningful responses from the students than in the pilot.

# CHAPTER 2

# REVIEW OF SCHOLARLY AND PRACTITIONER KNOWLEDGE

This dissertation study aimed to explore virtual reality's potential uses in fashion design education. As discussed in Chapter 1, there were two areas in which virtual reality could be a valuable adjunct to fashion/apparel design education: assisting students with design ideations and enhancing engagement in theory courses. In this chapter, I will discuss the theoretical frameworks that informed the study and the implemented VR curriculum.

## Historical Foundations

While virtual reality for education in general, and art education in particular, has been studied for the past decade, most of this research centered around technologies that would not be considered VR today. Initially, this meant examining virtual learning environments and social worlds like Second Life. The latest iteration of VR differs in kind and degree (Bailenson, 2018) and has only infrequently been studied in connection with design education.

Initial research into Virtual Worlds focused on students connecting over geographic distance, the opportunity for collaboration, and relational aesthetics (Stockroki, 2014). The current technology is more immersive and needs to be evaluated on its own merits and for its unique capacities. While many recent studies have focused on IVR for education, only a few explore its potential for design education (Radianti et al., 2020). The studies that have been conducted have primarily come from the perspective of architecture, interior, and industrial design (Kalantari & Neo, 2020; Häkkilä et al., 2018). The exploration of VR in the context of fashion studies is relatively unique. Given the recent trend of rapidly adopting these technologies in the fashion industry's broader world, this line of inquiry seemed urgent and relevant.

Despite the lack of research in fashion design education, recent studies have offered promising avenues of investigation in several related areas, including the effect of VR on creativity, potential enhancement of spatial understanding, and engagement with content in virtual field trips. Several studies have explored virtual reality's value in enhancing creativity, a central aspect of any design field. While what constitutes creativity may be challenging to quantify precisely, Chandrasekera (2019) delineated measures that indicated the creative process in action. In this study, students self-reported an increased sense of attention and flow and heightened engagement with the design process. Kwon (2018) noted that the students reported increased engagement and motivation, directly coinciding with greater verisimilitude in the virtual experiences. Following a study with Industrial Design students in Iceland, Hakkila et al. (2018) reported that "Virtual reality and the use of head-mounted displays were found to offer both inspiring and motivating experiences, as well as to function as a utilitarian tool in the design process" (Häkkilä et al., 2018, p.9). As might be expected, students enjoyed the experience for the pure pleasure of using novel technology, but in addition, virtual reality enhanced their ability to solve design challenges (Häkkilä et al., 2018).

One of VR's benefits is its ability to transport users to places that would be impractical, dangerous, or even impossible (Johnson-Glenberg, 2018). While it would be a valuable and exciting experience for fashion students to explore museum collections or historic sites in VR, this innovation could create an even deeper connection with the material. It had the potential to encourage students to empathize with the past and the forces that shaped both people and what they wore (Carlos, 2020), (Huang et al., 2020), (Schutte, 2019). A deeper and more empathetic understanding of the values and worldviews of those in eras past could encourage greater engagement with the subject and a deeper analysis of the way these forces shape fashion.

## Theoretical Framework

The most intriguing concepts within which to frame the dissertation study are the "two profound affordances" offered by VR; presence/immersion and embodiment/agency (Johnson-Glenberg, 2018, p.2). The embodiment or agency concept is grounded in theories of the mind-body connection and its role in cognition. Sometimes referred to as Grounded (Barsalou, 1993) or Enactive Cognition (Gallagher & Lindgren, 2015), this theory states that physical actions can reinforce learning. The second affordance, presence, is the degree to which the learner is engaged and feels as though they truly exist in the virtual world. This depth of immersion can enhance curiosity (Schutte, 2019), enjoyment, and engagement - in fact, the deeper the sense of immersion, the more pronounced the positive effects. (Huang et al., 2020).

### *Affordances*

The concept of affordances is central to the scope of this inquiry. William Gibson coined the term to describe how animals (and humans) perceive and relate to their environment (1979). "The verb afford is found in the dictionary, but the noun affordance is not. I have made it up." (Gibson, 1979. P. 56). Gibson asserted that the interaction of man and his perception of elements in his environment is somewhat transactional - an element is evaluated for the use that it offers the perceiver - what it can afford, either for positive or negative ends.

Interestingly, Gibson (1976) points out that there is no distinction between the natural environment and the environment as modified by man "It is a mistake to view the natural and the artificial as though they were two environments. ...there is only one world, however diverse, and all animals live in it, although we human animals have altered it to suit ourselves.' (p.56) He includes a warning related to environmental issues. "We have done so wastefully, thoughtlessly, and if we do not mend our ways, fatally." He

describes some absolutes, that the ground is the base on which all animals interact and that the bodies of such are governed by some immutable laws, like gravity (Gibson, 1979). Virtual reality may alter some of these - gravity does not always exist, nor is the ground always the base. The point is not to consider what individual elements in the virtual space afford but what the experience affords.

Other researchers have richly explored Gibson's theory since his initial conception; it seems clear that he regarded it as an initial framing. Scholars have discussed whether or not an affordance is independent of the perception or only exists in relation (Norman, 1988), expanded upon the concept with further delineations, sequential and nested affordances, for instance (Gaver, 1991), and applied these delineations to technology like software (McGrenere & Ho, 2002). The theory becomes even more interesting in the study of virtual reality. Much of the discussion hinges on the nature of what an environment is and the nature of the perceiver. In a virtual setting, the assumption must be that the participant perceives the virtual world as real. However, when talking about the affordances offered by VR, we are not necessarily talking about objects' affordances *within* the virtual environment. It is the utility that the technology itself tends to offer, particular affordances that are unique to the virtual experience.

Two affordances are usually discussed regarding the virtual reality experience (Grabarczyk & Pokropski, 2016). The affordances that are unique to virtual reality are commonplace in our lived space - immersion, presence, and agency. We are assumed to feel as though we are present in the natural world. We understand that our actions affect our environment. It is the artificial creation of these common affordances that is unique and interesting.

While the terms immersion and presence are often used interchangeably, there is a shade of difference. Slater and Wilbur (1997) delineate between immersion and

presence in this way - immersion centers on the properties of the virtual technology that creates a greater or lesser degree of separation between the virtual and the real world, and presence is the psychological state that results from immersion. Li et al. (2003) assert that the affordance of immersion includes the participant feeling "Active in an environment." I would describe this as agency. In the case of narrative VR experiences, the participant is an observer. As a result, delineating between the affordances of presence and agency as distinct but sometimes coexisting is helpful. Grabarczyk and Pokropsk (2016) maintain that the very sense of presence, of being there, is related to a sense of embodiment and the ability to act upon one's environment.

Ermi and Mayra (2005) divide the sense of immersion into three types: challenge based, sensory, and imaginative. In my research, this proved a useful framing. Years before the advent of HMD, there were virtual desktop environments in which people felt very immersed and, even to a certain extent, embodied (Pasfield-Neofitou et al., 2015). Virtual reality can be defined as a "Computer-mediated synthetic world that can be interactively experienced through sensory stimuli" (Fiore et al., 2007. P. 28). Therefore, even non-immersive synthetic experiences can be a form of virtual reality and offer the same affordances.

In a recent study, Tang et al. (2002) approached the concept of affordances specifically for art education. They examined the affordance of presence and the potential for extraneous cognitive load in a lesson about the history of the Mona Lisa. Recent studies have looked at IVR's potential for increased motivation, engagement, knowledge retention, and skill transfer. While there were no indications that IVR created better retention or learning outcomes, the perceived cognitive load seemed lower overall with the more immersed groups. (Shutte, 2019)

### *Agency*

Agency, as it relates to VR, is the extent to which the user feels that they can affect the virtual environment - to move within it and to act upon it (Johnson Glenberg, 2018). Greater agency creates a deeper sense of immersion and allows the body to engage in virtual acts performed using the physical body. The sense of embodiment that virtual reality affords could address the perennial problem in any design discipline that requires spatial awareness, like engineering, architecture, or fashion design. Much of the research on VR in design has centered around its application in engineering or architecture. As with fashion design, these disciplines require the student to cross a threshold from drawing to creating an object in space. It is challenging for many students to make the leap from a design concept, usually in a 2D drawing, to a three-dimensional, and in the case of fashion design, wearable object.

Johnson Glenberg (2018) applies the concept of embodied cognition - the idea that bodily activities have a direct relationship to cognitive processes (Barsalou, 1993), to the experience of acting in virtual reality. The user, wearing a head-mounted display and hand trackers, moves their body and perceives a congruent response in their perceived environment. It is a powerful sensation. In the case of the app Tilt Brush, for example, the arm moves to create a stroke of color in an immersive world that the user can see and feel in what appears to be a three-dimensional environment. As with Gestural or Action Painting, the user is physically acting out their impulses in the process of art-making (Tate, 2020).

Research has indicated that gestures reinforce learning in many areas (Goldin-Meadow, 2011). Embodied, grounded, or enacted cognition is a variation on the theory that learning is not the sole province of the mind but is influenced and reinforced by a complex interplay of thought and action (Baraslou, 1993). Studies have shown that

students retain knowledge more readily when the body physically performs movement-related instruction (Goldin-Meadows, 2011). Virtual reality has been shown to be effective in demonstrating abstract concepts and improving spatial awareness. (Yang, 2018). Kinesthetic movement may reduce cognitive load when learning new things (Chandrasekera, 2015), and activation of sensory-motor pathways may create stronger long-term memories (Goldin-Meadow, 2011; Johnson Glenberg, 2018).

For example, studies on enactment have determined an increase in reading comprehension when students act out the stories they read. (Gallagher & Lindgren, 2015). The enactivist approach to cognition explores the effect of bodily enacting "metaphors" to enhance learning. The idea behind the enactivist approach is that both physical (sensorimotor) and affective dimensions influence how we experience the world (Gallagher & Lindgren, 2015). In their 2015 study, "Meteor," Gallagher & Lindgren had students physically experiment with a virtual (metaphoric) meteor in one of two ways, either with low immersion, using a desktop model, or high immersion, employing a head-mounted device. The high immersion groups' mapping of abstract concepts following the lesson was significantly more detailed and dynamic, revealing a correlation between bodily enactment and learning abstract concepts (Gallagher & Lindgren, 2015).

This idea is especially interesting for fashion design if we consider that design ideation is a metaphor for the finished garment. Given this, the simulated action of creating in the virtual world should be a potent tool for developing design skills. Body/mind engagement has the potential to help students understand the abstract principles and elements of design. Several studies on virtual reality for STEM applications have shown that it can aid in learning complex scientific and mathematical concepts by connecting "symbolic and experiential information" (Pantelidis, 2009, p. 60). Studies around architecture and interior design have revealed a benefit to spatial

understanding (Perdomo, Shiratuddin, Thabet, & Ananth, 2005), (Bailenson et al., 2008, p. 108). Studies on creativity, as defined by the ability to swiftly develop alternate solutions to problems (Kwan, 2018), have indicated that immersive virtual reality deepens focus and promotes more rapid remediation of design problems (Kalantiri & Neo, 2020) (Huang et al., 2020).

Some researchers believe that the success of embodied cognition in education may have been overstated in an excess of enthusiasm for the new technology (Skulmowski & Rey, 2018). These authors counsel development of a practical and clear taxonomy for virtual reality education and feel that careful planning and structuring of the student learning experience in future research is critical to gaining unambiguous results (Skulmowski & Rey, 2018). Integrating the task of designing with the body's engagement informed the development of the student learning experiences, and their observations, responses, and design work comprised the data.

**Embodied Cognition**

Proponents of embodied or grounded cognition theories offer viewpoints that address the value that the affordance of embodiment can provide. Examining curiosity and engagement can inform the exploration of the importance of presence. As a consequence of this technology's newness, this research could be more plentiful, though there is more every year. Research on virtual reality for arts education is even less plentiful, and it is almost nonexistent for fashion education. My research on VR for fashion design education offered the opportunity to evaluate a new technology for a novel application

Since Dewey (1959) developed his experiential learning theory, many educators have accepted it as self-evident that knowledge acquisition is based on experience and socially constructed (Lave & Wenger, 1991). Saunders (1961), in discussing one of the

most foundational theorists in art education, Viktor Lowenfeld, notes his emphasis on the act of creating. One of his most ardent assertions was that the process of art-making is far more significant than the product and that the experience itself is the critical component. The question, then, becomes - will a virtual or simulated experience provide the same benefits? If we assume that the virtual is experienced as real, we can examine the potential of virtual reality to increase creativity and exploration and open the mind to learning (Schutte, 2019).

***Immersion***

When Johnson-Glenberg (2018) notes that the sense of immersion engendered by the virtual reality experience creates a limbic connection, she indicates that it activates the motivational and emotional centers of the brain. Some of the earliest award-winning VR experiences place the user into a scene in which they see through the eyes of another (Williams, 2019), (ARTE France, 2016). This affordance could support students' development as designers in several ways.

If experiential learning is to occur, and the mind is to be more receptive to learning while using virtual reality, we must assume that the virtual experience is perceived as real. Dewey (1934) argued that art is both powerful and transformative and must be "an experience," both for the creator and the critic. If the act of creating is more important than the product (Dewey, 1959), both are contained within virtual reality - it offers both experience and opportunity for creative activity. Putting on a Head-Mounted Display creates an immediate and visceral experience as the wearer is transported elsewhere. These effects are the action of the "second affordance."

As a result of this affordance, VR may provide students with a deeper understanding of, and emotional connection to, the context of fashion design - past, present, and future. In experiences that take students to historical reenactments, they

can, for example, walk through the Titanic (Vicinity360, 2019) or experience the cramped apartments behind the walls where Anne Frank hid from the Nazis (Forcefield, 2019). While the value of such experiences has yet to be fully established (Bailenson, 2018), it was enlightening to hear how the students perceived it. I interviewed, observed, and engaged in arts-based participatory, collaborative research with students and faculty to better understand VR's impact on engaging students in the history of fashion.

A recent study by Minocha et al. (2017) found that immersion fostered engagement and a state receptive to learning. Immersion encourages curiosity (Shutte, 2020) and an urge to explore (Johnson-Glenberg, 2018). Engaging in the imaginative world can open the mind to learning and create a more receptive mental state (Barsalou, 1999). Bailenson (2008) sums this up, "Ideal learning environments of the future are likely to blend both real interactions with virtual ones, as well as telling processes with active/constructive ones" (p. 112).

This dissertation study built upon the work of previous researchers to explore the application of virtual reality to an area of education that has yet to be studied and provided insights that may apply not just to fashion but to other design disciplines as well. I believed that the activation of "profound affordances" would provide significant benefits to the learning experiences of design students. The agency engendered by creating in what appears to be three dimensions would enable students to approach design problems in a new way, manipulating the virtual world, their entire body participating in the solution. Immersion in the limbic state of the virtual world would deepen student understanding and increase engagement in theory courses.

# CHAPTER 3

# ACTION AND METHOD

## Research Question

RQ: How do students view Virtual reality as an addition to the Fashion Design curriculum?

Sub-questions were:

How do students identify the role of agency in Virtual reality as a factor influencing their design ideation?

How do students identify the role of immersion in Virtual reality as a factor influencing their engagement in a history/theory course?

## Setting

The study was conducted at Harcum College in the Fashion Design and Merchandising departments. VR sessions occurred during class periods, primarily studio work sessions. Participants were recruited via an email invitation (see Appendix A). Students who did not volunteer to participate worked on individual projects. Many who had not responded to the initial recruiting email became curious upon observing their fellow students and wanted to volunteer for the study. Although I had planned on a total of four to eight students for the study, fourteen ended up participating across the two semesters that the study was conducted. The sessions took place in the ground floor atrium of the Art & Design Center, a cleared space with no obstacles or furniture. There were two observers at all times to ensure the safety of the participants. There was an initial orientation experience; then, the students engaged in virtual reality sessions. The experiences in the History of Fashion class were seated and stationary for the most part, while the experiences related to the Fashion Design class were active and participatory.

## Research Design

This dissertation study introduced VR-based activities into the undergraduate design curriculum and sought to explore their impact on design ideation and engagement as perceived by the students. I structured the study to focus on the affordances of agency and immersion and whether the students viewed the activities as a worthwhile addition to the curriculum. I structured the project as a phenomenological study employing narrative inquiry and arts-based research.

As an innovation in the curriculum, lessons involving virtual reality were embedded in foundation courses running in both the Spring and Fall semesters of 2022. In the Spring semester, virtual reality and its potential capacity to deepen engagement through the affordance of immersion were studied in the History of Fashion course. In the Fall 2022 semester, students engaged in a creative virtual reality project that examined agency's role in assisting with design ideation in the Fashion Design course. I believed that the activation of the two affordances would provide significant benefits - that the sense of immersion would deepen the student's engagement with the study of the forces that historically have shaped fashion and that the agency inherent in designing in a virtual space would help students to a deeper understanding of the process by which a two-dimensional design translates into a three-dimensional garment.

### *Qualitative Methodology*

There were several reasons to proceed with this as a qualitative study based on interpretive phenomenology and arts-based methods. The first is the small sample size; I had anticipated fewer than six students per semester. In addition, as a two-year school, there is only a limited time with the students. It would be difficult under such circumstances to quantify the potential effects on engagement or design ideations of the VR intervention over time. One could examine design work before and after the VR

experience, and while there are metrics of design quality that could be applied, it would not be clear that this was a direct result of the experience. Similarly, engagement due to the immersion inherent in a 360° video shown in History of Fashion is subjective. Thus, it seemed that the way to formulate this study was not to ask whether the affordances of immersion or agency improved learning outcomes but to ask how the student participants perceived their value. Student voices can and should play a central role in developing and evaluating educational initiatives and can illuminate both benefits and problems (Gregory et al., 2016). Philosophically, I am more comfortable with this kind of question. I find some phrasing in research to be disturbing - I am thinking of the term "human subjects," for example. In action research of the kind that I engaged in, I prefer to think of my student participants as co-researchers and the study as a co-creation of knowledge.

### *VR and Phenomenology*

The primary research methods were instructor observations, student interviews, and art pieces. Proceeding as a narrative and arts-based phenomenological inquiry made sense for several reasons. There were the practical - the sample size was minimal, rendering qualitative research less doable. There were the personal - I enjoy writing in a more narrative style, and there were the philosophical. The students and I were both exploring a new way of learning and a new tool for design. We are a small department and close-knit, with a great deal of respect and affection between us. We are accustomed to constructing meaning together.

Beyond all that, phenomenology may be the most appropriate window through which to discuss the VR experience. In *Virtual Realities: Case studies in immersion and phenomenology* (2021), Bender and Broderick make a case for phenomenology by noting the particularly solitary and experiential nature of using VR. Someone outside the

headset can tell you what they observe, but they cannot know how it feels to be inside it - an experience that differs for each person. They compare the study of virtual reality to the study of film, wherein "the audience experience is precisely one of the methodological avenues for producing a rich understanding of how the medium works" (Bender & Broderick, 2021, p. 31). This kind of knowledge had the potential for significant depth as the participant/researchers explored and described their encounters with this new experience that was "situated, embodied, specific and fully signifying" (Ihde, 2019. p. 52).

The primary data sources for this study came from the interviews at the conclusion of each semester. As stated above, this study was designed to respect the participants' experience and partner with them in constructing an answer to the research questions. A semi-structured interview format provided a framework and direction for the questions. It also allowed students to expand upon any aspect of the experience that they found significant in greater depth. This interview format addressed the research question but allowed space for the participants to be co-constructors of meaning (Galetta, 2013). The questions asked were open-ended and challenged the students to reflect upon the subjective nature of the experience. Formulations like: How do you feel about…? Do you think it is valuable? What were the problems? Benefits? Describe your experience… were used. This technique elicited interactions that were less interview and more conversation.

**Participants**

The study participants were first and second-year students in the Fashion Design and Merchandising departments at Harcum College. Despite the school's small size, the fashion departments reflect a wide range of interests, abilities, and levels of preparedness. Harcum was founded as a Junior College, although we now refer to

ourselves as an Associate's Degree granting institution. Junior Colleges were traditionally more vocationally focused than four-year universities and provided academic support for students that may need more preparation for a four-year school. Despite the change in the descriptor, Harcum College still maintains many of the qualities of a Junior College. Admission to Harcum requires no testing, and we accept all students regardless of previous academic performance. As a result, the student population of the Fashion Departments is very diverse in their level of preparation for higher education, their computer skills, and their design experience. Some students enroll because they are eager to launch their fashion careers sooner rather than later. Some would only have been accepted at a school with open admissions. The common feature of our students is their drive to create and their love of fashion.

Most students are from the Philadelphia area or smaller towns in mid-Pennsylvania. With a few exceptions, the students in the fashion department are recent high school graduates in their late teens. They are generally between the ages of 17 and 23. Most, perhaps 80 percent, are female. We are a majority-minority school and department; about seventy percent are Black or African American, twenty percent are Latino, and the remainder is Asian or White. Despite these relative constants, each year and each class are different, bringing its own distinct characteristics. They are both representative of many design students in America and many students from urban settings, and they are unique. Philadelphia has a distinct culture, and each cohort is shaped by the specific events of their time.

The students who participated in the immersion study in History of Fashion during the Spring 22 semester had all been at the college for at least one semester, and most were in their senior year. They were comfortable in the department and knew me well as their Advisor, Professor, and Program Director. The students participating in the

Fall 2022 part of the study were in their first semester at Harcum College and in an introductory course. If our students are unique, the incoming class in Fall 2022 was particularly so. The characteristics of this cohort have been discussed extensively in education circles this year (Leonhardt, 2022), (Malesic, 2022), (Marijolovic, 2023), (McMurtrie, 2022).

Having spent a good portion of their high school career under COVID restrictions definitely had an effect. As a whole, this class seemed especially unprepared, emotionally fragile, and, indeed, traumatized. They displayed a lack of computer skills compared to previous classes, which I found surprising. Having spent several years of their high school experience on Zoom, I would have expected them to be more competent. This lack may be due to the prevalence of phones as their primary means of connection or economic and technology inequity (Davies et al., 2021). While all first semesters are an adjustment for students, this class had a more challenging time than most in learning introductory design skills and struggled with Adobe Photoshop (an essential tool in Fashion Design).

Student participants were asked to volunteer via email (Appendix A), although some asked if they could join once they saw their fellow students using VR. After receiving IRB approval and informed consent from the student participants, they answered an initial pre-screening questionnaire to eliminate potential problems with cyber-sickness (Appendix B). During the class sessions using VR, the other instructor and I took notes and made observations using a semi-structured list of questions (Appendix C). These focused on observable student behaviors, attitudes, and challenges during the VR sessions. At the end of the semester, I conducted semi-structured interviews in which the students related their impressions, opinions, and design work (Appendix H). Using visual arts-based research methods (Leavey, 2013), the students

analyzed their design decisions, inspiration, and final art pieces to evaluate the VR experiences during the final interviews. The consent form included a request for permission to take videos and photographs of the students and their work. These would only be used for demonstration purposes, never commercial. Pseudonyms are used in this paper. They were generated randomly (Random, 2013), with fidelity to each individual's cultural background. Two faculty members acted as facilitators. Our study became a community project in which the participants and the researchers worked together in a spirit of exploration to describe and evaluate the experience. We sought to construct meaning collectively and agree on future plans to incorporate VR into the curriculum.

**Methodology**

The study took place over two semesters, Spring 2022 and Fall 2022. Each semester's research focused on one of the two affordances, immersion, and agency. As a result, the research design varied each semester, but the overall structure was similar. Selected participants answered a pre-screening questionnaire to mitigate potential problems like cyber-sickness (Appendix B). There was an introduction to the related course material in a session prior to the VR experience. (Appendix D).

Implementation of the VR curriculum required the support of one additional fashion design faculty member, who received the same training in the use of VR that the students did (Appendix G) (Oculus, 2019) and was made aware of potential hazards and signs of cybersickness to watch for while students were in the virtual environment. This faculty member assisted in data gathering by writing field notes on VR sessions using an observational protocol. (Appendix C). Students participated in a discussion forum centered on the VR experiences throughout the first semester, focusing on immersion. At

the close of each semester, the students reported their impressions of the experiences through semi-structured interviews (Appendix E), (Appendix F).

Each student used an Oculus Quest unit with a head-mounted display and responsive hand controls. The head-mounted display covers the users' eyes and upper face and produces the sensation, when worn, of seeing and hearing whatever is in the virtual environment. Responsive hand controllers use buttons and triggers that allow the user to interact with the virtual environment. It takes a little practice to become accustomed to their use. The students received initial orientation sessions before their first experiences to establish a comfort level with the hardware (Appendix G). They were introduced to the equipment, and each engaged in the *First steps* (Oculus, 2019) orientation that is resident in the Oculus Quest units. *First steps* (Oculus, 2019) is a 15-minute introduction to the use of the HMD and hand controllers, in which a friendly and smiling animated creature shows the user how to manipulate items in the virtual environment, move around, and, eventually, it dances with them. During the orientation session, safety issues were discussed (Appendix G).

The technology's first use occurred in the Spring of 2022 semester, and the second experience took place in the Fall of 2022. In Spring 2022, students taking History of Fashion used VR to contextualize their own work within the broader sweep of fashion history through the affordance of immersion. In the Fall 2022 semester, the introductory Fashion Design course incorporated VR for design ideation through the affordance of agency. The data was processed in the Fall/Winter of 2022-2023, and the findings will be presented in the Spring of 2023.

### *Semester 1: Immersion - History of Fashion, Spring 2022*

As described earlier, the foundation of my dissertation research was Johnson-Glenberg's "two profound affordances" (2018), agency and immersion. In Spring 2022, I

began by focusing on the latter, using virtual reality viewers in the History of Fashion class to enable students to explore history-related experiences. The participants reported on their perception of the intervention and evaluated its value as an addition to the theory class, History of Fashion.

All participants filled out a pre-screening questionnaire to establish any preconditions that might make the experience uncomfortable (Appendix B). The three VR experiences were embedded throughout the semester when relevant content was discussed (Appendix D). While all the students in the class viewed and discussed the videos or experiences, there were no graded assignments associated with using VR for this study. Only those that had agreed to participate in the study participated in the final interview (Appendix E). All the students in the course participated in discussion forums on the content of the videos. Non-participants viewed the experience on their computers while participant students utilized the IVR headset.

The students were introduced to three historical virtual reality experiences throughout the semester. They viewed *Lincoln in the Bardo* (The New York Times, 2017), *Anne Frank House* (Forcefield, 2019), and *Traveling While Black* (Williams, 2019). Following the three experiences, students discussed their impressions on a forum on Canvas (Appendix D). At the end of the semester, the participants were interviewed to explore their perceptions of how the VR experiences affected their engagement with the course material (Appendix E).

Each of the films, whether viewed with the VR headset or on the computer, was introduced during the previous class and contextualized within the period we studied. The response questions for both the participant and non-participant groups were the same. The course format is hybrid and based upon a flipped classroom model, so the students' experience engaging in different activities during the same class period was not

unusual. All students were asked to watch the introductory material. While the students using VR watched the experience in that mode, the other students viewed the same material in their preferred modality (Appendix D).

The three experiences are different in some significant ways. *Lincoln in the Bardo* (The New York Times, 2017) is a 360° movie, as opposed to a virtual reality app. It is based on an award-winning novel by George Saunders (2018) that takes place following the death of President Lincoln's young son and imagines the boy as a ghost, interacting with other ghosts in a sort of limbo world. The story is fictional, and the viewer can only watch, not interact with, the virtual world. The second experience, *Anne Frank House* (Forcefield, 2019), has no overarching story or narrative. It is a virtual re-creation of the space in which Anne Frank and her family hid from the Nazis during World War II. This experience allows the viewer to move through the cramped and dark spaces and to interact with objects that trigger bits of narrative. It is less of a storytelling experience and more interactive. The third experience, *Traveling While Black* (Williams, 2019), is a return to a passive-watching mode with a strong narrative flow but is not fictionalized. The documentary moves the viewer to various sites related to the early civil rights movement and interviews several people who give first-person accounts. These people recall traveling in the south during the Jim Crow era or were civil rights activists. The final encounter is with Samaria Rice, mother of Tamir Rice, the child shot by police in 2018 while playing with a toy gun. As the semester progressed, the students discussed each experience on an online forum in Canvas.

***Semester 2: Agency - Fashion Design, Fall 2022***

This part of the study explored the potential use of virtual reality for design ideation. It focused on the quality of agency to encourage design students to translate design principles to a virtual 3D rendering, creating a dress design using *Tilt Brush*

(Google, 2019). There have been some recent experiments in using VR for fashion design (Ebner, 2020), but few formal studies. Joundi et al. (2020) researched 3D VR sketching tools with engineering students designing drones. The students reported that it was particularly helpful in mediating between idea and construction, particularly in shape development. One study researched the use of a VR application, *Gravity Sketch* (2019), to compare the workflow with pen and paper sketching when designing footwear (Ekstromer et al., 2018). Although hampered by the unfamiliarity of the tool, the students enjoyed using VR to design. Both these previous studies provided guidance in the creation of the processes and protocols that I used in my research.

The Fall 2022 study was connected to the introductory Fashion Design course. The participants were first-semester students, and as part of this course, they were learning about the elements and principles of design: shape, proportion, color, texture, movement, emphasis, and balance. The virtual reality assisted assignment encouraged them to consider these principles while creating a garment on a virtual dress form in the app *Tilt brush* (2019). This was not a graded assignment, and participation was completely voluntary.

The virtual experiences took place during class periods in the thirteenth week of the semester. Students worked in the large lower atrium, observed by the researchers to ensure physical safety within the workspace. As with the previous semester's research, interested students filled out a pre-screening questionnaire to rule out conditions that may make virtual reality uncomfortable (Appendix B). They were given an orientation to the use of the equipment and the virtual space during their first session (Appendix G) (Oculus, 2019).

The students were interviewed one-on-one to discover their thoughts on potentially incorporating VR into the Fashion Design curriculum (Appendix F). The

researchers took notes throughout the process, and the participants were encouraged to think aloud while working (Joundi et al., 2020) (Appendix C) (Appendix F). The student work was printed for viewing by the class after the session, and a discussion of their design ideas, decisions, and processes occurred.

## Measures

As introduced above, the measures used in the study were post-semester interviews (Appendix E), participation in a discussion forum online (Appendix D), observational field notes (Appendix C), and reflective analysis of design work (Appendix H). The interviews were semi-structured, with the opportunity for questions to lead wherever they may. These interviews aimed to understand the students' perceptions, so the interviewers were encouraged to be responsive to wherever the conversation led. The main areas of exploration were whether and to what extent the students found the interface to feel immersive and whether and to what extent the act of creating in the virtual space enhanced their enjoyment, engagement, or understanding of the principles of design. While there was a framework for questions, the interviewer strayed from the framework to engage in probing, specifying, follow-up, and clarifying questions (Appendix E).

### *Interviews*

A significant data source for this study came from the interviews at the conclusion of each semester. This study was designed to respect the participants' experience and partner with them in constructing answers to the research questions. A semi-structured format provided a framework and direction for the questions, but it also allowed students to expand upon any aspect of the experience they wanted to discuss in greater depth. This interview format made space for the participants to be

co-constructors of meaning (Galetta, 2013). The questions asked were open-ended and reflected the subjective nature of the experience.

The interviews began with a briefing: *"Thank you for agreeing to participate in this study of educational uses for Virtual reality. I will ask some questions about the three experiences you engaged in over the semester. Feel free to add any information to the conversation that you think is relevant, and, of course, you do not need to answer anything that you do not wish to. These experiences, although related to your History of Fashion class, are strictly optional enrichment activities, and your involvement, either in the VR experiences or the interview, will not affect your grade in the course. I am interested in your perceptions of the experiences and the relative value you would ascribe to using the technology."*

The following questions composed the basic framework:

1. What did/didn't you like about the VR videos/app? Can you describe your experiences?
2. To what extent did you feel as though you were actually there in the virtual space?
3. Did you enjoy the experiences? Were there situations where you felt unexpectedly positive/neutral/negative feelings (e.g., joy, enthusiasm, excitement, fear, anxiety)?
4. If you liked one more than the others, Why was that?
5. Do you feel the VR experience helped you connect with the subjects more than other media, like a video might? Is it a valuable tool in design? Why or why not?
6. Did you experience any problems in using the VR viewer? Can you describe them? How did you handle the problems?
7. Would you like to have more experiences like this in the future? Why or why not?

### *Online Discussion Forum*

The online discussion questions varied slightly depending on the experience but sought to ascertain the level of engagement with the subject of the video. The students were asked to describe their impressions and interact with one another to analyze the experiences. In the discussion forums, I looked for emotional responses and their correlation with engagement. I was not explicitly asking for a detailed analysis of the content of the experiences, but many of the students offered it. I was surprised by the degree of higher-level thinking that the VR group exhibited in response to relatively simple questions.

### *Researcher Observations*

The observations/field notes made during the VR sessions are designed to illuminate the level of presence as defined by the following categories:

"Category one: Expressions, organizes the participants' verbal expressions to determine if they express a sense of immersion by speaking as if they are actually there.

Category two: Engagement describes the evidence of physical interaction with the virtual environment, including the display of any emotions during the experience.

Category three: Explanations emerged from the student answers to questions during the experience and interview responses afterward."

*Observational Protocol was adapted from Thomas (2019, pp. 81 and 125).

The Observational Protocol (Appendix F) sought to answer the following questions:

(1) Do the participants' terminology express a sense of immersion?

(2) Do students explain their experiences as if they are actually there?

(3) Do the students display any emotions during the virtual experiences?

(4) Do students respond physically as if they are within the virtual environment?

(5) Do they jump, duck, run, or walk, to accommodate what they view in the virtual world?

(6) Can students explain their design process when asked about it?

(Thomas, 2019)

### *Arts-Based Research*

Visual art communicates on many levels, some that are not even conscious. As the participants explored using VR to create visual design work, it was telling to include images of the actual pieces the participants created. This work can communicate holistically, encouraging a deeper analysis of the student experience. Even in the creation of garments, there is a potential for metaphor and symbolism. Additionally, "Visual methods help researchers keep their own bodies and the bodies of those they study in mind." (Knowles et al., 2008, p. 79). Considering this study's interest in the effect that embodied cognition will have on design, it seemed important that the research include a discussion of the designs themselves.

## Data Analysis

The data gathered consisted of observations, student interviews, discussion forums, and an examination of the art pieces generated. With these rich sources, it was possible to triangulate the data and establish some consistent themes. The interviews were recorded and transcribed using voice-to-text software. The transcripts were reviewed manually for accuracy and coded using a line-by-line inductive process in Altas.ti. Themes and phrases in the interviews and the discussion forums were coded to discover persistent or repeating ideas, perceptions, and students' responses. The videos, images, and artwork were coded to reflect common themes, techniques, and styles. The data were analyzed using a coding frame developed to discover patterns and draw out themes. Interviews, discussion thread responses, observational field notes, videos of the

students as they worked in VR, and GIFs of the resulting design work were merged for analysis and interpretation.

When analyzing the data, Fraelichs's (1989) "Horizontalization" method, as presented by Moustakas (1994), was used as a guide. This example of horizontalization illustrates the importance of being receptive to every statement of the co-researchers' experiences, granting each comment equal value and thus encouraging a rhythmical flow between the research participant and researcher, an interaction that inspires comprehensive disclosure of experience. (Moustakas, 1994, p.122). The many videos and images served as additional and vital sources of data. Demeanor, mood, gesture, and affect were essential considerations in evaluating the student responses.

# CHAPTER 4

# FINDINGS

In analyzing the qualitative data sources, I examined 135 documents consisting of videos, photographs, artwork, interviews, observational field notes, and excerpts from an online discussion forum. The documents were coded into 38 Total Codes, which were divided into two groups to reflect the two semesters. Within each group, there were sub-themes, as seen in the tables below:

**Table 2**

*Themes, theme-related components, and assertions for Semester 1*

| Themes, theme-related components | Assertions |
|---|---|
| *Heightened emotion*<br><br>Students report emotional reactions to the Virtual Reality experiences.<br><br>Observation of student expression and affect during the experience indicate engagement.<br><br>Students write passionately about the subjects of the experiences in the discussion forums. | Virtual reality elicits an emotional response that increases engagement with the topic. |
| *Immersion*<br><br>Students report a sense of being there, often relating that it is so intense as to be shocking and amazing.<br><br>Students describe noticing small and telling details that they would not have otherwise.<br><br>Students are observed reacting to things in the virtual environment with pleasure. | The sense of immersion is enjoyable to students and increases their connection to the subject. |
| *Enhancement to education*<br><br>Students describe a sense of empathy with the subjects of the experiences. | Virtual Reality fosters a sense of empathy and results in a higher level and more nuanced understanding of the subject. |

| | |
|---|---|
| Students recall and describe more details and a greater understanding of the space represented.<br><br>Student forum responses exhibit a higher level of sophistication, engagement, and analysis than students that saw the video in 2D. | |

**Table 3**

*Themes, theme-related components, and assertions for Semester 2*

| Themes, theme-related components | Assertions |
|---|---|
| *Comfort with technology interface*<br><br>Students expressed comfort with the VR tool.<br><br>Students were observed interacting with seeming ease.<br><br>Students reported that VR was far easier than the computer | The students are very comfortable working with the Virtual Reality interface. |
| *Confidence in creativity*<br><br>Students expressed pleasure and enjoyment while creating in VR<br><br>Students were proud and excited to share their work.<br><br>Students reflected that it would be a useful way to stimulate creativity. | Working in Virtual Reality creates a feeling of confidence in the students' creativity, and they are pleased with and proud of the results. |

| | |
|---|---|
| *Sense of freedom in design decisions*<br><br>Students describe a feeling of disinhibition while creating in the virtual space.<br><br>Students were observed making confident, expressive whole-body gestures.<br><br>Students report a deep sense of artistic freedom and enhanced inspiration. | Students feel a sense of creative freedom in Virtual Reality, they feel as though no one is watching, and they can do anything they desire without fear of judgment. |
| *Students created avant-garde environmental works*.<br><br>Students expressed a feeling of ownership of the space and a desire to engage with it.<br><br>Student work is large-scale and breaks boundaries. | The virtual space is comfortable for the students, they feel ownership of it, and it encourages them to experiment artistically. |
| *Gesture and embodiment*<br><br>Students were observed using whole-body movements and gestures to create.<br><br>Students report great pleasure at being able to move freely through the perceived space.<br><br>Student artwork displays a variety of strokes, reminiscent of action painting (The Art Story, 2018) | The whole-body engagement inherent in working in Virtual Reality is enjoyable and enables the students to create experimental work with a variety of colors and stroke styles. |

The experiences offered throughout the semester had initially been designed to explore two profound affordances of virtual reality, immersion, and agency. The intervention had been designed so that immersion would be the topic of the experiences

associated with the History of Fashion course, and agency would be associated with the Fashion Design course. The History of Fashion experiences were generally more passive viewings, while the Fashion Design experience was a creative activity. Neither of the two avenues produced data that was as clearly delineated between the affordances as I had expected. Immersion proved to be a significant affordance in creative experiences that were designed to explore agency, while embodiment was not the aid to 3D ideation that I had hoped it would be. While immersion clearly enhanced the passive viewing experience, several students commented on the effect of agency. One student, Susan, noted that a higher degree of agency actually reduced her sense of immersion. Others reported that the ability to move through space deepened their understanding of the lived experience of those in times past.

**Immersion and Fashion History**

This was the first time several students had experienced immersive virtual reality. Their initial response was generally one of delight and amazement. As the students experienced the initiation video, they smiled, laughed, and looked around, almost immediately seeming to lose their sense of the observer and the actual space (Figure 1). In the words of one student, "I'm blown away. I had never used VR before. So I was blown away by how cool and realistic and immersive and intense it was. It definitely made me want to get one really badly." Susan

After the initial orientation, all were eager to use the VR unit for all three history-based experiences.

**Figure 1**

*Alia first experiencing VR.*

As was reported following the pilot study during COVID, the most notable effect that VR seemed to provide was a heightened sense of emotional connection to the content of the videos. Based on the discussion threads and follow-up interviews, the students who used VR instead of the computer to view their experience reported a strong emotional response. Their comments in the discussion forum more frequently expressed empathy with the subjects and were overall less general. They were more inclined to draw connections and empathize with the subjects of the experience.

### *Themes from the Data*

#### Heightened emotions

The students viewed *Traveling While Black* (Williams, 2019) in both the pilot study and this one. Their responses were powerfully emotional during both studies Many of my students are Black and could relate to aspects of this experience. While the headlines were not as visceral and immediate as they were during the pilot, the responses were intense. Students expressed anger and sadness; several described the

experience as "difficult," "tough," and "heartbreaking." Their demeanor was starkly different from the smiling and playfulness exhibited during the orientation. They sat with a profound stillness, hardly moving and almost expressionless (Figure 2). Talia said, "I felt sadness and anger while watching this film. I feel this way because the generational trauma of these events still have effects on society today, and there's still a long way to go before these ideals are dissipated."

> Watching this was really tough and it just shows that no matter how much time has passed, African Americans still experience these issues daily. The most heartbreaking part of this entire experience as the conversation with the mother of 12-year-old Tamir Rice, who was shot and killed by police. Her strength is honorable, and I really can't imagine how she held it together so well (Fionna).

**Figure 2**

*Talia watching Travelling while black (Williams, 2019)*

Note: Students expressed strong emotional responses during the VR experiences.

### Immersion

Students using VR more frequently commented on the physical space perceived in the experience. However, one student reported that the awkwardness of learning to navigate the virtual environment diminished her sense of immersion:

> As much as the clicking and the interacting was cool, I was new to it. And it felt a little awkward for me. I couldn't like casually and seamlessly walk and open a door. So it would when you think that hard about something. It removes you from the experience to be like, okay, click hold, move, you know? (Susan)

Many students expressed an increased appreciation of the physical space:

> When going through the Anne frank virtual tour thought it was interesting going through each room and seeing everyone's routine, and it made me think what if I was in her shoes? I could imagine what she went through and how that could've been my family or someone know could've gone through. I think Anne Frank was so brave going through this (Shannon).

"It shocked me to know how much space they had, I honestly thought they would all be sharing a closet. The Anne Frank story always gets me a bit teary-eyed. This family went through so much and died tragically." (Fiona)

### Enhancement to Education

Many students who had viewed *Anne Frank House* (Forcefield, 2019) reported feeling a personal connection to the family, "While watching the VR video, I felt like I was in the actual house. Seeing the different rooms and the stuff that was done in them. Picturing myself in Ann's position, I think that I would have been devastated." said Peta. "And the interactive going through and Frank's house also, I thought was really cool to be able to look around and walk around. It definitely made it feel like it. It would stick way better in my mind." (Susan)

Their responses to the experiences displayed thoughtful analysis. In response to the simple question: What did you learn watching the video? What was surprising? - the students who had watched the VR experience answered with complex thoughts and connections. For example, "I think that the two houses divided by a barrier is a very strong symbol that represents the physical and psychological state of the Jews who lived in the period of the holocaust" (Ricardo).

> There aren't really words to describe that kind of environment for children. However, I did notice that despite their situation, I think they tried their best to make it feel like home with games and picture and a bookshelf full of books. In the room meant for Otto, Edith, and Margot, I see there are plenty of books and a writing desk. I also noticed that on the left bed with the white lace, there is a curtain above the bed for privacy. Overall the rooms give a strong family unit despite their tragedy (Talia).

Another attribute of the VR experience seemed to be a greater understanding of the content, as revealed by more detailed analysis by the students that had used VR.

> All moments, it is heart-broken to know this part of the history. I have learned in this course that the past has its really bad moments, and without exception, this video expresses the reality of African Americans. It reminds me as well Black Lives Matter, the journey one has to bear in order to feel free (Ricardo).

Having run a pilot intervention using VR for the Fashion History class previously, the findings of the Immersion part of the dissertation study were not unexpected. All the students interviewed confirmed the previous semesters' results, indicating that they enjoyed using VR for these historical reenactments. They felt it would be a valuable addition to the curriculum and enhanced their understanding of the subject.

**Agency and Fashion Design**

The surprises came during the other section of the study. Noting the struggles that beginning designers experience, particularly around ideating in three dimensions, I believed that VR's sense of embodiment would help the students better visualize in 3D. It did not go quite as I had expected.

*Tilt brush* (2019) is an app that enables the user to paint in 3 dimensions. There is an array of creative brushes, some animated or glowing, and a full-color palette. The space appears initially to be a featureless, vast area, but the user can select different environments in which to create. One of these contains a dress form, the traditional base for draping and creating garments. It can be sized to any scale and appears thoroughly natural; the user can walk entirely around it. Despite this being their first semester, the students were familiar with dress forms and had worked on them several times in real life.

Upon encountering this familiar object in VR, the participants' responses were varied. When presented with a dress form in the three-dimensional virtual environment and invited to create, slightly less than half (5) of the 11 students created a garment that actually fit on the dress form. The other six were evenly split between what I will call the 2D designers and the super 3D. There was an additional piece that does not fit neatly into any category. I had hoped virtual reality would enable students to translate 2D ideas to 3D garments more easily. This did not occur. However, the study was successful based on the interviews with the students following the experience.

Without exception, the students enthusiastically enjoyed the experience and thought VR should be a part of the Fashion Design curriculum. They embraced VR as a design ideation tool, not for the practical reasons I had envisioned but as a source of

inspiration. They spoke of the feeling of creative freedom that they experienced, the sheer pleasure of using the tool, and their comfort with this kind of interface. The sense of immersion, with its corresponding feeling of being alone in the space, eliminated inhibitions and created a low-pressure creative space.

### *Themes from the Data*

#### Comfort with the Technology Interface

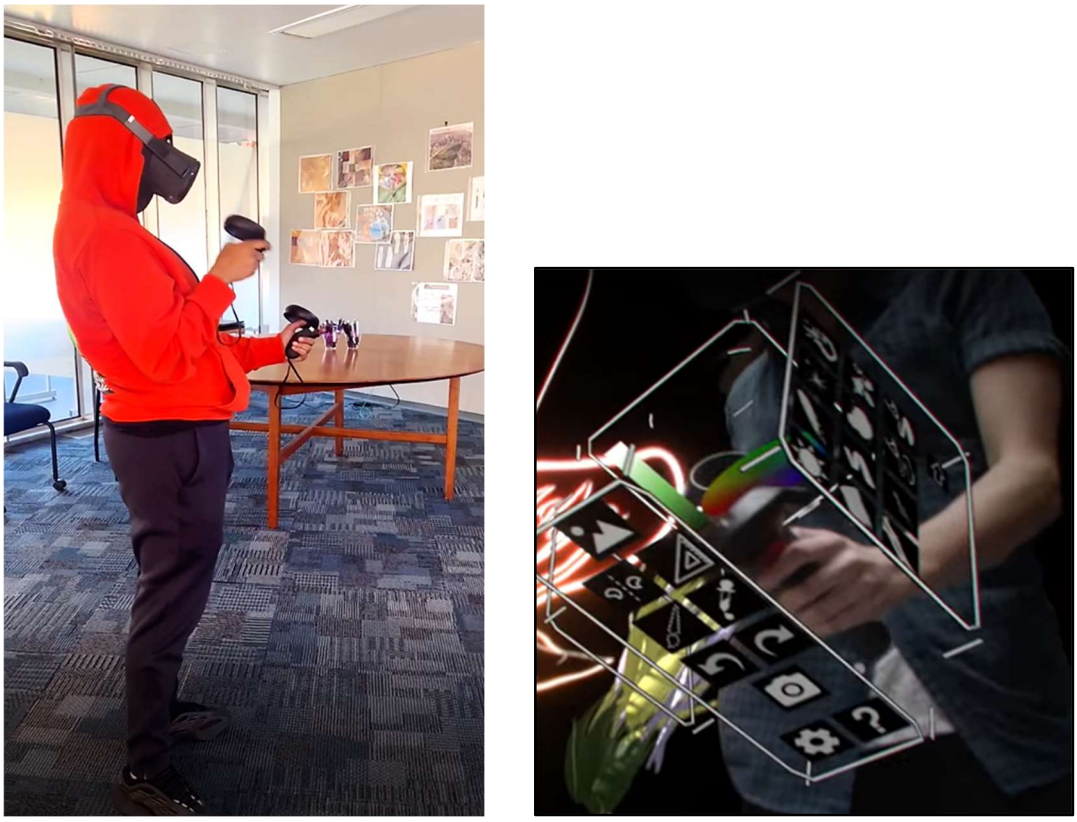
All the students had no problems navigating to *Tilt Brush* and used the graphics tools with little or no instruction. The interfaces are very similar to Photoshop - color pickers, brushes, and sizing. However, the physical act of making the tool selections with their hands seemed more straightforward for the students - more intuitive (Figure 3). It was a stark contrast to their' struggles in learning Photoshop for their design class.

> It comes normal to us. Like social media, the phone, electronics - It reminds me of a Wi, but, like in your head, maybe. I do not know. It was easy to use. That's how the Wi was, this little box that just sat by your TV (Kennisha).

> I feel as though it is easier because - as us, as we teens - I feel as though, like - people, like, there's a lot of people in our class that's creative. And it's like, I know people want to make their own things, so it's like, so I feel like, I know people that work by theyself [sic]. So you see people not joining in or, like, getting aggressive. I feel like this would be better for the classroom (Dace).

**Figure 3**

*Comfort with the tools*



Note: Image on the left is Kira using Tilt Brush, on the right is a photograph of what the interface looks like within the headset. From: Moon, R. (2022). Google Tilt Brush. XR pedagogy. photograph. Retrieved February 25, 2023. https://www.xrpedagogy.com/en/google-tilt-brush-how-to-use-virtual-reality-to-improve-creativity/.

### Confidence in Creativity

The immersion in the virtual space and the accompanying feeling of being alone resulted in lowered inhibitions about the creative act. When observing the students during their sessions, most showed little hesitancy, moving with confident and

expressive gestures. Some talked to themselves, narrating snippets of their progress or sometimes just responding to what they had done with exclamations like "Oh, snap!" (Figure 4).

Many of these students had previously expressed insecurity in their design drawing classe, often hesitant to even make a mark. Jevon described the sense of disinhibition in the VR space, "It's like you in our own world. You know what YOU want. You know what you're feeling. What you do from that point? Is aight [sic] it's what I want, what I feel, and how I want to go about it."

> When I was on there - when I'm sitting down, I don't really know what to draw on the paper. But I'm there, and I just start doing anything! Like, Ideas come out to your mind of nowhere, but it's not really out of nowhere, is it? If it's already there. Maybe (Kennisha).

***Figure 4***

*Fiona and her dress*

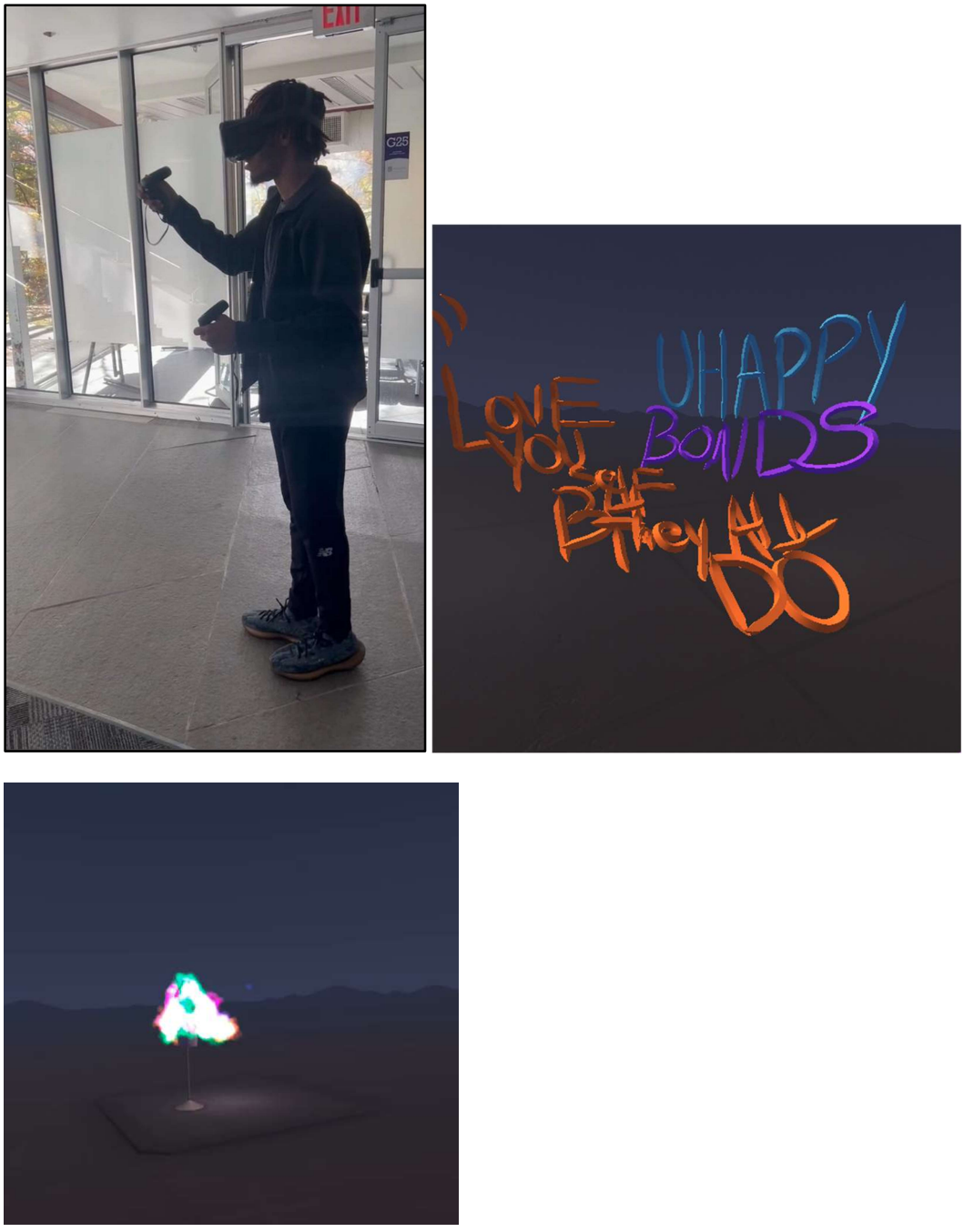
**Sense of Freedom in Design Decisions**

Although none of the students felt that Tilt Brush was realistic as an actual design tool, several expressed the opinion that it would be a valuable way to encourage experimentation and enhance inspiration "It's not really for, to wear, it's just to make art pieces with. So maybe that could be something," Kennisha said.

> I felt comfortable when you told me to do it. And that's my second time doing it, like I did it before, but it was for a game, and it's like - me? If clothes were in there, I would do it every time because I would use THIS to create clothes and get a vision line and then use it to my advantage (Figure 5) (Dace).

**Figure 5**

*Dace and his inspiration*




Note: Dace began on the dress form, covered it with smoke, then proceeded to write words in the sky

I was inspired by…my own creations. (pauses) Uh - I feel like it was, like, just based off, like, the mood I was in. It was like, I wanted to make an environment based off my mood and how I was feeling type situation (Jevon).

**Students Created Avant-garde Environmental Works**

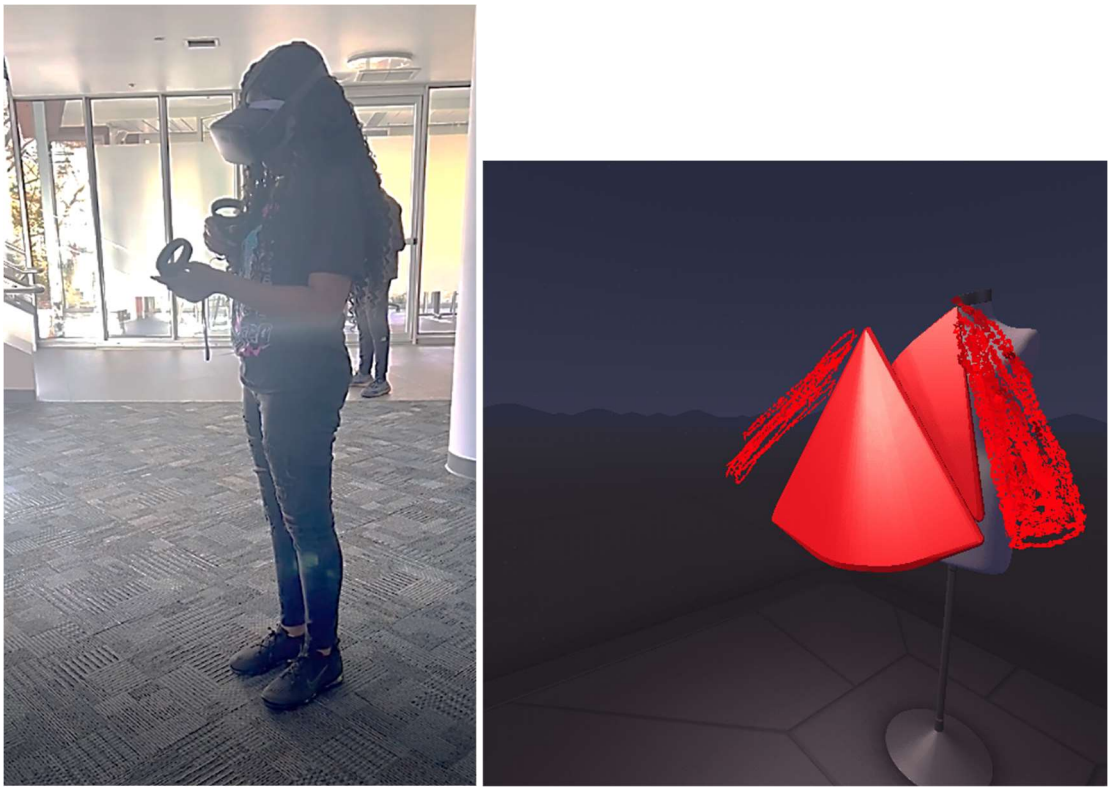
***2D Creators***

My first surprise came from the 2D creators – the flat dress designers. Three of the eleven students approached the dress form in the virtual environment and created a two-dimensional drawing that hung in the air in front of the form (Figure 6). This was interesting because the students were encouraged to move around as part of the orientation. Indeed, part of the instructions was, "You can walk all the way around the dress form." Most students, even the 2D creators, did so. They circled it, looking it up and down before settling in front of it and beginning to work.

Viewed from the working angle, each of their garments appears to be on the form. However, a quick trip to the left or right shows them to be hanging in space, like laundry on a line. Some of these works are pretty elaborate in their surface decoration, and all, when viewed from a certain angle, give the illusion of three-dimensionality. With the exception of one, the students that worked in this way tended to be slower to begin and more careful and hesitant in their strokes. Generally, after the first tour around the form, they settled in one place and remained there for the entire time. Their pieces took an average of 15 minutes.

**Figure 6**

*Mela and her 2D dress*



### *3D Creators*

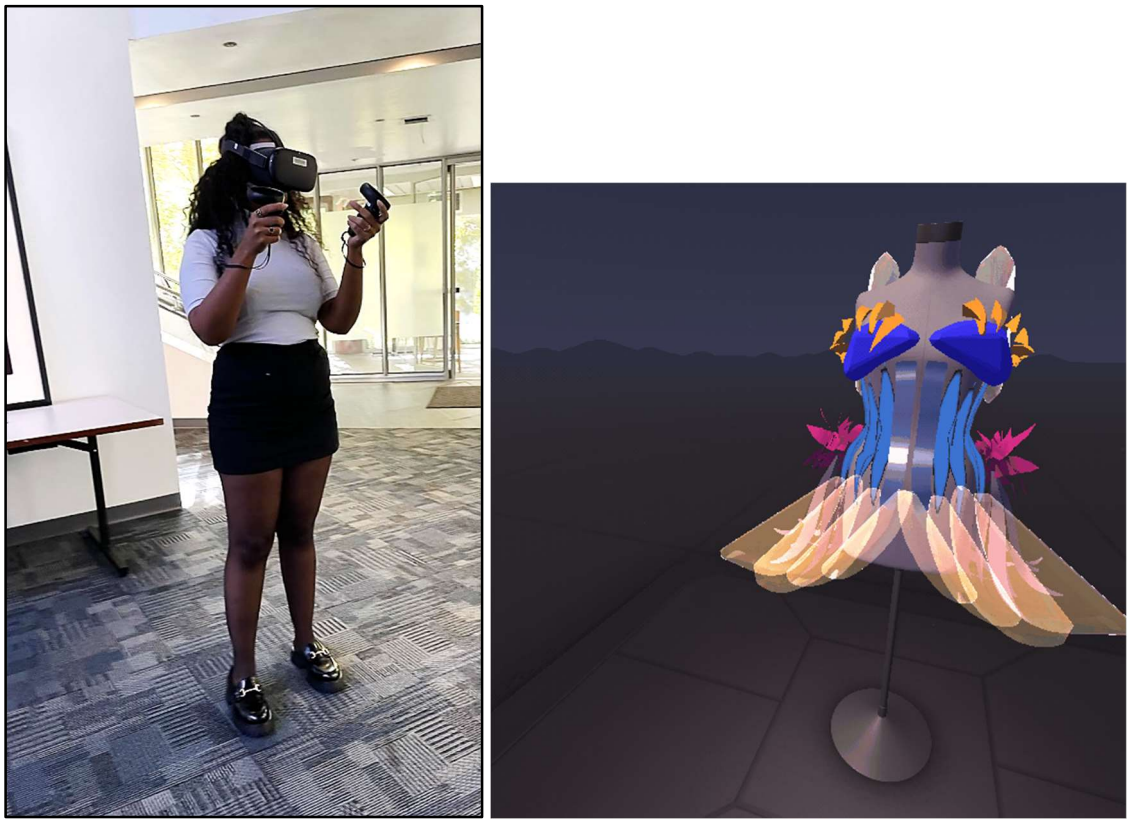
Although most of the volunteers were first-semester students in the Fashion Design class, several second-year students wanted to try it. These students, who have been studying the process of creating a physical garment from a design drawing for the past year, were more likely to produce an actual garment on the dress form. The app is primarily a painting tool and has few brushes that mimic the behavior of actual fabric. I told the students this and encouraged them to experiment. I pointed out that this was not a 3D prototyping software but, rather, a way to play with design ideas.

The senior students also walked around the dress form in actual space, looking at it before deciding where to start. They held up their wrists, clicking through the brushes and color palette, and universally asked, "where is the eraser?" before they began. With

the senior students, most of the 3D designs began with the students drawing the outline of the garment on the form. Then they selected brushes to color in the design that they had created. They tended to create cohesive looks, using a similar stroke and color or two for the entire piece. Their work dressed the form in a way that was recognizably a garment (Figure 7). These students took about 10 minutes to complete their looks.

**Figure 7**

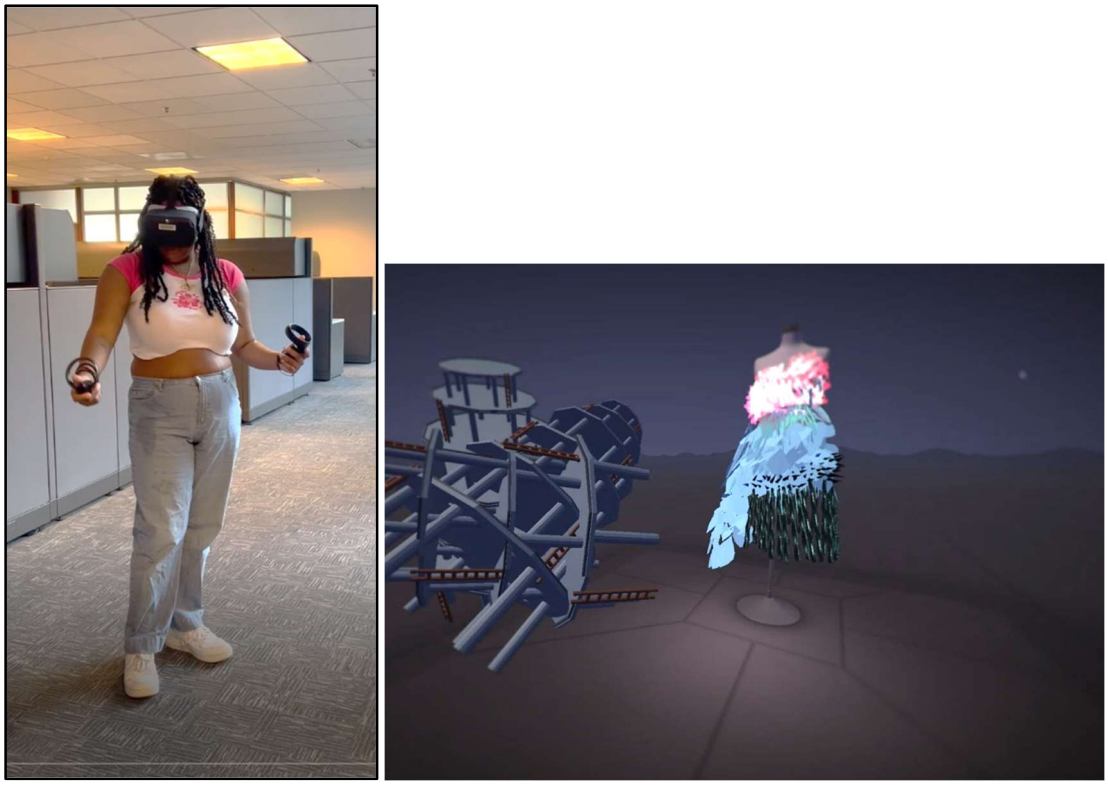
*Talia, a 3D creator, and her creation*



There were two exceptions - one was Mani, a student that quickly created a high-waisted blue and pink cocktail dress, then moved away from the form to create an Escher-esque structure hovering in midair (Figure 8). From my observation notes, "Mani is moving to the edge of the barrier. What is she doing? She is going to hit the partition." At that point, the safety barrier within the headset must have turned red because she took a step back.

**Figure 8**

*Mani creates dresses and structures.*



The other exception to the senior students' usual approach was Gloria. She put on the headset, looked around a few times, then began making huge, expressive gestures. Moving her arms from the shoulders and turning her head, she was clearly not confined to the space around the dress form. She worked quickly, handing the headset back to me after only 6 minutes. She smiled and said, "I would like to do that again sometime." Her work was the most unusual of the entire group. It was an environment with a window and clouds in the sky. A board hanging in the air exhorts, "Think, Create, Free." There is a dress, old-fashioned with puff sleeves, and a long skirt, but it hovers in front of the dress form. The dress form itself is outside of the imaginary room she has delineated (Figure 9).

**Figure 9**

*Gloria's created space*

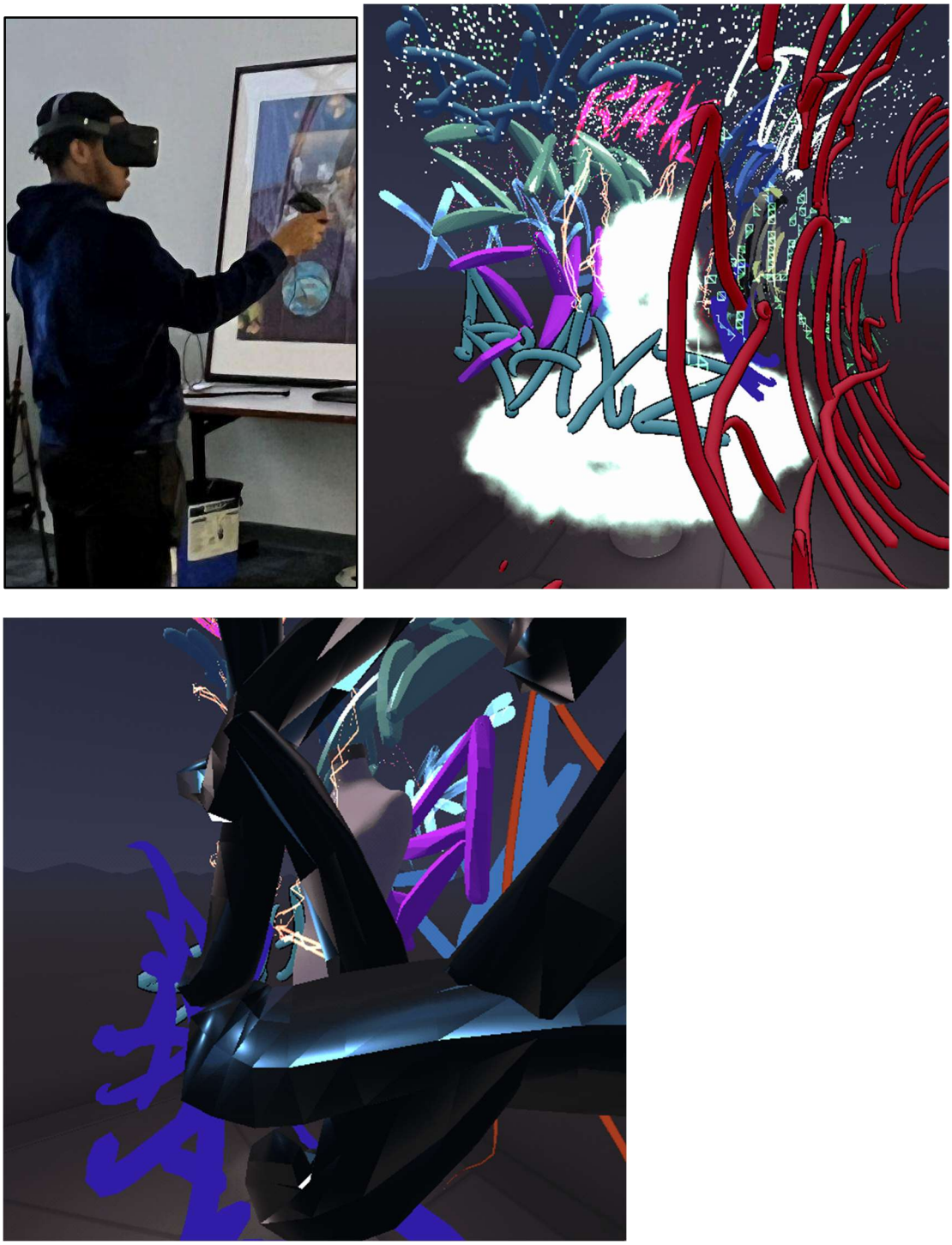

***Super 3D***

The works that fall into the Super 3D category were the most unexpected. Three students worked this way, two freshmen males and Gloria, mentioned above. Their process took the longest, with the young men spending almost an hour on their work. When they were done, it looked nothing like clothing design but was undoubtedly expressive. These students were also the most vocal in their support of VR and enthusiastic about its adoption into the program.

These students began with the dress form. They walked around it, appearing to look at it from several angles, then began to work. Their gestures were expressive, whole body movements, confident and athletic. They started on the dress form, then exploded out from it. Marks began to cover the sky to fill the space. Letters hung in the air, like graffiti on an invisible wall, while chains of DNA-like structures fell from the sky (Figure 10). Dace created a dress made of smoke, then hid it from view in a pink shell while he wrote in the sky and created waves of fire (Figure 5).It was as though the 3D space demanded an equally environmental response. They produced not garments but conceptual art. It can only be truly experienced from within the bounds of the work itself.

**Figure 10**

*Jevon and his creation*



### Gesture and Embodiment

Several of the junior students approached the dress form as a three-dimensional object that they were encountering in a space that felt actual to them. Their answers were affirmative and confident when asked if they understood how to navigate the space. They walked around the form, understood its understood dimensionality, and created a garment that would encircle it. The stroke choice was interesting, with some students using their entire arms while others kept their gestures small and close to the body. Watching their motions and then seeing their work was fascinating. Their actions and gestures correlated to more fantastical and exuberant creations while more reserved gestures produced more conventional garments. Amira, for example, moved around the form, working on all sides but using careful and controlled gestures. When viewed in VR, you coils see that she had chosen a tape-like brush, probably the most analogous to actual fabric, and had set about constructing a garment that would translate to the real world. It was, as she said, "Not beautiful." but it was functional (Figure 11).

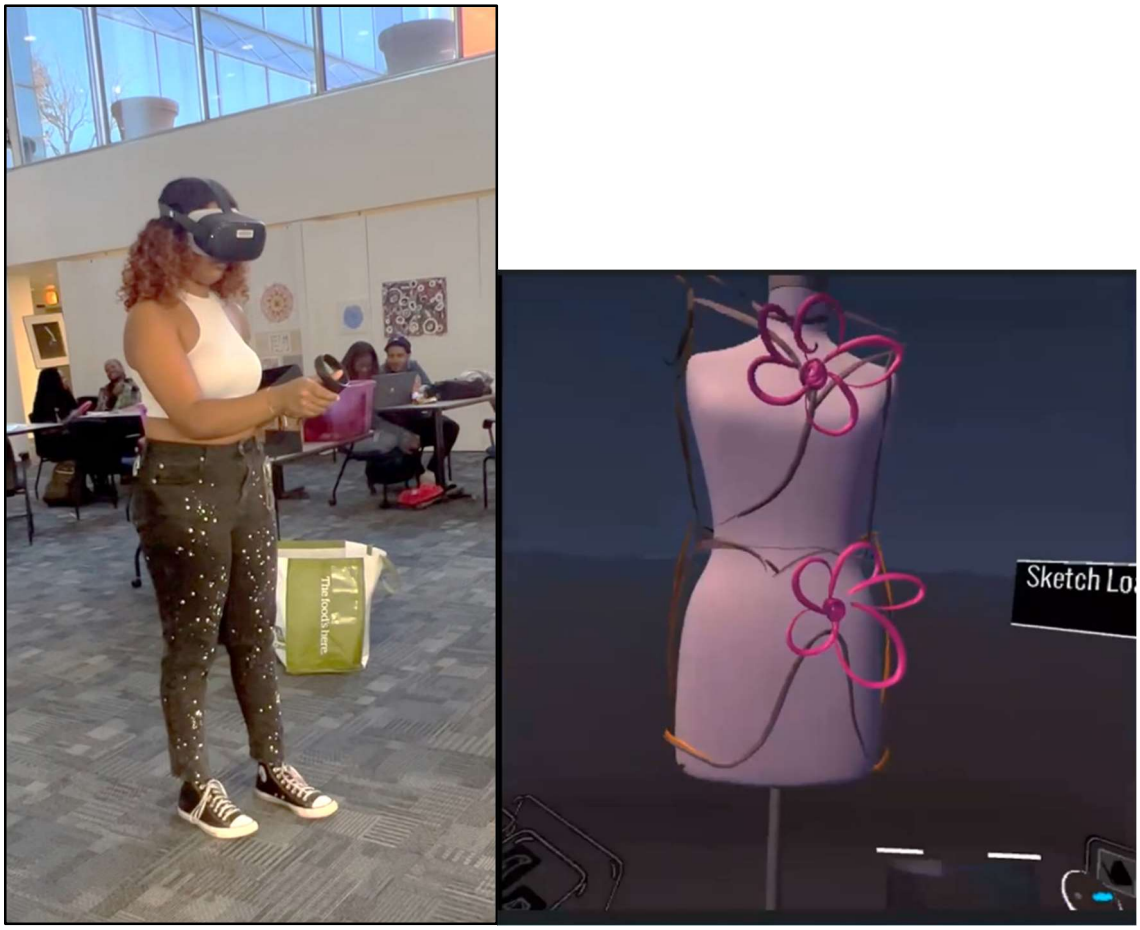
**Figure 11**

*"Not Beautiful"*

Another student used a tube-shaped brush to do a delicate outline around the form with the addition of ornamental flowers. She walked around and around the form, touching it delicately and infrequently. Her work has the same spare and airy quality as her movements.

**Figure 12**

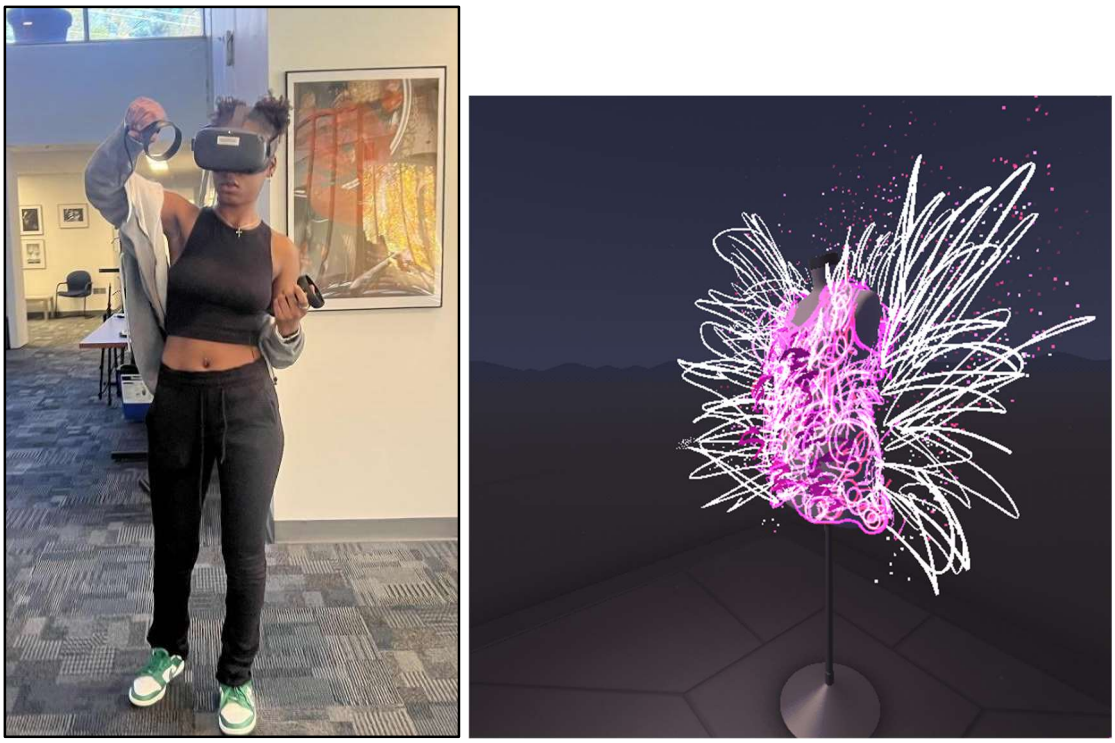
*Lisa's flower dress*



Kennisha was extremely active, using her entire body and expansive movements (Figure 12). She developed a circular stroke, using her entire arm, and circled the form often, moving swiftly. Her gestures were confident and vigorous, reminiscent of the Action Painters of the 1960s. Her resulting dress was exhilarating - pink swirls and electric angel wings. Like Action Painters, the students' creative process seemed to involve a "dialogue between the artist and the canvas" (The Art Story, 2018), in this case, the virtual environment. In some pieces, the dialogue takes on visual form, becoming literal, actual letters hovering in the space, as with Dace and Jevon (Figure 5 and Figure 10).

**Figure 13**

*Kennisha's angel dress*



### Enjoyment

All students involved in the study expressed enjoyment and pleasure, and all wanted to continue using VR in their educatoin. In observing the students, they seemed relaxed and happy while creating and quietly introspective during the history experiences. In both, they seemed highly engaged, which was affirmed in the interviews later.

> I think that also has to do with the type of learner that I am like; I can't just rote memorize words. I if I physically do it or see it, I can read picture like the way I was standing and stuff when I'm doing things so much better. I don't know if that's called Visual learning or whatever. Yeah. So it, it goes with my learning style very well. So I really liked it and would enjoy that as a learning, you know, accessory. Oh, my gosh, excellent (Susan).

Dace was enthusiastic in his support of VR for fashion design;

> I feel like this would be better for the classroom. Like, I feel that if someone was to have a vote right now, I feel like everyone gonna pick this because they can create their own stuff - they can do what they want to do.

# CHAPTER 5

## DISCUSSION, CONCLUSIONS AND IMPLICATIONS

While VR technology is still relatively new, both in the fashion industry and in education, it has the potential to add value to both. The technology has implications for the way that fashion is designed, presented, and consumed. Virtual fashion shows, virtual fitting rooms, and more immersive retail experiences demonstrate its potential to be a disruptive technology (Hackl, 2020). Designers can use it for prototyping their ideas with positive implications for design and sustainability. VR can enable students to better understand garments' proportions, fit, and movement (Sarakatsanos et al., 2021). In education, it has been shown to enhance learner enthusiasm and engagement and to encourage curiosity (Schutte, 2019), (Hamilton et. Al, 2021).

The findings of this study support the idea that greater immersion can increase student engagement and, certainly, student enjoyment. It is less clear whether it is an aid to understanding design principles and 3D construction through embodied cognition. While the student participants all expressed the opinion that VR would be a valuable addition to the fashion curriculum, the pieces they designed using it are abstract rather than functional. The virtual reality tools seemed to encourage creativity and self-expression but did little to further spatial understanding.

There has been significant research on VR in the past several years; as Mark Zuckerberg declares virtual reality the "next chapter of the internet" (2021), interest in the technology and its potential has grown acute. There have been many studies on virtual reality and education in the past two years, and while they have yet to examine quite the same area that this study has, they confirm some of my findings.

In a study of 40 engineering students, Horvat et al. (2021) found that the level of prior expertise significantly affected the intervention's success. The study discusses the

kinds of expertise - technology, design, and spatial ability. They conclude with a recommendation that future researchers control for this range in expertise and ability and that it should be "accounted for while analyzing the effect of new experiences on the learning process" (Horvat, N., Martinec, T., Lukačević, F. et al., 2022, p. 1228). My students that had engaged in the creative activity may have been familiar with VR but had little to no previous design expertise, and their spatial ability level was unclear. This inexperience may be part of the reason that their garments were so varied, often abstract, and certainly impractical.

Joundi et al. (2020) found that many of the 28 graduate student participants in their study enjoyed using the app *Gravity Sketch* (2019) as a tool for design ideation in creating a sneaker. The overall response was mixed, though the majority rated it "amazing," "good," or "interesting." Several students called it "very liberating" (Joundi et al., 2020. P. 229). These responses reflect the enthusiasm reported by the students at Harcum - most expressed positive views, and the overall tenor of their comments was that they, too, found it liberating. *Gravity Sketch* (2019) is an app that more directly reflects an actual design experience than Tilt Brush. In future work with the students, I also intend to use *Gravity Sketch* (2019).

Although it was not an initial focus of my research questions, it appeared that one of the benefits that the students found in using VR was the initiation of a “flow state” (Csikszentmihalyi, 1990). Csikszentmihalyi's theory of Flow (1990) describes the state that many of the students reported, one of enhanced and unselfconscious creativity. Creativity is an integral component - a feeling of relaxed attention, and mindful problem solving wherein the user is so engaged in the activity that they lose track of time (Csikszentmihalyi, 1990). The student participants were invariably surprised when they were told how long they had been using the headset, although whether they perceived it

as longer or shorter varied. Other studies have noted the tendency of virtual reality to encourage a creative flow state

A number of previous studies have shown that the level of immersion and sense of presence correlates positively with the depth of flow (Hoffman and Novak 1996; Novak et al. 2000; Zaman et al. 2010). Kwon (2018) noted that this experience is especially easy to induce in VR.Kwon (2018) used an EEG to study participants' brainwaves by asking them to perform a creative challenge while in VR or with a pen and pencil. The brainwaves showed an increase in stable focus and attention with the VR group. The fashion students in my study seemed to exhibit a similar level of focus, based both on their observable actions and aspects, and their own self reporting.

Virtual reality seemed to encourage an open and exploratory mindset in the student participants. They were interested in trying different aspects of the tools, and eager to repeat the experiences. This echoes the findings of studies noting the positive characteristics that VR seems to engender. A recent study by Minocha et al., (2017) found that immersion fostered a state receptive to learning, and that the more pronounced the immersion, the stronger the effect. Immersion seems to encourage curiosity and an urge to explore (Johnson Glenberg, 2018; Schutte, 2019), findings that were consistent with my research.

The results from both experiences implemented for this study in the two semesters echo the results of recent studies on enjoyment as a factor in engagement. A recent study of archeology students using both questionnaires and EEG readings found that the VR experience elicited "high levels of immersion and engagement while showing a state of increased cognitive processing" (Škola et al., 2020. p. 18). Similar results were recorded in a marketing education class (Moreira et al., 2021) and in STEM courses (Huang, 2020). The most consistent themes in my study participants' responses were

enjoyment and a correspondingly high level of engagement. That there may be some level of novelty-induced pleasure is likely, but Huang's (2020) research indicates that this effect should not be minimized. "While individuals' psychological responses and motivation may significantly increase in a VR learning experience for novelty, the novelty effect may not steeply decrease when individuals are becoming familiar with the novelty" (Huang, 2020, p. 170)

Related to the benefits of enjoyment, students in my study reported increased empathy and lively curiosity. Shutte (2019) describes how virtual reality's affordance of presence can facilitate desirable states of mind that build upon curiosity and empathy. This mindset, Shutte asserts, sets the stage for learning. They found that "an interactive virtual reality experience resulted in greater overall curiosity, as assessed by three dimensions of curiosity (joyous exploration, deprivations sensitivity, and stress tolerance) than a non-virtual reality control condition" (Schutte, 2019. P. 666). These aspects of curiosity were displayed in the art the students created and in their reporting on the experiences later. The exuberant environmental art the Harcum College students created exhibited a spirit of joyous exploration. In their own words, they later reported their increased connection with the subjects of the historical videos in ways that indicated a deep empathy for the subjects. This study was designed as a partnership between the participants and the researcher, and its goal was to listen to the students. They clearly expressed their belief that the VR experiences had value to their education.

**How do students view Virtual reality as an addition to the Fashion Design curriculum?**

The students in the study were unanimously positive in their view of VR as an addition to the curriculum. Most suggested that it be introduced earlier and used more often.

***How do students identify agency's role in Virtual reality as a factor influencing their design ideation?***

The students identified the role of agency as a factor in their enjoyment of the VR tool. They noted that it had a freeing effect on their creativity and that they felt comfortable and confident while using VR. They were eager to show their designs and seemed pleased with their results. When asked if they believed VR would help them design actual garments, they were less sure. Most felt that it was a pleasurable activity that increased their confidence and had the potential to be a source of inspiration. However, they did not see that it would help them make the 2D to 3D transition necessary to create actual garments. A surprising suggestion was that VR should be the first design tool introduced in the program. These students believed that it would be a valuable preparation for design drawing. They also suggested that VR would help in learning CAD programs like Photoshop by being a lower-stakes introduction to computer design tools.

***How do students identify the role of immersion in Virtual reality as a factor influencing their engagement in a history/theory course?***

The students felt that the immersion inherent in the Virtual Reality experiences deepened their connection to the material in the History of Fashion. They all felt that the feeling of "being there" helped them to better empathize with the subjects of the videos and gave them a deeper appreciation for life in past eras. The students also felt that it

made their discussions on the forum richer and more interesting than when responding to 2D videos. The recommendation of all the student participants was to use VR more in the History class - every week if possible - and that all the students be able to participate.

**Limitations**

Typically, the problems associated with making a technology innovation are practical: expense, lack of IT support, or inadequate instructor preparation (Jacka, 2018). There are less obvious but still significant barriers that are intrinsic and have the potential to reside in both faculty and students. Ertmer (1999) describes these as first and second-order barriers. The first-order barriers are those described above - they are extrinsic to the instructors. Among the "volunteer army" (Kotter, 2019, p.12) that I enlisted was an educational technology specialist who handled IT issues. I taught both of the courses involved in the dissertation study, enlisted one other faculty member to assist, and provided them with instruction on using the technology and observation protocols. I needed to communicate a compelling vision, build a collaborative community of students and faculty, and challenge the status quo.

The act of introducing new technologies into an existing system is, inherently, an innovation. It is new, it is untried, and it may be successful, or it may not be. Bentley's (2010) *Innovation and diffusion as a theory of change* provides relevant insight into how to succeed in the project. Diffusion - whether the technology is effectively adopted - depends upon several factors. The novelty factor is often at work when introducing new technology (Yang et al., 2018). There is undoubtedly a surprising intensity to the experience of using IVR for the first time. Although Bailenson (2018) cautions that the use of new technology should be shaped by the needs of the program, not merely the novelty of the tool, there is a certain "hedonic motivation" (Gregory et al., 2016, p. 249) in the use of new technology that the students experienced and expressed. The novelty

effect was considered when evaluating a new technology's potential for engagement (Huang et al., 2020).

Once they were past the initial rush, it was informative to hear the students' perceptions of the experience and its value. The diffusion of a technology depends upon it being perceived as invaluable and inexpensive enough to become ubiquitous (Bentley, 2010). Whether VR can achieve both of these benchmarks is still to be determined. However, the students all expressed a desire to repeat the VR experience and own a unit for themselves. In time, they may become as common as phones, tablets, or laptops.

As with any action research, there were limitations to this study. Some were unique to the unusual recent events that have shaped these students and these classes. The wake of the COVID pandemic has had lasting and unprecedented effects. As a result, these students may be so unique that there is the potential that these findings will not be transferable once we have put the events of the past three years further behind us. Additionally, there were potential points of caution in the setting, the role of the researcher, and the tools employed.

The fact that most of the participants were first-year students in a new setting may have made them feel more pressure to participate in the study and to feel as though they should be positive in their responses. I tried to mitigate this by creating a relaxed and low-stakes environment in which to use VR. By staging the experiences during free work sessions, students could work on whatever they liked. There was no suggestion by me or the other researcher that there was an imperative to try VR. Despite this, several students became curious after observing the participants and asked to try it as well.

The uniqueness of this class makes the issue of transferability and generalizability tricky. As a result of our unusual circumstances, I am not confident that my findings will be as relevant as they would have been in a more normal time. There is

also a great deal of difference between regions in local culture, demographics, and psychographics.

As my work was structured as a phenomenological study, context was necessary for developing the narrative. The cultural background of the students – many of whom are not academically inclined but are very creative provided some insight into their responses. In conducting comparable research, I believe that it will be valuable for the schools in question to have some structural similarities, similar cultures, or missions, even if the circumstances that, in this case, shaped the participants differ. I hope we will never again experience the confluence of factors that occurred during and after the Covid pandemic. Nevertheless, I think there is value in examining what happened here and now with this particular group of students. It was not what I expected, but it was fascinating, nonetheless.

My role as a researcher was always a source of worry. As a professor, advisor, and their Program Director, the participants may have felt some pressure to both try the intervention and to please me by reporting that they liked it. It was challenging to keep from expressing my enthusiasm for VR, and I am sure I sent some signals indicating how much I enjoyed it despite my best efforts. I made a concerted effort to truly listen to what the students said and did, checking my bias. I kept the interviews casual and followed the students' conversational lead. I hoped this would result in a more honest appraisal that would answer the research question.

Finally, the tool, *Tilt Brush,* may not have been the best choice for exploring embodied cognition. The brushes it provides are not similar to fabric and are far more fanciful. As a result, the students immediately launched into fantastical creations, and the concept of 2D to 3D that I had hoped to convey was lost in the sheer pleasure of creating. A better alternative may be something like *Gravity Sketch*, which has actual

product development uses. I was afraid that it would be too advanced for the students' level, but they picked up VR with surprising ease.

**Researcher Reflections**

It is only possible to discuss this study by addressing the historical moment in which it took place. This period has been truly unique and without precedent. The ongoing impact of the COVID-19 pandemic and related socioeconomic and political factors must be considered when evaluating this study and its results. The pandemic has had far-reaching effects on all aspects of society, and definitely on the experiences of college students. The sudden shift to online learning, social isolation, collective trauma, and uncertainty surrounding the future profoundly impacted this generation of students and continues to do so.

I have been interested in virtual reality and its potential since 2008 when I began working on educational projects in Second Life. As I have pointed out earlier, Second Life is more accurately called a Virtual Environment, not Virtual Reality. Although it has the appearance of 3 dimensionality, it is mediated through the computer screen, so is not truly immersive. I created several collaborative projects, including an exhibition space and educational resource center, The Cerulean Gallery (Crooks & Julian, 2011), The Artist Project, a rethinking of how to teach looking at art (Crooks & Julian, 2016), and an installation/gallery that featured works with environmental themes. The perceived communal space in Second Life lent itself to studying collaboration and relational aesthetics - the projects centered around the experience of sharing the viewing and creating simultaneously between physically distant people.

I was excited and intrigued when I first tried the Oculus Rift headset. It differed significantly from the communal and collective experience of Second Life's virtual world. Indeed, the headset transported me to a place where I was alone but emphatically and

excitingly there. The immersion was deep, immediate, and intense. I could see VR's potential for education and engagement and looked forward to experimenting. In January 2020, I received a grant to buy six new, unwired Oculus Quest headsets. They had been the hot buy of that Christmas season, so they were backordered. I finally received them on March 11, 2020. We were told to vacate the campus and begin remote instruction on March 13. Harcum College returned to in-person learning in September 2021, but with masking and social distancing enforced. The VR headsets were still in their boxes, unopened.

The disruptions and fallout from the pandemic and its related effects required adjustments to the original plans for the study, and they still reverberate. One of the more obvious factors that I had not considered was the students' hesitance to share a headset with other students. Another, more subtle, was the widespread sense of disengagement among the incoming cohort. Marley (2021) described it as a "Stunning" level of disconnection in their article for The Chronicle of Higher Education. Half of the students were not attending class at all, and many more dropped out. This class differed from the eager and engaged group I had envisioned when designing my study.

The incoming first-year class of 2022 was unprepared at a level I had never seen. These observations have been born out by national studies - "Recent results from the National Assessment of Educational Progress (NAEP) showed historic declines in American students' knowledge and skills and widening gaps between the highest- and lowest-scoring students" (*The nation's report card: NAEP* 2022), and exacerbated by inequity. My students, primarily urban and lower income, many LGBTQ+, were hit particularly hard during the shutdown. "Many in Black and Hispanic households lost family members or faced severe financial setbacks while at the same time working on the

front lines as essential workers. For LGBTQ+ youth, some were sent back home to potentially unsafe environments" (Malesic, 2022, p. 1).

The group of students in this study exhibited symptoms of trauma. Getting them to focus on class (Lake & Pillow, 2022) was not easy. Nationwide more than half of college students reported mental health problems and social anxiety (Leonhardt, 2022). They were underprepared, anxious, and traumatized (Marijolovic, 2023). I was tired. It helped a little to know that this situation was not unique to our school - to read in Chronicle of Higher Ed, "Those who teach at colleges with a high percentage of students who are lower-income, come from communities hit hard by COVID, or have work and family responsibilities say the cumulative toll of the pandemic has led to emotional overload and physical exhaustion" (McMurtrie, 2022).

In light of all this, I began to have doubts about the study altogether. I devised a system of sterilizing the HMDs between uses, and the History of Fashion portion of the study went well. For the creative portion, I was nervous. I had hoped that the embodiment inherent in VR would help students bridge the 2D to 3D design challenge. The students in this group had yet to master even the 2D aspects of design. Most could not do design drawings. All were struggling to learn Photoshop. Giving them a new technology to learn could have been a disaster.

However - it was not. While the study did not produce the results I had predicted, it gave students something valuable. What they found in using VR might have been precisely what they needed. They loved it. It gave them a sense of freedom and creative confidence - the opportunity for "joyous exploration" (Shutte, 2020, p. 4). It lowered the stakes and allowed them to play. Students that had previously been struggling, paralyzed with a fear of failure in their 2D design classes experienced a relaxed sense of creative freedom. A quality of the space seemed to encourage risk

taking, an essential element of creativity (Henriksen et al., 2021). Fear of judgement often stifles creativity, but VR seemed to remove that anxiety. The students felt that they could create like no one was watching. They emerged from the experience proud and pleased by their creation, and further research on the effect VR might have on self-efficacy and mastery should be undertaken.

Other studies have identified four or five affordances that VR offers, immersion, presence, empathy, embodiment and usability (Shin, 2017). My study focused on two of the affordances usually ascribed to VR, those of presence and agency. Yet another affordance seemed to be an important element of the students' experiences, that of seclusion. This affordance was recently identified in Entering the artwork (Lugonja, 2022), a study of virtual museum experiences. While blah referred to it as an anti-affordance, the participants in the study reported enjoying the privacy to engage with the art on their own terms. This was a significant element of my students' enjoyment of the experience as well. They were able to interact with their designs without distraction or self-consciousness.

The benefits that virtual reality can bring to education are particularly necessary for underserved students. There are few spaces in which these students can feel free to create freely, and few opportunities to use technology in a way that is enjoyable and comes with no pressure. The economic divide was so starkly evident during COVID, when I realized that many of my students, learning remotely, did not even have computers. They would Zoom in through their phone, or their parents' laptop, sometimes having to drive to a place where they could receive a signal. As a result, this cohort is less prepared for a future career that will almost certainly require them to engage with technology (Leonhardt, 2022), (Henriksen et al., 2021). Introducing them to

a technology that they found  fun, exciting and not intimidating could help relieve their anxiety around computers and other tech.

**Implications for Future Practice**

There can be no question, based on the experiences in this study, that I will continue to incorporate virtual reality experiences into the curriculum of the History of Fashion class. The student participants have been clear in their enthusiasm for the value of VR experiences - more robust engagement with the material, a deeper understanding of the subjects, and enjoyment of the tool.

The students expressed similar enthusiasm for the creative experience of using *Tilt Brush*. While it did not produce the results that I had anticipated, acting as an aid to the 2D - 3D transition, it worked as a design brainstorming session, freeing the students to think outside the box quite literally. I also suspect that *Tilt Brush* and other creative apps like *Gravity Sketch* may help students with the interfaces of the programs they are required to learn, like Photoshop. I intend to introduce virtual experiences early in the semester. One of the pleasantly surprising revelations was the comfort, ease, and lack of hesitation with which the students took to the app's graphic interface. I hope this will lower psychological barriers when Photoshop and Illustrator are introduced - they will be a bit more familiar and will associate these programs with a fun, enjoyable activity.

In its current state, immersive VR may not help students with 3-dimensional design ideation in the way that I had hoped. There are other programs, however, that exhibit potential. Programs like Clo3D and Browzwear are designed specifically for fashion design and have already been widely adopted throughout the industry.  These tools aim to streamline the design and production process, facilitate more accessible communication between designers and manufacturers, and reduce waste (Sayem, 2022). "Lately, the potential in reduced lead times, prototype errors, and sample numbers have

persuaded fashion companies to test digital 3D representations prior to physical production." (Särmäkari, 2021. p. 11). While not immersive, these technologies allow for the perception of 3 dimensionalities on a two-dimensional screen. Ultimately, they may prove more effective at fostering the design-to-garment understanding than immersive VR. This research direction is the next avenue that I intend to pursue.

**Conclusion**

This study did not proceed as I had expected in many ways. The students had never achieved the level of design competence that I had assumed when I developed my planned study. The question of 2 to 3D concepts turned out to be beside the point when the students had not even mastered drawing their ideas. I believe that this study was a success. The goal had been to explore the use of a novel technology and to gather and understand the students' perception of it. While the results turned out differently than I had thought, we discovered benefits that I hadn't anticipated. The results were fascinating, providing answers to questions I had not even thought to ask. I was so riveted during the creative sessions that I stayed throughout, even when the faculty assistant was present. Watching each student's unique approach, gestures, and clearly deep immersion, and then seeing their design work, was exhilarating. Hearing them describe the experience afterward reinforced the value they had found in using VR. They did not use it for design. They used it as a creative outlet, as a space for free expression. Given the many challenges of this semester, they found that the VR experience brought them pleasure, joy, and a much-needed opportunity for creative play. This was the value that the VR experiences brought, and it was what they needed.

REFERENCES


Ahmed, I., Berg, A., Balchandani, A., Andersson, J., Hedrich, S., & Young, R. (2019). The state of fashion 2019 - A year of awakening. *The State of Fashion*. Retrieved February 17, 2023, from https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/the%20state%20of%20fashion%202019%20a%20year%20of%20awakening/the-state-of-fashion-2019-final.ashx

American Psychological Association. (2022, September 1). Student Mental Health is in crisis. campuses are rethinking their approach. *Monitor on Psychology*. Retrieved February 5, 2023, from https://www.apa.org/monitor/2022/10/mental-health-campus-care

The Art Story. (2018). *Action painting movement overview*. The Art Story. Retrieved February 5, 2023, from https://www.theartstory.org/movement/action-painting/

Bailenson, J., Yee, N., Blascovich, J., Beall, A, Lundblad, N., & Jin, M. (2008). The use of immersive virtual reality in the learning sciences: Digital transformations of teachers, students, and social context. *Journal of the Learning Sciences*, *17*(1), 102–141. https://doi.org/10.1080/10508400701793141

Bailenson, J. (2019). *Experience on demand: what virtual reality is, how it works, and what it can do*. W. W. Norton & Company, Inc.

*Balenciaga: Fall 21*. (n.d.). Retrieved October 3, 2021, from https://videogame.balenciaga.com/en/.

Barsalou, L. W. (1993). Challenging assumptions about concepts. *Cognitive Development*, *8*(2), 169–180. https://doi.org/10.1016/0885-2014(93)90012-t

Barton, J. (2020). *The fabric of reality is a fashion show unlike any other*. Huffington Post. https://www.huffingtonpost.co.uk/entry/fabric-of-reality-watch-again_uk_5f31011dc5b6e96a22b4d1fd

Bender, S. & Broderick, M. (2021) *Virtual Realities: Case studies in immersion and phenomenology*. Palgrave Macmillan.

Bentley, Tom. (2009). Innovation and diffusion as a theory of change. *Second International Handbook of Educational Change (pp.29-46)*. doi:10.1007/978-90-481-2660-6_2

Bianchi, M. (2002). Novelty, preferences, and fashion: when goods are unsettling. *Journal of Economic Behavior & Organization*, *47*(1), 1–18. https://doi.org/10.1016/s0167-2681(01)00162-7

Borrelli-Persson, L. (2020, February 4). Has fashion really embraced technology? We chart the ever evolving relationship between maker and machine. *Vogue*. Retrieved February 5, 2023, from https://www.vogue.com/article/has-fashion-really-embraced-technology-a-timeline-of-tech-and-fashion

Browchuk, E. (2020). Digital fashion weeks and virtual Shows: A rundown of fashion's new rhythm. *Vogue*. https://www.vogue.com/article/digital-fashion-weeks-2020.

Carlos, M. (2020) Effect of imagine-self and imagine-other: Virtual reality perspective taking tasks on affective empathy and prosocial behaviors (dissertation). ProQuest, Stanford University, CA. https://stacks.stanford.edu/file/druid:kp113zc2559/FernandaHerrera_Dissertation-augmented.pdf

Crooks, J., & Julian, J. (2011). The Cerulean Gallery. Retrieved February 5, 2023, from https://juliansea.wixsite.com/slceruleangallery

Crooks, J., & Julian, J. (2016, September 20). *SL artist Project - The Artist Colony - Final*. YouTube. Retrieved February 5, 2023, from https://youtu.be/cbXqjVdLDpE

Crooks, J. & Julian, J. (2014). The Ed Media Center: A Second Life professional development model for relational aesthetics. *Explorations in Virtual Worlds: New Literacy and Learning Platforms,* 46 - 60. https://eric.ed.gov/?id=ED578675

Crooks, J. & Julian, J. (2016). *The Second Life artist project: New possibilities for visual arts education*. International Art Education Association InAEA 2nd Biannual Virtual Conference. Second Life. https://files.eric.ed.gov/fulltext/ED602057.pdf

Chandrasekera, T. (2019). *The effect of Augmented Reality and Virtual Reality interfaces on epistemic actions and the creative process* (dissertation). ProQuest, Ann Arbor, MI.

Christensen, C. M., & Eyring, H. J. (2011). *The Innovative university: changing the DNA of higher education from the inside out*. Jossey-Bass.

CLO3D. (2019, August 28) *Parsons School of Design introduces courses in CLO this fall.* CLO3D.com. https://www.clo3d.com/company/newsdetail/167

Csikszentmihalyi, M. (1990). *Flow: The Psychology Of Optimal Experience*. Harper and Row.

Csikszentmihalyi, M. (2004). *Flow, the secret to happiness*. TED. https://www.ted.com/talks/mihaly_csikszentmihalyi_flow_the_secret_to_happiness.

Curtis, A. (Director). (2011) *All watched over by machines of loving grace* [Film]. BBC.

Dewey, J. Art as Experience. *The Journal of Philosophy*, vol. 31, no. 10, 1934, p. 275., https://www.jstor.org/stable/i335058

Davies, M., Collinson, T., Phippen, A., Kaye, L., Williams, T., Basken, P., Ross, J., & Lem, P. (2021, March 15). Universities must stop presuming that all students are tech-savvy. *Times Higher Education (THE)*. Retrieved February 5, 2023, from https://www.timeshighereducation.com/opinion/universities-must-stop-presuming-all-students-are-tech-savvy

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science, 323*. doi:10.1126/science.1167311

Ebner, A. (2020, February 3). *Fashion Forward*. UD Library. Retrieved February 5, 2022, from https://library.udel.edu/news/2020/02/03/fashion-forward/

Ekstromer, P., Wangdahl, J., & Wever, R. (2018). *Virtual reality sketching for design ideation* (thesis). https://www.researchgate.net/publication/329774758_VIRTUAL_REALITY_SKETCHING_FOR_DESIGN_IDEATION

Ermi, L. & Mayra, F. (2005) Fundamental components of the gameplay experience: Analysing immersion. *DiGRA Conference on Changing Views: Worlds in Play*, Vancouver, 16-20

Ertmer, P. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47-61. https:// doi:10.1007/bf02299597

Euclide, E. (2018, July 16). *VR Initiation Protocol*. Edward Euclide. Retrieved February 21, 2022, from http://www.eeuclide.com/

Fernandez, C. (2021, November 19). *Op-ed: The end of fashion establishment gatekeepers*. The Business of Fashion. Retrieved February 5, 2023, from https://www.businessoffashion.com/opinions/media/op-ed-the-end-of-fashion-establishment-gatekeepers/

Fiore, S., Harrison, G., Hughes, C. & Rutström, E. (2007) Virtual experiments and environmental policy. *RFF/EPA Conference Frontiers of Environmental Economics*, Washington.

Flavin, M. (2012). Disruptive technologies in higher education. *Research in Learning Technology, 20*(Sup1), 1984. http://doi:10.3402/rlt.v20i0.19184

Forcefield Entertainment. (2019) *Anne Frank house* [Virtual reality application]. https://annefrankhousevr.com/

Frank, A., Pressler, M., & Brockway, H. (2015). *The Diary of Anne Frank*. Puffin.

Gallagher, S. & Lindgren, R. (2015). Enactive metaphors: Learning through full-body engagement. *Educational Psychology Review. 27.* https://doi-org.ezproxy1.lib.asu.edu/10.1007/s10648-015-9327-1

Gallardo, K., & Nohemi R. (2020). Evaluating virtual reality as a learning resource: An insight into user experience, usability and learning experiences. *The Twelfth International Conference on Mobile, Hybrid and Online Learning*. *(pp. 65–69)*. Monterey, MX; IARIA. https://www.academia.edu/43459892/Evaluating_Virtual_Reality_as_a_Learning_Resource_An_Insight_into_User_Experience_Usability_and_Learning_Experience

Galletta, A. (2013). *Mastering the semi-structured interview and beyond: From research design to analysis and publication*. New York University Press.

Gautam, A., Williams, D., Terry, K., Robinson, K., & Newbill, P. (2017). Mirror worlds: Examining the affordances of a next generation immersive learning environment. *TechTrends*, *62*(1), 119–125. https://doi.org/10.1007/s11528-017-0233-x

Gaver, W. W. (1991). Technology affordances. Proceedings of the SIGCHI conference on human factors in computing systems (pp. 79–84). New York, NY: Association for Computing Machinery.

Gibson, J. (1979). The theory of affordances. *The Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.

Goldin-Meadow, S. (2011). What modern-day gesture can tell us about language evolution. *Oxford Handbooks Online*. https://doi.org/10.1093/oxfordhb/9780199541119.013.0057

Gregory, S., Gregory, B., McDonald, M., Nikolic, S., Farley, H., O'Connell, J., Butler, D., Jacka, L., Grant, S., Jegathesan, J.J., McGrath, N., Rudra, A., Stokes-Thompson, F., Sukunesan, S., Zagami, J., Sim, J., Schutt, S., Gaukrodger, B., Hearns., M. & Irving, L. (2016). Exploring virtual world innovations and design through learner voices. In S. Barker, S. Dawson, A. Pardo, & C. Colvin (Eds.), *Show Me The Learning*. *Proceedings ASCILITE 2016 Adelaide* (pp. 245-254). https://researchoutput.csu.edu.au/ws/portalfiles/portal/20227331/10028484_Published_paper.pdf

Google. (2019). *Tilt brush* [VR app]. Oculus store. https://www.oculus.com/experiences/quest/2322529091093901

Gravity Sketch. (2019). *Gravity sketch* [VR app]. Oculus store. https://www.oculus.com/experiences/quest/1587090851394426

Hackl, C. (2020, June 8). *Why virtual dresses and augmented fashion are a new profitable frontier for brands*. Forbes. https://www.forbes.com/sites/cathyhackl/2020/06/08/why-virtual-dresses--augmented-fashion-are-a-new-profitable-frontier-for-brands/.

Häkkilä, J., Colley, A., Väyrynen, J., & Yliharju, A.-J. (2018). Introducing virtual reality technologies to design education. *Seminar.net*, *14*(1), 1–12. Retrieved from https://journals.oslomet.no/index.php/seminar/article/view/2584

Hamilton, D., McKechnie, J., Edgerton, E., Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design. *Journals of Computers in Education*. 8, 1–32. https://doi.org/10.1007/s40692-020-00169-2

Horvat, N., Martinec, T., Perišić, M., Škec, S.(2022) Comparing design review outcomes in immersive and non-immersive collaborative virtual environments. *Procedia CIRP (109)*, 173-178. https://doi.org/10.1016/j.procir.2022.05.232

Huang, Roscoe, R. D., Johnson-Glenberg, M. C., & Craig, S. D. (2021). Motivation, engagement, and performance across multiple virtual reality sessions and levels of immersion. *Journal of Computer Assisted Learning*, *37*(3), 745–758. https://doi.org/10.1111/jcal.12520

Huang, W. (2020). *Investigating the novelty effect in virtual reality on Stem learning* (dissertation).

Ihde, D. (2019). Postphenomenology and "places". in E. Chapman (Ed.), *The phenomenology of real and virtual places*. (pp. 51-59). Routledge.

Jacka, L. (2020). *Using virtual worlds in educational settings: Making learning real*. S.l.: Routledge.

Johnson-Glenberg, M. (2017). Embodied education in mixed and mediated realties. *Smart Computing and Intelligence Virtual, Augmented, and Mixed Realities in Education*, 193–217. https://doi.org/10.1007/978-981-10-5490-7_11

Johnson-Glenberg, M. (2018). Immersive VR and education: Embodied design principles that include gesture and hand controls. *Frontiers in Robotics and AI*, *5*. https://doi.org/10.3389/frobt.2018.00081

Joundi, J., Conradie, P., Saldien, J., & De Marez, L. (2018). Exploring the potential and challenges of VR prototyping in fashion design. *Proceedings of the Symposium on Spatial User Interaction - SUI '18*. ACM Press. https://doi.org/10.1145/3267782.3274768

Joundi, J., Christiaens, Y., Saldien, J., Conradie, P., & De Marez, L. (2020). An explorative study towards using VR sketching as a tool for ideation and prototyping in product design. *Proceedings of the Design Society: DESIGN Conference*, *1*, 225–234. https://doi.org/10.1017/dsd.2020.61

Henriksen, D., Mishra, P., Creely, E., & Henderson, M. (2021). The role of creative risk taking and productive failure in Education and Technology Futures. *TechTrends*. https://doi.org/10.1007/s11528-021-00622-8

Kalantari, S., & Neo, J. R. J. (2020). Virtual environments for design research: Lessons learned from use of fully immersive virtual reality in interior design research. *Journal of Interior Design*, *45*(3), 27–42. https://doi.org/10.1111/joid.12171

Kanamgotov, A. (2015). A framework for immersion in virtual reality. https://www.semanticscholar.org/paper/A-framework-for-immersion-in-virtual-reality-Kanamgotov/

Knowles, J, Cole, A., & Weber, S. (2008). Visual images in research. In *Handbook of the arts in qualitative research: Perspectives, methodologies, examples, and issues* (pp. 75–86). essay, Sage.

Kwon, C. (2018). Verification of the possibility and effectiveness of experiential learning using HMD-based immersive VR technologies. *Virtual Reality*, *23*(1), 101–118. https://doi.org/10.1007/s10055-018-0364-1

Lake, R., & Pillow, T. (2022, November 2). The alarming state of the American student in 2022. *Brookings*. Retrieved February 5, 2023, from https://www.brookings.edu/blog/brown-center-chalkboard/2022/11/01/the-alarming-state-of-the-american-student-in-2022/

Leonhardt, M. (2022, July 15). Crisis on campus: 60% of college kids have mental health disorders, and schools are unprepared. *Fortune*. Retrieved February 5, 2023, from https://fortune.com/well/2022/07/12/mental-health-crisis-college-schools-unprepared/

Li, Hairong, Daugherty, Terry, & Biocca, Frank. (2003). The role of virtual experience in consumer learning. *Journal of Consumer Psychology, 13*(4), 395–407.

Lindgren, R., Tscholl, M., Wang, S., & Johnson, E. (2016). Enhancing learning and engagement through embodied interaction within a mixed reality simulation. *Computers & Education*, *95*, 174–187. https://doi.org/10.1016/j.compedu.2016.01.001

Lugonja, K. (2022). *Entering the Artwork The Effect of Virtual Reality Affordances on Art Interpretation* (thesis).

Lundquist, M. (2017). *Lincoln in the bardo (Saunders)*. LitLovers. Retrieved February 21, 2022, from https://www.litlovers.com/reading-guides/13-reading-guides/fiction/10902-lincoln-in-the-bardo-saunders

Luo, H., Li, G., Feng, Q., Yang, Y., & Zuo, M. (2021). Virtual reality in K-12 and Higher Education: A systematic review of the literature from 2000 to 2019. *Journal of Computer Assisted Learning*. https://doi.org/10.1111/jcal.12538

Malesic, J. (2022, May 13). *My college students are not OK*. The New York Times. Retrieved February 5, 2023, from https://www.nytimes.com/2022/05/13/opinion/college-university-remote-pandemic

Marijolovic, K. (2023, January 25). *Trauma and social anxiety are growing mental-health concerns for college students*. The Chronicle of Higher Education. Retrieved February 5, 2023, from https://www.chronicle.com/article/trauma-and-social-anxiety-are-growing-mental-health-concerns-for-college-students?cid=gen_sign_in

Martin, G. (2020). *Homepage*. Harcum College. https://www.harcum.edu/s/1044/edu/index.aspx?sid=1044.

Marain, A., & Trochu, E. (2019). *From Lil Miquela to Shudu Gram: Meet the virtual models*. Vogue Paris. https://www.vogue.fr/fashion/fashion-inspiration/story/from-lil-miquela-to-shudu-gram-meet-the-virtual-models/1843.

McGrenere, J., & Ho, W. (2000). Affordances: Clarifying and evolving a concept. *Proceedings of Graphics Interface 2000* (pp. 179–186). Montreal, Canada.

McMurtrie, B. (2022, July 12). A 'stunning' level of student disconnection. *The Chronicle of Higher Education*. Retrieved February 5, 2023, from https://www.chronicle.com/article/a-stunning-level-of-student-disconnection.

Mensitieri, G., & Lehrer, N. (2020). *The most beautiful job in the world: Lifting the veil on the fashion industry*. Carlton, Victoria, Australia, VA: Melbourne University Press.

Mertler, C. A. (2017). *Action research: Improving schools and empowering educators* (5th ed.). Thousand Oaks, CA: Sage.

Minocha, S., Tudor, A. & Tilling, S. (2017). *Affordances of mobile virtual reality and their role in learning and teaching*. https://doi.org/10.14236/ewic/hci2017.44

Moreira, G. J., Luna-Nevarez, C., & McGovern, E. (2021). It's about enjoying the virtual experience: The role of enjoyment and engagement in the adoption of virtual reality in Marketing Education. *Marketing Education Review*, *32*(3), 224–239. https://doi.org/10.1080/10528008.2021.1965486

Morgan, A. (2020, July 11). *The true cost*. YouTube. Retrieved October 29, 2021, from https://www.youtube.com/watch?v=nxhCpLzreCw.

Moustakas, C. (1994). Phenomenological research: analyses and examples. In *Phenomenological research methods* (pp. 120-154). SAGE Publications, Inc., https://dx.doi.org/10.4135/9781412995658

National Assessment of Educational Progress. (2022, May 31). The nation's report card: NAEP. *The Nation's Report Card | NAEP*. Retrieved February 5, 2023, from https://nces.ed.gov/nationsreportcard/

N.D. (2020). *Gestural – Art Term*. Tate. https://www.tate.org.uk/art/art-terms/g/gestura

N. D. (2016). *Notes on Blindness. ARTE, the European culture TV channel, free and on demand*. Retrieved February 5, 2022, from https://www.arte.tv/digitalproductions/en/notes-on-blindness

Nichols, G. (2018, July 24). *View the pyramids of Ancient Egypt in this 360 degree VR capture*. ZDNet. https://www.zdnet.com/article/view-pyramids-of-ancient-egypt-via-this-360-degree-vr-capture/.

Norman, D. A. (1988). *The psychology of everyday things* (Vol. 11). New York, NY: Basic Books

Oculus. (2019). *First steps* [VR app]. Oculus store. https://www.oculus.com/experiences/quest/1863547050392688/

Pantone. (n.d.). *Pantone Color of the year 2021 / introduction*. Pantone. Retrieved October 3, 2021, from https://www.pantone.com/color-of-the-year-2021.

Pasfield-Neofitou, S., Huang, H. & Grant, S. (2015) Lost in second life: virtual embodiment and language learning via multimodal communication. *Education Tech Research Dev* **63**, 709–726. https://doi.org/10.1007/s11423-015-9384-7

Pellas, N., Dengel, A. & Christopoulos, A. (2020)A scoping review of immersive virtual reality in STEM education, *IEEE Transactions on Learning Technologies*, *13(4)*, 748-761. https://doi.org/ 10.1109/TLT.2020.3019405

Perdomo, J. & Shiratuddin, M., Thabet, W. & Ananth, A. (2005). Interactive 3D visualization as a tool for construction education. *F4B/23 - F4B/28*. doi: 10.1109/ITHET.2005.1560307.

Prabhu, V., Sutton, C., & Sauser, W. (2008). Creativity and certain personality traits: Understanding the mediating effect of intrinsic motivation. *Creativity Research Journal*, *20*(1), 53–66. https://doi.org/10.1080/10400410701841955

Proulx, N. (2019, February 28). *Film club: 'traveling while black'*. The New York Times. Retrieved March 26, 2022, from https://www.nytimes.com/2019/02/28/learning/film-club-traveling-while-black.html

Radianti, J., Majchrzak, T., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, *147*, 103778. https://doi.org/10.1016/j.compedu.2019.103778

*Random Picker - choose a random thing from your list*. Random Lists. (2013, May). Retrieved February 21, 2022, from https://www.randomlists.com/random-picker

Sarakatsanos, O., Chatzilari, E., Nikolopoulos, S., Kompatsiaris, I., Shin, D., Gavilan, D., & Downing, J. (2021). A VR application for the virtual fitting of fashion garments on avatars. *2021 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*. https://doi.org/10.1109/ismar-adjunct54149.2021.00018

Särmäkari, N. (2021.) Digital fashion on its way from niche to the new norm. *The New Normal Sartorial and Body Practices of the Quarantine Era*. pp. 117-134.

Sayem, A. (2022) Digital fashion innovations for the real world and metaverse, *International Journal of Fashion Design, Technology and Education*, 15:2, pp. 139-141,: https://doi.org/10.1080/17543266.2022.2071139

Segran, E. (2020, June 9). *Hanifa's virtual 3D fashion show is haunting, beautiful, and brilliantly executed*. Fast Company. https://www.fastcompany.com/90513959/hanifas-virtual-3d-fashion-show-is-haunting-beautiful-and-brilliantly-executed.

Schutte, N. S. (2019). The impact of virtual reality on curiosity and other positive characteristics. *International Journal of Human–Computer Interaction*, *36*(7), 661–668. https://doi.org/10.1080/10447318.2019.1676520

Shin, D.-H. (2017). The role of affordance in the experience of virtual reality learning: Technological and affective affordances in virtual reality. *Telematics and Informatics*, *34*(8), 1826–1836. https://doi.org/10.1016/j.tele.2017.05.013

Smith, A. (2020). *Is there any future for VR in fashion? Checking the latest VR apps, virtual shopping and more*. WTVOX. https://wtvox.com/digital/future-of-vr-best-vr-apps-for-fashion/.

Saunders, G. (2018). *Lincoln in the bardo: A novel*. Random House.

Saunders, R. (1961). The contributions of Viktor Lowenfeld to art education part II: Creative and mental growth. *Studies in Art Education*, *2*(2), 7. https://doi.org/10.2307/1319643

Škola, F., Rizvić, S., Cozza, M., Barbieri, L., Bruno, F., Skarlatos, D., & Liarokapis, F. (2020). Virtual reality with 360-video storytelling in Cultural Heritage: Study of Presence, engagement, and Immersion. *Sensors*, *20*(20), 5851. https://doi.org/10.3390/s20205851

Starr, C., Anderson, B. & Green, K. (2109) I'm a computer scientist!: virtual reality experience influences stereotype threat and STEM motivation among undergraduate women. *Journal of Science Education and Technology 28(5)*, 493–507. http://dx.doi.org.librarylink.uncc.edu/10.1007/s10956-019-09781-z

Stephenson, N., & Kodaj Dániel. (1992). *Snow crash*. Metropolis Media.

Stokrocki, M. (2014). Art Treasure Quests in Second Life: A Multi-Literacy Adventure. *Art Education*, *67*(2), 37-42. https://doi.org/10.1080/00043125.2014.11519264

Thomas, M., (2019) *Virtually there: A phenomenological study of secondary students and their engagement with virtual reality field trips (*Electronic Theses and Dissertations). 1700. https://egrove.olemiss.edu/etd/1700

The New York Times. (2017, September 16). *Diversifying Fashion Week* [Video File]. Retrieved from https://www.youtube.com/watch?v=ZvkhsqUdUZI.

The New York Times. (2017). *Lincoln in the Bardo* [360° Video]. Retrieved January 17, 2022, from https://www.youtube.com/watch?v=phuCt50JCk8.

Vicinity360 (2019, July 25). *360° Experience Inside the TITANIC Part.1 Deck A&B 8K Virtual Tour Panoramas (Honor and Glory DEMO)*. YouTube. https://www.youtube.com/watch?v=bWhJC6OYCOc.

Wall Street Journal. (2016, February 16). *All Access at Jason Wu's New York Fashion Week Show* [Video file]. Retrieved from https://www.youtube.com/watch?v=qETYh1cSiWY&t=343s.

Williams, R.(2019) *Traveling While Black.* Felix and Paul Studio.

Winkler, N., Röthke, K., Siegfried, N., & Benlian, A. (2020). *Lose yourself in VR: exploring the effects of virtual reality on individuals' immersion*. Aisnet.org. https://aisel.aisnet.org/hicss-53/da/augmented_reality/2/

Yang, X., Lin, L., Cheng, P.-Y., Yang, X., Ren, Y., & Huang, Y.-M. (2018). Examining creativity through a virtual reality support system. *Educational Technology Research and Development*, *66*(5), 1231–1254. https://doi.org/10.1007/s11423-018-9604-z

Zwieglinska, Z. (2021, October 4). *How fashion brands are navigating nfts and what's next for the metaverse*. Glossy. Retrieved February 21, 2022, from https://www.glossy.co/fashion/how-fashion-brands-are-navigating-nfts-and-whats-next-for-the-metaverse/

Zuckerberg, M. (2021, October 28). *Welcome to meta: Meta*. Welcome to Meta | Meta.Retrieved February 21, 2022, from https://about.facebook.com/meta/

# APPENDIX A

## RECRUITMENT AND CONSENT LETTER

Dear Student:

My name is Julian Crooks and I am a doctoral student in the Mary Lou Fulton Teachers College (MLFTC) at Arizona State University (ASU). I am working under the direction of Dr. Brian Nelson, a faculty member in MLFTC. We are conducting a research study on the potential benefits of Virtual Technology for Fashion Design education. The purpose of this study is to understand better whether students perceive value in immersive VR experiences as learning tools in. History of Fashion

We are asking for your help, which will involve your participation in a brief **virtual** intervention. There will be participation in 3 virtual reality experiences during class, which will encompass about 35 minutes over the course of three class sessions. The VR experience is not a necessary part of class time but could occur during the class period. The experiences will not be recorded.

The study will conclude with a Zoom interview, about 10 minutes long, concerning your knowledge, experiences, attitudes, and beliefs about virtual reality and its value as a learning tool in History of Fashion. Only the audio portion of the Zoom call will be recorded. The interviews will not be conducted during class time

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. Choosing not to participate in the study does not affect your standing at Harcum College. You must be 18 or older to participate in the study.

The benefit to participation is the opportunity for you gain further knowledge in the field of Fashion history and experience in the use of virtual reality. There are some potential risks to using Virtual Reality which can include:

--Cybersickness

--Triggering of seizures or other conditions due to visual effects

--Injury from tripping, falling, or colliding with physical objects

--Contagions from sharing head-mounted displays

Cybersickness is a common side effect of VR immersion. Symptoms include:

--Headache

--Feeling dizzy or lightheaded

--Sudden drowsiness or fatigue

--Vision problems

--Nausea & vomiting

If you agree to participate, I will ask you to fill out a pre-screening questionnaire to rule out potential conditions that may increase your risk for cybersickness. You will be monitored while using the VR units, and you may stop the experience at any point. Each participant will use their own units, and these will be cleaned and sanitized before and after each use.

If you agree to participate, I will request your permission to audio record your responses to the interview questions. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know. I will ask for your oral consent at the time of the interview for those who are selected.

Your responses will be confidential. Results from this study may be used in reports, presentations, or publications but your name will not be used.

If you have any questions concerning the research study, please contact the research team –team – Dr. Brian Nelson at (480)-727-4550 or Julian Crooks at julian.crooks@gmail.com or (267) 481-2978.

Thank you,

Julian G. Crooks, Doctoral Student - CoPI

Dr. Brian Nelson, Professor - PI

Please let me know if you wish to be part of the study and will let me record your responses by signing this Consent letter.

By signing below you are agreeing to be part of the study

Name:

Signature:

Date:

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact Dr. Brian Nelson at (480) 727-4550 or the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at (480) 965-6788

# APPENDIX B

## PRESCREENING QUESTIONS FOR PRE-EXISTING CONDITIONS ELIGIBILITY CRITERIA

**Do you experience motion sickness or car sickness?**

0 Never

1 Has happened once or twice

2 Rarely

3 Sometimes

4 Often

5 Very often

**Do you have any conditions that where flashing or intense light might affect you, such as epilepsy, migraines, unexplained seizures, recent concussions, or light sensitivity?**

Yes

No

Please explain:

**Do you have any neurological or vestibular issues or, have you had any recent experiences (e.g., a head injury) that affect your balance or gait?**

Yes

No

Please explain:

**Do you have any uncorrected vision impairments, such as blindness, partial blindness, limited field of view, blurred vision, or stereoblindness? That is, do you have any issues affecting your vision that are <u>not</u> corrected with contacts, glasses, etc.?**

Yes

No

Please explain:

**Do you have any issues affecting your physical mobility or body movements?**

Yes

No

Please explain:

**Have you ever experienced virtual reality (VR)?**

Yes, and I had no physical side effects.

Yes, and I had some physical side effects.

No

Please explain:

**Do you experience blindness or issues affecting your field of view?** Yes
No Unsure

Please explain:*:*

**Do you have any issues affecting your ability to move your head and look around?**

Yes

No

Please explain:

**Do you have any issues affecting your ability to move your upper body, hands, or fingers, such as lifting your arms, grasping objects, etc.?**

Yes

No

# APPENDIX C

## OBSERVATIONAL PROTOCOL

Category Discussion:

The first two categories derived mainly from the observation protocol and sought to answer the following more specific questions:

(1) Do the participants' terminology express a sense of immersion?

(2) Do students explain their experiences as if they are actually there?

(3) Do the students display any emotions during the virtual experiences?

(4) Do students respond physically as if they are within the virtual environment?

(5) Do they jump, duck, run, walk, to accommodate what they are viewing in the virtual world?

(6) Can students explain their design process when asked about it?

Category one: Expressions, organizes the participants' verbal expressions to determine if they express a sense of immersion by speaking as if they are actually there.

Category two: Engagement describes the evidence of physical interaction with the virtual environment including the display of any emotions during the experience•

Category three: Explanations emerged from the student answers to questions during the experience and interview responses afterward.

*Observational Protocol was adapted from Thomas (2019, pp. 81 and 125).

# APPENDIX D

## LESSON PLANS FOR IMMERSION EXPERIENCES

Lesson Plan 1

# Lincoln in the Bardo

*Lesson Plan for History of Fashion*

## OVERVIEW & PURPOSE

Students will watch a 360 video based upon the George Saunders novel, Lincoln in the Bardo in several modalities. They will use their knowledge of the period to make a considered analysis of the participants and discuss with the class.

## OBJECTIVE

Students will analyze the characters in the video and will evaluate the ways in which their words and actions reflect the values of the period.

## INTRODUCTION

Summary

February 1862. The Civil War is less than one year old. The fighting has begun in earnest, and the nation has begun to realize it is in for a long, bloody struggle.

Meanwhile, President Lincoln's beloved eleven-year-old son, Willie, lies upstairs in the White House, gravely ill. In a matter of days, despite predictions of a recovery, Willie dies and is laid to rest in a Georgetown cemetery.

“My poor boy, he was too good for this earth,” the president says at the time. “God has called him home.” Newspapers report that a grief-stricken Lincoln returns, alone, to the crypt several times to hold his boy’s body.

From that seed of historical truth, George Saunders spins an unforgettable story of familial love and loss that breaks free of its realistic, historical framework into a supernatural realm both hilarious and terrifying. Willie Lincoln finds himself in a strange purgatory where ghosts mingle, gripe, commiserate,

quarrel, and enact bizarre acts of penance. Within this transitional state—called, in the Tibetan tradition, the bardo—a monumental struggle erupts over young Willie’s soul.

Lincoln in the Bardo is an astonishing feat of imagination and a bold step forward from one of the most important and influential writers of his generation. Formally daring, generous in spirit, deeply concerned

with matters of the heart, it is a testament to fiction’s ability to speak honestly and powerfully to the things that really matter to us.

Saunders has invented a thrilling new form that deploys a kaleidoscopic, theatrical panorama of voices to ask a timeless, profound question: How do we live and love when we know that everything we love must end? (From the publisher.)

George Saunders

• Birth—December 2, 1958

• Where—Amarillo, Texas, USA

• Education—B.S., Colorado School of Mines; M.F.A., Syracuse University

• Awards—PEN/Malamud Award (more below)

• Currently—lives in Syracuse, New York

George Saunders is an American writer of short stories, essays, novellas and children's books. His writing has appeared in The New Yorker, Harper's, McSweeney's and GQ. He also contributed a weekly column, "American Psyche," to the weekend magazine of The Guardian (UK) until October 2008. In 2017, he achieved wide acclaim for his first novel, Lincoln in the Bardo.

## VERIFICATION

1. Class discussion: Overview of the Civil War Period
2. Access previous knowledge
3. Introduction to Lincoln and historic events
4. Discuss novelization of events, the intersectionality represented by “the Bardo,” and ways in which the characters appearances and dialogue reveal their motivations

## ACTIVITY

1. Introduction to VR equipment
2. Discussion of safety protocols and boundaries
3. Introductory experience: “First Steps”
4. Created seated boundary and watch video
5. Faculty will monitor for safety and record reactions

6. Post VR verbal wellness check
7. Students will participate in the Discussion Forum, answering the following questions:

   Which ghost stories did you find particularly engaging …funny …moving …sad …even irritable?

   Follow-up Question: How do the ghosts' feelings — their anger, resentments, and desires — reflect the events of their previous lives?

Adapted from (Lundquist, 2017).

# Anne Frank House

*Lesson Plan for History of Fashion*

## OVERVIEW & PURPOSE

Students will engage in a virtual tour of Anne Frank House's Secret Annex. They will uncover details of her story through the tour, and will consider what the experience of living in hiding from the nazis was like.

## OBJECTIVE

Students will analyze the tour and will evaluate the ways in which the little details of their life reflect the larger experience. They will reflect on what life in the Secret Annex was like.

### INTRODUCTION

Students will watch a video about Anne Frank, and will be introduced to the tour. They will be encouraged to examine details and to consider the way that the details found in the space speak about the inhabitants and their experiences.

## ACTIVITY

Discussion of World War II and Anne Frank

Introduction to the tour and how to access through VR or online.

Introduction to VR equipment

Discussion of safety protocols and boundaries

Faculty will monitor for safety and record reactions

Post VR verbal wellness check

Students will participate in the Discussion Forum, answering the following questions:

Use the discussion thread to respond to the following questions:

• Look around the space. What words would you use to describe the space?

Otto, Edith and Margot Frank's room

• Look around the room. What can you see?

• What does the room tell you about the Frank family?

• Click on the icon that describes a day in the Secret Annex.

Adapted from (Lundquist, 2017).

# Traveling While Black

*Lesson Plan for History of Fashion*

## OVERVIEW & PURPOSE

Students will watch the 360 video, Traveling While Black (New York Times, 2016) as a springboard for discussion surrounding racism as it was experienced in the 1950's and 60's and the forms that it takes today. They will consider the question:

*How have race and racism impacted African Americans' ability to move freely throughout the United States in the past and today?*

### OBJECTIVE

Students will discuss the movie, and will relate issues presented to their own lived experience. They will analyze the way that similar themes are present both in history and in modern times, and whether there has been progress or change. While not related to fashion per se, the historic reincactments give a sense of the look and zeitgeist of this era.

#### INTRODUCTION

*"Traveling While Black" is a 20-minute 360 degree video that touches on themes of racism and resistance. It tells the history of "The Negro Motorist Green Book," a travel guide that listed restaurants, bars, hotels and private homes that welcomed African-American travelers across the country in the 1940s, 1950s and early 1960s. The film*

*explores the complicated history of "The Green Book" and the dangers and humiliations that black travelers still face today." (Proulx, 2019).*

## ACTIVITY

Discussion of Civil Rights Era

Introduction to the video and how to access through VR or online.

Introduction to VR equipment

Discussion of safety protocols and boundaries

Faculty will monitor for safety and record reactions.

Post VR verbal wellness check

Students will participate in the Discussion Forum.

After watching, think about these questions:

• What moments in this film stood out for you? Why?

• Were there any surprises? Anything that challenged what you know — or thought you knew?

• What messages, emotions or ideas will you take away from this film? Why?

• What questions do you still have?

An additional challenge: What connections can you make between this film and your own life or experience? Why? Does this film remind you of anything else you've read or seen? If so, how and why?

After you have posted, try reading back to see what others have said, then respond to someone else by posting another comment. Use the "Reply" button or the @ symbol to address that student directly.

(adapted from Proulx, 2019)

# APPENDIX E

## STUDENT INTERVIEW FRAMEWORK - IMMERSION

These are the interview questions, in no order. Due to the exploratory and phenomenological nature of this study, the questions will be used as a framework for the interviews. Not all questions may be addressed, and the researcher will not be bound to them when a better line of questioning arises from the interviews.

Briefing: *"Thank you for agreeing to participate in this study of educational uses for Virtual Reality. I am going to ask some questions about the three experiences that you engaged in over the course of the semester. Feel free to add any information to the conversation that you think is relevant, and, of course, you don't need to answer anything that you don't wish to. These experiences, although related to your History of Fashion class, are strictly optional enrichment activities and your involvement, either in the VR experiences or the interview will have no effect on your grade in the course. I am interested in your perceptions of the experiences and the relative value that you would ascribe to the use of the technology."*

1. What did/didn't you like about the VR videos/app? Can you describe your experiences?

2. To what extent did you feel as though you were actually there, in the space?

3. Did you enjoy the experiences? Were there situations in which you felt unexpectedly positive/neutral/negative feelings (e.g., joy, enthusiasm, excitement, fear, anxiety)?

4. If you liked one more than the others, Why was that?

5. Do you feel that the VR experience helped you to connect with the subjects more than other media like a video might? Why or why not?

6. Did you experience any problems in using the VR viewer? Can you describe them? How did you handle the problems?

7. Would you like to have more experiences like this in the future? Why or why not?

Debriefing: "*Thank you for sharing your perceptions and your input! When the study is complete, I will be happy to share the results with you. Feel free to reach out if any questions or further thoughts occur to you."*

# APPENDIX F

## STUDENT INTERVIEW FRAMEWORK - AGENCY

These are the interview questions, in no particular order. Due to the exploratory and phenomenological nature of this study, the questions will be used as a framework for the interviews. Not all questions may be addressed, and the researcher will not be bound to them when a better line of questioning arises from the interviews.

Briefing: *"Thank you for agreeing to participate in this study of educational uses for Virtual Reality. I am going to ask some questions about the three experiences that you engaged in over the course of the semester. Feel free to add any information to the conversation that you think is relevant, and, of course, you don't need to answer anything that you don't wish to. This experience, although related to your Fashion Design class, are strictly optional enrichment activities and your involvement, either in the VR experiences or the interview will have no effect on your grade in the course. I am interested in your perceptions of the experiences and the relative value that you would ascribe to the use of the technology."*

1. What did/didn't you like about the VR apps? Can you describe your experiences?

2. Did you prefer Tilt Brush or Gravity Sketch? Why?

3. Did the ability to interact with the virtual space have an effect upon your design ideation? In what way? In what ways is it different from the experience of designing in 2D (on paper or on the computer)?

3. Did you enjoy the experiences? Why or why not?

4. Do you think that thes experiences are transferable to designing actual garments or accessories? Why or why not?

5. Did you experience any problems in using the VR viewer? Can you describe them? How did you handle the problems?

7. Would you like to have more experiences like this in the future? Why or why not?

Debriefing: "*Thank you for sharing your perceptions and your input! When the study is complete, I will be happy to share the results with you. Feel free to reach out if any questions or further thoughts occur to you*

# APPENDIX G

# VR INITIATION PROTOCOL

Participant: _____ Date: _____

*Soft-Talk:*

Experience/comfort with technology:

Experience Level: _____ Knowledge Level: _____

Expectations of VR:

**Shop-Talk/Housekeeping**

Intro to the Research Protocol

You will be encountering various virtual reality experiences. It is the goal of this research to

observe and document these initial human encounters with virtual reality technology.

While you are in the headset I'm going to ask you to, as much as possible, talk out loud your

experience. This will be a big help for the research. Whatever you feel is relevant to be saying

is what I want to hear.

Throughout the session I will be asking you some deliberately naive questions, this is to make

sure I'm not making assumptions about your experience.

**Hardware Intro**

Controllers: these are your controllers. (Model holding one, extend it in an offering gesture for

the participant to take hold of it. If they do not take it, ask them to take hold of the controller)

Trigger: Your trigger button here is commonly used throughout the applications.

Grip Buttons: Now, hold your controller and then grip it hard. On the side of your controller are two buttons called your “grip buttons”. They trigger when you grip your hand tight enough.

Menu Buttons: There are also two menu buttons, which you will not need to use during the experience but may be needed to adjust volume while you’re in applications. There is the menu button which will bring up menu’s of individual applications, like settings, options, etc.

The system button will bring you to the VR system menu.
You cann change your volume in the bottom of your headset by adjusting a slider.

Headset/Head-Mounted Display:

1. demonstrate putting the headset on (glasses? focusing?)
2. demonstrate removing the headset

**Safety**

Emergency / Trauma / Bad-Trip Protocol

While you are in the headset you will be experiencing sensory inputs that simulate immersion

and can trigger trauma and sensory sensitivities. These experiences can stimulate nausea, vertigo and dizziness.

At anytime, for any reason, you can remove the headset.

Which might seem strange to suggest but the immersion that the system simulates can make

this less obvious of an option while within the virtual environments.

Chaperone Wall / Green Safety Wall

You might be wondering, how do I not run into the walls?

While you wear the headset and approach the physical boundaries of the room, a blue gridded wall will appear and outline your physical play-space. When you first enter the space, you will get a chance to explore these boundaries with the headset on.

**Consensual Touch**

While you have the headset on, no one will ever touch your body or even enter your play-space

without your explicit permission. This is to ensure both physical and psychological safety throughout the session. While you are in the headset, no one will enter your physical play-space or touch you without your express consent.

At times, it may be necessary for me to help you adjust in the space.

If/when this situation happens, I will first ask, “May I enter the play space?” Please give me verbal consent in the moment if this is okay. I will then also ask, “Is it alright if I touch... for

example... your left hand, to reposition your thumb?”

And will again require expressed consent before touching your body. If you do not respond, I will not enter your play-space or touch your body.

**Pretending**

Have you ever seen someone experience VR?

I’d like you to pick up the controllers (without the headset) and show me what you think you

might be doing in like 10 minutes while in VR.

**Putting it on for the first time**

(Quickly re-demonstrate how to put the headset on, eyes first, then strap, loosen the strap all

the way before giving it to them.)

**First Steps**

[15 Minutes]

(Prompt users sparingly, let them drift in this first-time experience. Remind them softly & kindly vocalize their experience, whatever they find relevant.

Do NOT prompt them with anything like,

“What do you see.” Or anything that privileges sensory descriptors as this often already

happens, and working to gather more psychological/conscious/lucid responses is necessary

early. Always lead with Participant? Then your prompt/question.)

Participant? I’d like to remind you to please try to vocalize your experience, whatever you find

relevant.

Participant? Where are you?

Participant? What are you doing?

**Removing the HMD**

Okay, we are about to end the session. Before this, I'd like to ask you to tell me about your

first time in VR.

Before we take off the headset, I'd like to remind you to please talk out loud about your

experience, even now and while you remove the headset.

Go ahead and remove your headset.

I'd like to just sit here and chat for a sec about what that was like for you, what you're thinking

about now, anything that's on your mind at this point.

Adapted from (Euclide, 2018). www.eeuclide.com

# APPENDIX H

## QUESTIONS FOR ARTS-BASED INQUIRY

Please describe the inspiration for this piece. What were you intending to create or communicate?

Please talk about the process of creating in virtual reality. Did you enjoy it? What were the challenges?

Would you be interested in replicating your virtual design in real life? Why or why not**?**

# APPENDIX I

## UNIVERSITY APPROVAL FOR HUMAN SUBJECT TESTING

**INSTRUCTIONS**

Complete each section of the application. Based on the nature of the research being proposed some sections may not apply. Those sections can be marked as N/A. Remember that the IRB is concerned with risks and benefits to the research participant and your responses should clearly reflect these issues. You (the PI) need to retain the most recent protocol document for future revisions. Questions can be addressed to research.integrity@asu.edu. **PIs are strongly encouraged to complete this application with words and terms used to describe the protocol is geared towards someone not specialized in the PI's area of expertise.**

IRB: 1. Protocol Title: Virtual Reality for Fashion Design Education

**IRB: 2. Background and Objectives**

2.1 List the specific aims or research questions in 300 words or less.

2.2 Refer to findings relevant to the risks and benefits to participants in the proposed research.

2.3 Identify any past studies by ID number that are related to this study. If the work was done elsewhere, indicate the location.

**TIPS for streamlining the review time:**

✓ Two paragraphs or less is recommended.

✓ Do not submit sections of funded grants or similar. The IRB will request additional information, if needed.

Response:

**2.1** This study will explore the potential of Virtual Reality (VR) for fashion design studies in an associate's degree program at a college in Pennsylvania. The research question is: How do students view Virtual Reality as an addition to the Fashion Design curriculum? The student participants will use virtual reality experiences as an adjunct to the course of study in an introductory Fashion Design and Merchandising course. The study will gather the observations, impressions, and opinions of the participating students to identify whether they perceive VR as useful in enhancing engagement and/or assisting in design ideation. The study is framed as phenomenological exploration, and will rely upon student observations, interviews and creative work as its primary data.

2.2 This study is low risk and action research based and is intended to support the local context.

**2.3** A previous pilot study was conducted in Spring 2022. The ID number is STUDY00015257

**IRB: 3. Data Use - What are the intended uses of the data generated from this project?**

Examples include: Dissertation, thesis, undergraduate project**,** publication/journal article, conferences/presentations**,** results released to agency, organization**,** employer, or school**.** If other, then describe.

Response:

The data will be used in a dissertation, presentations, and publications. Results may be released to the institution and to participants.

**IRB: 4. Inclusion and Exclusion Criteria**

4.1 List criteria that define who will be included or excluded in your final sample.

Indicate if each of the following special (vulnerable/protected) populations is included or excluded:

- Minors (under 18)
- Adults who are unable to consent (impaired decision-making capacity)
- Prisoners
- Economically or educationally disadvantaged individuals

4.2 If not obvious, what is the rationale for the exclusion of special populations?

4.3 What procedures will be used to determine inclusion/exclusion of special populations?

**TIPS for streamlining the review time.**

✓ Research involving only data analyses should only describe variables included in the dataset that will be used.

✓ For any research which includes or may likely include children/minors or adults unable to consent, review content [here]

✓ For research targeting Native Americans or populations with a high Native American demographic, or on or near tribal lands, review content [here]

For research involving minors on campus, review content [here]

Response:

Participants will include students in the Introduction to Fashion Design and Merchandising course at Harcum College. Minors, adults who cannot consent, prisoners, undocumented individuals, and non-English speakers will not participate in the study. Native Americans may participate, but they are not being specifically recruited.

**IRB: 5. Number of Participants**

Indicate the total number of individuals you expect to recruit and enroll. For secondary data analyses, the response should reflect the number of cases in the dataset.

Response:

The total number of participants expected to be recruited is 4 students.

**IRB: 6. Recruitment Methods**

6.1 Identify who will be doing the recruitment and consenting of participants.

6.2 Identify when, where, and how potential participants will be identified, recruited, and consented.

6.3 Name materials that will be used (e.g., recruitment materials such as emails, flyers, advertisements, etc.) Please upload each recruitment material as a separate document, Name the document: recruitment_methods_email/flyer/advertisement_dd-mm-yyyy

6.4 Describe the procedures relevant to using materials (e.g., consent form).

✓

Response:
The Co-PI will conduct the recruitment process. They will recruit participants online by email using a Recruitment Consent letter, which is attached.

As the CO-PI and researcher, I will be an insider, collaborating with the participants in a spirit of exploration. As the Director of Fashion Programs at Harcum, I am responsible for designing the curriculum, mentoring faculty, and I teach several classes a semester. I will not be teaching the course that is related to the research but will oversee the participants during the VR experiences. The proposed study will require the support of two faculty members, those who are teaching the course. who will receive training in the use of VR, and who have previously (in an initial study I conducted), expressed enthusiasm for the project. I will administer the training to faculty and as well as facilitating the VR-based experiences for the students. The other faculty members will assist as needed.

IRB: **7. Study Procedures**

7.1 List research procedure step by step (e.g., interventions, surveys, focus groups, observations, lab procedures, secondary data collection, accessing student or other records for research purposes, and follow-ups). Upload one attachment, dated, with all the materials relevant to this section. Name the document: supporting documents dd-mm-yyyy

7.2 For each procedure listed, describe **who** will be conducting it, **where** it will be performed, **how long** is participation in each procedure, and **how/what data** will be collected in each procedure.

7.3 Report the total period and span of time for the procedures (if applicable the timeline for follow ups).

7.4 For secondary data analyses, identify if it is a public dataset (please include a weblink where the data will be accessed from, if applicable). If not, describe the contents of the dataset, how it will be accessed, and attach data use agreement(s) if relevant.

**TIPS for streamlining the review time.**

- ✓ Ensure that research materials and procedures are explicitly connected to the articulated aims or research questions (from section 2 above).
- ✓ In some cases, a table enumerating the name of the measures, corresponding citation (if any), number of items, sources of data, time/wave if a repeated measures design can help the IRB streamline the review time.

Response:

**Intervention.**

The study will take place during the Fall 2022 semester. Four students will be recruited with an email invitation to participate. There are usually 15 to 18 students in each class, and if more than four volunteer, the participants will be selected at random. Selected participants will answer a pre-screening questionnaire to mitigate the potential for problems like cyber-sickness. The virtual reality experiences will be related to the material in a first semester introductory course, FSH104 Introduction to Fashion Design and Merchandising. This course seemed like a good fit for the study – as it is an introductory course that covers both theories and concepts related to fashion and creative design activities and application each week. In fact, it is a course that meets twice a week – the first day is a Theory class and the second is a Studio class. This course seems to provide an opportunity to examine both the passive watching experiences related to the theory part of the course and the active creative sessions relating to the design part of the course.

This intervention is designed to function as an enriching supplement to the concepts being taught in the course. It will take place during time that is dedicated to working in the studio. Students that are not participants will be engaged in similar activities – i.e. watching a video, designing a dress – but will not be using VR.

To examine the effect that the affordance of immersion may have upon perceived level of engagement, the volunteers will use virtual reality to view three videos related to the course material in FSH104 Introduction to Fashion Design and Merchandising. The two videos, British Fashion Icons in 360, and Coco Chanel, the Little Black Dress, will be embedded throughout the semester. The students will report on their perception of the intervention and evaluate its value as an addition to the FSH104 Introduction to Fashion Design and Merchandising class. Four student volunteers will be recruited through an email invitation. Each student will be assigned their own unit to use over the course of the semester.

The potential participants will be first-semester students, and as part of this introductory course, they will be learning about the elements and principles of design: shape, proportion, color, texture, movement, emphasis and balance. The virtual reality-assisted creative experiences will be explorations of these principles using the app *Tilt brush* (2019). Later in the semester, they will use *Gravity sketch* (2019), to design an accessory. *These* will not be graded assignments, and participation will be completely voluntary. In the case of both the immersion and creative experiences, the material will be related to the topic being studied in the course that week. They will reflect the activities that the students not participating in the study will be doing, but using VR tools instead of analog art supplies or a computer.

Participant volunteers will be pre-screened to determine whether they are at risk of adverse effects from the virtual reality experience. The pre-screening questionnaire is attached

The participants will use Oculus Quest VR viewers, with head-mounted displays (HMD) and hand trackers The space in which the experiences will take place is a large, open atrium area that is free of furniture and obstacles. The virtual barriers will have been created in advance, and the participants will be monitored throughout the immersions. The immersions will include both passive viewing experiences and applications that involve standing and moving around the space. A 6x6 foot "guardian barrier" will be created within the HMDs that will be visible to the users. The participants will be monitored by the CoPI during the immersions, who will verbally check in with them during the experiences.

The student participants will use the VR viewers in two different ways. The first, passive viewing experiences will study the effect that the affordance of immersion has upon engagement in two fashion based 360 videos from Google Arts and Culture. The second kind of experience will be active, in which the participants will be creating a garment and an accessory within the virtual space. The four participants will be instructed in the use of the viewers prior to beginning and will engage in an orientation within the headsets. They will be monitored throughout the experience by the CoPI to ensure that they are feeling alright.

The first session will begin with the orientation. Following the orientation, students will be directed to view 2 different virtual reality experiences that immerse the viewer in various fashion related videos. The first, *Fashioning the Future with British Icons* (2019) is 4.37 minutes long. The second, *How did the Little Black Dress become an Icon* (2017), is 2.49 minutes long. These videos will be shown during Week 4 of the semester and are related to the theory topic in class that week – an overview of modern fashion history. Students in the class that are NOT participants will also view the videos. However, they will only view them online.

Video of the students using the VR headsets will be recorded with the consent of the participants. The students will be observed, and field notes collected on whether their behavior indicates a greater or lesser degree of immersion.

Following the immersion experiences, the participants will participate in two creative VR experiences, with the directive to design a gown and a shoe. The virtual experiences will take place during class periods in the fifth and fifteenth weeks of the semester and will relate to content in the course. In the fifth week, we will be discussing the Met Gala and Avant Garde design as a prompt before creating the gown. In the fifteenth week, we will be discussing accessories design in the class. Students that are NOT participants will also create a gown and a shoe design but will use traditional media. None of these are graded assignments.

The design participants will work in the large lower atrium and be carefully observed by the researcher to ensure physical safety within the workspace. As with the previous semester's research, interested students will fill out a pre-screening questionnaire to rule out conditions that may make virtual reality

uncomfortable for them (attached). They will have had an orientation already prior to the immersion experiences. In the second session, the participants will be given a creative brief and will work within the HMD's. They will be given as much or little time as they would like to spend, up to 20 minutes.

The total amount of time spent over the course of all three experiences should be as follows:

Orientation 15 minutes
Immersion experiences 6.86 minutes
Creative experiences up to 40 minutes (20 minutes for each)

Total: Approximately 61.82 minutes over 3 sessions

(This is not an exact number, as some people spend longer in the orientation or in finding their way through experiences.)

Following each experience, the CoPI will check in with the participants again to ensure that they are not experiencing adverse effects; asking "Are you feeling okay after the VR experience? Are you experiencing a headache, dizziness, nausea, vision problems, or sudden fatigue?"

The working sessions within the VR may be recorded with the participants' consent. The researchers will take notes throughout the process and the participants will be encouraged to think aloud. Following the creative session, the student work will be printed for viewing by the class and a discussion of their design ideas and process will occur. The students will be interviewed one-on-one to discover their thoughts on the VR curriculum, and all participants will be asked to reflect upon the experience in a journal each time they engage with the VR unit. The same protocol will be followed for each session. At the conclusion of the semester the participants will meet as a group to discuss their thoughts regarding incorporation of VR into future curricula.

While related to the material discussed in class, the VR experiences will not necessarily take place during class time. So, no parts of the study are required for class participation, nor will there be any grade or assessment associated with the use of the viewers, either for students that chose to participate in the study or those that do not.

The four participants will be the same students for all experiences. They will each have a dedicated viewer and handset to avoid contaminants. The participants will engage in the planned VR experiences as part of the study but will be permitted to use them outside of the experiences. When using the units, the students will have to check them out, and will be monitored for safety. They will be asked to do a short reflection after each use of the VR units.

**Interviews and Journals.** At the conclusion of the course, students will describe their experiences through open ended interviews and in their

journals. The interviews are expected to take about 20 minutes each. They will be videotaped with the participants' consent. The interview questions are attached but provide only a very loose framework. The students will be encouraged to describe their experiences and conclusions about the VR experience in their own words.

**Discussion Forums:**

There will be an expectation that all student will, as part of the course, participate in a discussion forum about the 360 videos whether they elected to use VR or watch them on the computer.

**Videotaped sessions:**
The students' activities in the virtual environment will be recorded both from outside and from within the headsets. Only the creative activities will be recorded from within the virtual environment.

**Arts Based Inquiry:**
At the close of the Fall semester, students will choose one of the pieces of virtual design that they created during the course of the semester. If they desire, these will be displayed at the end of the semester exhibition, and/or included in this study. The participants will be asked to write about their work using the framework that is attached.

British Fashion Council. (2016). *Fashioning the Future with British Icons*. *YouTube*. Retrieved August 10, 2022, from https://youtu.be/JWErvj6Okm0.

Google Arts and Culture. (2017). *How did the Little Black Dress become an Icon?* *YouTube*. Retrieved August 10, 2022, from https://youtu.be/N6kovrOuL5g.

**IRB: 8. Compensation**

**8.1 Report the amount and timing of any compensation or credit to participants.**

**8.2 Identify the source of the funds to compensate participants.**

**8.3 Justify that the compensation to participants to indicate it is reasonable and/or how the compensation amount was determined.**

**8.4 Describe the procedures for distributing the compensation or assigning the credit to participants.**

**TIPS for streamlining the review time.**

- ✓ If partial compensation or credit will be given or if completion of all elements is required, explain the rationale or a plan to avoid coercion
- ✓ For extra or course credit guidance, see "Research on educational programs or in classrooms" on the following page: https://researchintegrity.asu.edu/human-subjects/special-considerations.
- ✓ For compensation over $100.00 and other institutional financial policies, review "Research Subject Compensation" at: https://researchintegrity.asu.edu/human-subjects/special-considerations for more information.

Response:

No compensation or credit will be provided to participants

**IRB: 9. Risk to Participants**

List the reasonably foreseeable risks, discomforts, or inconveniences related to participation in the research.

**TIPS for streamlining the review time.**

- ✓ Consider the broad definition of "minimal risk" as the probability and magnitude of harm or discomfort anticipated in the research that are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.
- ✓ Consider physical, psychological, social, legal, and economic risks.
- ✓ If there are risks, clearly describe the plan for mitigating the identified risks.

Response:

There are potential risks to using Virtual Reality that include:
These include:

--Cybersickness
--Triggering of seizures or other conditions due to visual effects
--Injury from tripping, falling, or colliding with physical objects
--Contagions from sharing head-mounted displays

These risks will be managed with a pre-screening questionnaire, wellness checks throughout the experience and a verbal check upon completion of the intervention. The participants will be carefully observed while immersed. The area is free of tripping hazards, the boundaries will be created in advance and the experiences will be seated.

Each of the participants will have a dedicated VR unit and will use the same one each time. They are equipped with removable washable silicone mask covers, which will be washed and sanitized after each use. The handsets will also be sanitized after each use, and the head-mounted displays subject to deep cleaning.

**IRB: 10. Potential Direct Benefits to Participants**

List the potential direct benefits to research participants. If there are risks noted in 9 (above), articulated benefits should outweigh such risks. These benefits are not to society or others not considered participants in the proposed research. Indicate if there is no direct benefit. A direct benefit comes as a direct result of the subject's participation in the research. An indirect benefit may be incidental to the subject's participation. Do not include compensation as a benefit.

Response:

Student will have an opportunity to explore new tools for fashion design and to reflect upon the potential uses of VR for design education.

IRB: **11. Privacy and Confidentiality**

Indicate the steps that will be taken to protect the participant's privacy.

11.1 Identify who will have **access to the data**.
11.2 Identify where, how, and how long data will be **stored** (e.g. ASU secure server, ASU cloud storage,
filing cabinets).
11.3 Describe the procedures for **sharing, managing and destroying data**.
11.4 Describe any special measures to **protect** any extremely sensitive data (e.g. password protection, encryption, certificates of confidentiality, separation of identifiers and data, secured storage, etc.).
11.5 Describe how any **audio or video recordings** will be managed, secured, and/or de-identified.
11.6 Describe how will any signed consent, assent, and/or parental permission forms be secured and how long they will be maintained. These forms should separate from the rest of the study data.
11.7 Describe how any data will be **de-identified**, linked or tracked (e.g. master-list, contact list, reproducible participant ID, randomized ID, etc.). Outline the specific procedures and processes that will be followed.
11.8 Describe any and all identifying or contact information that will be collected for any reason during the course of the study and how it will be secured or protected. This includes contact information collected for follow-up, compensation, linking data, or recruitment.
11.9 For studies accessing existing data sets, clearly describe whether or not the data requires a Data Use Agreement or any other contracts/agreements to access it for research purposes.
11.10 For any data that may be covered under FERPA (student grades, etc.) additional information and requirements is available at https://researchintegrity.asu.edu/human-subjects/special-considerations.

Response:
11.1 Only the PI and Co-PI will have access to the data.
11.2 The data will be stored on a password-protected computer for a period of four years and then deleted or destroyed.
11.3 Only the PI and Co-PI will need access to the data. If it needs to be shared, it will be zipped and sent with password protection via DropBox.
11.4 Sensitive data will be stored on a password-protected computer for a period of four years and then deleted or destroyed.
11.5 Audio and video files will be stored on a password protected computer. Audio recordings will have deleted from the recording device after they have been transferred to the password-protected computer. Transcripts will be made of the recordings Pseudonyms will be used for each subject, and the recordings will only be used with the participants' informed consent.
11.6 Consent forms will be stored on a password-protected computer for a period of four years and then deleted or destroyed.
11.7 With only four participants, this is not as great an issue. Their data will be stored on a password protected computer, and contact information will not be kept in the same file as the data from the study.

**IRB: 12. Consent**
Describe the procedures that will be used to obtain consent or assent (and/or parental permission).

12.1 Who will be responsible for consenting participants?
12.2 Where will the consent process take place?
12.3 How will the consent be obtained (e.g., verbal, digital signature)?

**TIPS for streamlining the review time.**

- ✓ If participants who do not speak English will be enrolled, describe the process to ensure that the oral and/or written information provided to those participants will be in their preferred language. Indicate the language that will be used by those obtaining consent. For translation requirements, see Translating documents and materials under https://researchintegrity.asu.edu/human-subjects/protocol-submission
- ✓ Translated consent forms should be submitted after the English is version of all relevant materials are approved. Alternatively, submit translation certification letter.
- ✓ **If a waiver for the informed consent process is requested, justify the waiver in terms of each of the following: (a) The research involves no more than minimal risk to the subjects; (b) The waiver or alteration will not adversely affect the rights and welfare of the subjects; (c) The research could not practicably be carried out without the waiver or alteration; and (d) Whenever appropriate, the subjects will be provided with additional pertinent information after participation.** Studies involving confidential, one time, or anonymous data need not justify a waiver. A verbal consent or implied consent after reading a cover letter is sufficient.
- ✓ ASU consent templates are [here].
- ✓ Consents and related materials need to be congruent with the content of the application.

Response:
The Co-PI will conduct the consent process. Participants that agree to be part of the study will sign the Consent Form indicating their consent to both the VR experiences and the follow-up data gathering: journals, discussion forums, interviews, videotaped sessions and design work created in VR..

**IRB: 13. Site(s) or locations where research will be conducted.**
List the sites or locations where interactions with participants will occur-

- Identify where research procedures will be performed.
- For research conducted outside of the ASU describe:
  - Site-specific regulations or customs affecting the research.
  - Local scientific and ethical review structures in place.
- For research conducted outside of the United States/United States Territories describe:
  - Safeguards to ensure participants are protected.
- For information on international research, review the content [here].

For research conducted with secondary data (archived data):

- List what data will be collected and from where.
- Describe whether or not the data requires a Data Use Agreement or any other contracts/agreements to access it for research purposes.
- For any data that may be covered under FERPA (student grades, etc.) additional information and requirements is available [here].
- For any data that may be covered under FERPA (student grades, homework assignments, student ID numbers etc.), additional information and requirements is available [here].

**Response:**

The VR interventions will take place at Harcum College, in the Art & Design Building, lower level atrium, at 270 Bryn Mawr Avenue, Bryn Mawr, PA 19010. There are no site specific regulations effecting the research and the college does not have an IRB. I have attached the email granting permission for the research to take place.

IRB: **14. Human Subjects Certification from Training.**

Provide the names of the members of the research team.

ASU affiliated individuals do not need attach Certificates. Non-ASU investigators and research team members anticipated to manage data and/or interact with participants, need to provide the most recent CITI training for human participants available at www.citiprogram.org. Certificates are valid for 4 years.

**TIPS for streamlining the review time.**

- ✓ If any of the study team members have not completed training through ASU's CITI training (i.e. they completed training at another university), copies of their completion reports will need to be uploaded when you submit.
- ✓ For any team members who are affiliated with another institution, please see "Collaborating with other institutions" [here]
- ✓ The IRB will verify that team members have completed IRB training. Details on how to complete IRB CITI training through ASU are [here]

Response:
Julian G. Crooks, Co-PI, CITI Training Certificate on file
Dr. Brian Nelson, PI, CITI Training Certificate on file

**General Tips:**

- Have all members of the research team complete IRB training before submitting.
- Ensure that all your instruments, recruitment materials, study instruments, and consent forms are submitted via ERA when you submit your protocol document. Templates are [here]
- Submit a complete protocol. Don't ask questions in the protocol – submit with your best option and, if not appropriate, revisions will be requested.
- If your study has undeveloped phases, clearly indicate in the protocol document that the details and materials for those phases will be submitted via a modification when ready.
- Review all materials for consistency. Ensure that the procedures, lengths of participation, dates, etc., are consistent across all the materials you submit for review.
- Only ASU faculty, full time staff may serve as the PI. Students may prepare the submission by listing the faculty member as the PI. The submit button will only be visible to the PI.
- Information on how and what to submit with your study in ERA is [here]. Note that if you are a student, you will need to have your Principal Investigator submit.
- For details on how to submit this document as part of a study for review and approval by the ASU IRB, visit https://researchintegrity.asu.edu/human-subjects/protocol-submission.