Virtual Reality, A Design Methodology
WORKSHOP SUMMARY AND OBSERVATIONS

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1. INTRODUCTION

Empathy is at the core of human centered design and design thinking. Being able to put oneself into someone else's shoes, truly immersing into the subject matter, discovering the actual issues to be solved is crucial to successful problem finding and problem solving. Educators aim to provide an educational environment that fosters empathy for diverse environments including environments where access to people and contexts is restricted, limited, or too distant. The research team proposes emerging technologies, such as virtual reality (VR), as a supportive tool for creating empathy for the users and environments people are designing for.

The goal is to empower design students with new design methodologies driven by VR to best identify and frame problems to be solved, understand the context and situation, and find the right design solutions in a highly technological and evermore complex world.

Therefore, Virtual Reality as a Design Research Methodology was implemented in a workshop framework to provide the opportunity for a diverse group of students in Industrial Design to come together and test the novel role of virtual reality in the creation of empathy in the front end of the design process. The objective was to give students an opportunity to experience virtual reality as a design research method in order to improve both the level of empathy developed by the designer for the end user, and test different types of media to be used for virtual reality experiences. Virtual reality experiences might have the potential to generate research results and designs that are better honed to end user's needs, and of more reliable quality. The findings of the workshop have potentially wide ranging implications for design research in particular and design education in general.

Designers are continuously looking for new methodologies to develop a stronger sense of empathy with their end user; ultimately designing more meaningful experiences for the users. Historically this often requires many site visits, interviews, and detailed documentation of the scenario. These data points are then relied upon throughout the design process to inform the final solution and outcomes. By utilizing Virtual Reality tools and techniques, the designer will be able to "put themselves in another's shoes". More closely identifying with the end user, the user's struggles, and the problems they face. Virtual Reality is in the midst of a re-emergence in current day entertainment and experiences. As technology and materials have become more accessible, the cost and proliferation of VR capable devices has grown exponentially over the last decade. Therefore, the research team constructed an experimental design charrette (workshop) in which to test the possibilities of implementing Virtual Reality experiences in the front end stages of design and design research. The workshop allowed the researchers the opportunity to begin to answer some of these questions:

How do we connect with spaces and people with limited or restricted access?

How do we design for a situation we have not experienced?

How do we develop true empathy for challenges of unprecedented magnitude?

2. WORKSHOP SUMMARY

The virtual reality workshop was provided in (2) three-hour sessions for 86 industrial design students ranging from sophomores to seniors attending college. The workshop began with a short introduction of the overall objectives to be tested and the environment the participants would be designing for. The virtual environment of focus for the workshop was the International Space Station (ISS). The selection was made based upon the idea that the ISS is an environment that cannot be accessed through what might be considered normal means of design research methodologies and data collection. Participants/Students in the first session were challenged to design personal hygiene solutions for micro-gravity aboard the ISS. The second session was divided in two, where one group was similarly challenged to design for personal hygiene, while the other group was challenged to design for injury avoidance aboard the ISS. With the help of contemporary media sources and a collaboration with an aerospace engineering PhD student researching Virtual Reality applications, the workshop utilized a virtual reality simulation model of the International Space Station, and 360-degree video footage of the International Space Station recorded by astronauts while aboard the station. With these two options for a virtual experience of the space station the workshop would offer students varying levels of "presence" in the space. *Presence is an internal psychological state and a form of visceral communication (Jerald, 2015)* The varied levels of presence would also offer the research group the opportunity to test two types of media and how those could help the viewer/designer develop empathy for the end user.

Figure 1: Research Group visual breakdown

In an effort to create control groups, students were divided into three research groups. Each group was provided a varying level of presence or immersion into the problem space. All groups had access to the traditional research packet (revolving around injury prevention and hygiene issues aboard the ISS), internet, and an ISS expert. The first group was allowed only the traditional methods of research. The second group was provided the same research packet, interview, and a 360-degree video tour of the international space station. These students were then able to view the tour through a low cost VR viewing headset (Google cardboard™). The third and final group was provided the same research packet and interview as the other groups; along with an immersive ISS simulation experience that was accessed through the Oculus Rift and HTC Vive head mounted VR displays. All of the groups had the same amount

of time for research and were given the opportunity to leverage the different experiences along with the research packet to help them identify the problem's context more fully. After the students researched and explored the problem space they were provided a worksheet in which to begin to "place" and formulate their opportunities for innovation. Each group then had one hour to ideate and refer back to either their research or their experience with either of the ISS simulations.

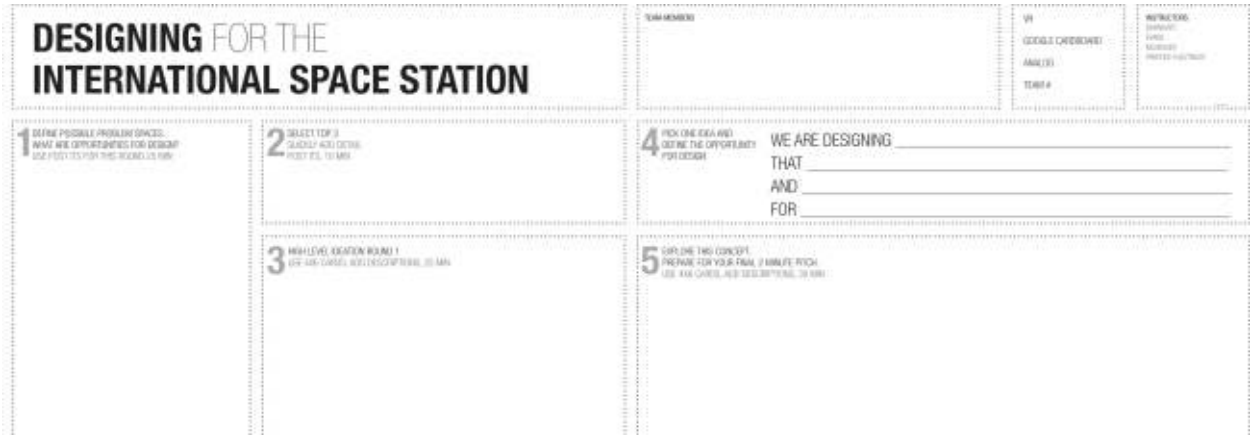

Figure 2: Workshop Worksheet for Participants

3. VARIABLES IDENTIFIED INFLUENCING THE WORKSHOP OUTCOMES

There were a number of variables that contributed to the workshop outcomes, and it is still to be seen if there is a positive or negative association with any or all of the variables. These variables include:

- Inconsistency of the question answer session with the aerospace engineering PhD student
- The time of day the workshops were run – session 1 was run in the morning session, session w was run in the afternoon
- The spaces in which the participants were working- open air vs closed spaces
- The learning curve and acclimation that is required for the VR head mounted displays
- Use of internet as another research resource

4. OBSERVATIONS AND OUTCOMES

Overall, the final concept solution drawings to the design challenges of the workshop were underwhelming. There was no strong differentiation between the different experiences of research methods, when examining the final concept outcomes. However, when looking at the problem statement and identification stages of the workshop, some observations can be made.

One observation made after reviewing the group worksheets, is that in nearly every case of VR exposure, both 360 video and the simulation, the participants clearly described zero gravity or low gravity as one of the main concerns in the problem definition stage. In contrast, the traditional research packet teams did not make the same explicit mention of the problem space. An inference can be made, due to the exposure of VR, the participants were faced with a zero gravity or micro-gravity experience, and therefore made it a point to identify that as a critical component to the problem space.

Another assumption can be made, that the traditional research packet teams, while they were aware of the problem of zero gravity, their omission of this component to the worksheets was due to inexperience, or making

Figure 3: Workshop outcomes

the assumption that viewers would know they were designing for zero gravity. Historically, these assumptions are commonly made by design students, and can lead to poor final results in their projects. When contrasting final concepts of the VR groups to the traditional groups, there seems to be a higher level of technicality to the concepts of the traditional research groups. Is this a product of the technical articles and data that were provided to them? Why, if the VR groups were provided the same materials and the addition of VR, might the concepts not be at a similar level of complexity and technicality? Could the students have been overwhelmed with the new experience and not provided enough time to digest the experience in order to leverage it as design research? Lastly, while exposing participants to the VR simulation experience, it was observed that there is a strong learning curve for navigation of the VR space. Controllers and identifiers within the simulation may not be intuitive enough at their present level of development. More exploration with these components is necessary for a better study. Further investigation of the outcomes of these experiences with VR is needed to develop the technology as a viable design research methodology.

5. NEXT STEPS

After completing the workshop and reflecting upon its outcomes, there are many more questions that need to be explored in this area to claim that Virtual Reality can be used effectively as a design research methodology. Is the complexity and technicality of the space station too foreign for this kind of study? Should the workshop present a problem space that is more relatable to the human experience? Inferences can be made as to how that may help the viewer develop a stronger sense of empathy for the end user in a problem scenario. The international space station is a very inhospitable climate, and unique in the way that people inhabit it. Experiences into more “grounded” experiences such as: homelessness,

aging, socioeconomic status, refugees, illness and disease, as well as stress and fear may be more enlightening. However, should VR one day be a strong enough or viable enough resource, the space station, foreign though it may be, should be within all designers' reach and capabilities. Future funding opportunities do exist with more relatable experiences; therefore, the research group will explore other experiences and contexts for design solutions. In addition, there is an opportunity to explore and investigate the effectiveness of different media experiences. Comparing and contrasting 360 video, traditional video, and VR simulation to name a few. Along with the varying media experiences, the team would also like to study the effectiveness of different viewing devices. Which devices lend themselves better to certain scenarios for design? The research team continues to modify and adjust the workshop to achieve fewer variables and a clear set of outcomes that can be evaluated.

6. CONCLUSION

In the beginning, the workshop was primarily testing the potential of VR in the early stages of design research. The way in which it was developed for this large of a group, the workshop tested: traditional research versus two different VR experiences or contexts (360 video and VR simulation).
Although, there may be no definitive conclusions on the effectiveness of VR at creating a stronger sense of empathy at the end of the workshop; the group will continue to refine the workshop and VR media experiences. The focus will be to find the right combination of experiences for empathy development. Research on VR and empathy together is in its infancy, and VR technology is making inroads in many prevalent arenas including: manufacturing, engineering, K-12 schools, and universities for testing. Researchers such as Elisabeth Sutherland in her 2015 MIT thesis have created new terms such as "staged empathy" to describe how VR engages empathy through techniques she has coined as "intentional looking" and "direct address" -- both only possible through a VR experience where the user has agency and immediate interaction with immersive context. Stanford University has done some recent research in 2016 showing that VR can impact empathy for homelessness, racial bias, and the elderly. With these ideas in mind and new developments surely on the way, the research group aims to continue to push the idea of VR as a methodology for design research forward.

7. APPENDIX

7.1. Workshop Timeline

Introduction to workshop and problem space: 5min
Group formation: 15min
Research with varying experiences: 1hr*
* Groups received roughly 20min to ask questions of the ISS expert
Problem Definition: 30min
Opportunity Selection and Ideation: 30min
Problem Statement Creation: < 5min
Concept Development: 40min
Present and Share outcomes: 20min
Total: 3hr 25min per session

7.2. Workshop Design Briefs

- Identify opportunities for design within the topic of personal hygiene in space.
- Identify viable solutions for nail clipping in space.
- Identify opportunities for design within the topic of injury avoidance in space.

7.3. Workshop Research Packet

L. Perry, and James E. Coston. "Analysis of Particulate and Fiber Debris Samples Returned from the International Space Station." *44th International Conference on Environmental Systems 13-17 July 2014, Tucson, Arizona*

Kasthuri Venkateswaran, Parag Vaishampayan, Jessica Cisneros, Duane L. Pierson, Scott O. Rogers, and Jay Perry. "International Space Station Environmental Microbiome — Microbial Inventories of ISS Filter Debris." *Appl Microbiol Biotechnol (2014) 98:6453–6466*

Steven F. Viegas, MD,, David Williams, MD,, Samuel Strauss, DO,, and Jonathan Clark, MD,. "Physical Demands and Injuries to the Upper Extremity Associated With the Space Program." *The Journal of Hand Surgery / Vol. 29A No. 3 May 2004*

Susmita Mohanty. "Design Concepts for Zero-G Whole Body Cleansing on ISS Alpha Part II: Individual Design Project." *International Space University*

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Sutherland, Elisabeth Ainsley. "Staged Empathy : Empathy and Visual Perception in Virtual Reality Systems." *DSpace@MIT*. Massachusetts Institute of Technology, 01 Jan. 2015. Web. 21 Mar. 2017.