Virtual Reality & Gamification for Pre-Occupancy Training

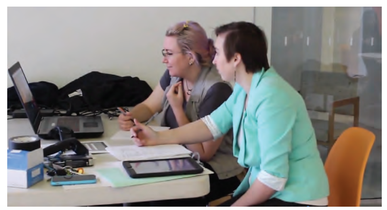
The objective of this research is to analyze and compare user behavior and learning retention via gamified and non-gamified virtual reality for use in pre-occupancy training. After completing trials for both gamified and non-gamified virtual reality we issued a standardized post-experience survey to collect data on what the participants learned, then compared and analyzed the results. The benefits of virtual reality and gamification have both been extensively studied and both suggest they are independently effective teaching tools. In our trials we have found that participants who went through the gamified virtual reality training were 50% more likely to come away with the desired learning objectives than participants who went through the non-gamified virtual reality. The benefits of virtual reality and gamification can be effectively combined and retain the benefits of that learning method in this situation. Based on our small sample and our literature review this technology can be used to train a more informed population regarding the effective operation of passive building systems.

HEATWAVE

Beginning in Fall of 2017 we began working with Opsis on the idea of a virtual reality pre-occupancy training tool. In the final version the objective of the game is to work smarter, not harder, and cool the room using as little energy as possible by fully utilizing the passive systems at your disposal. Items such as the fans and lights also add to your energy consumption, so there is an incentive to use the natural ventilation and daylighting to keep the energy meter in the green zone, which denotes a range of low energy use. You finish the experience in one of two ways: by attaining the proper temperature of the room or by running out of time.

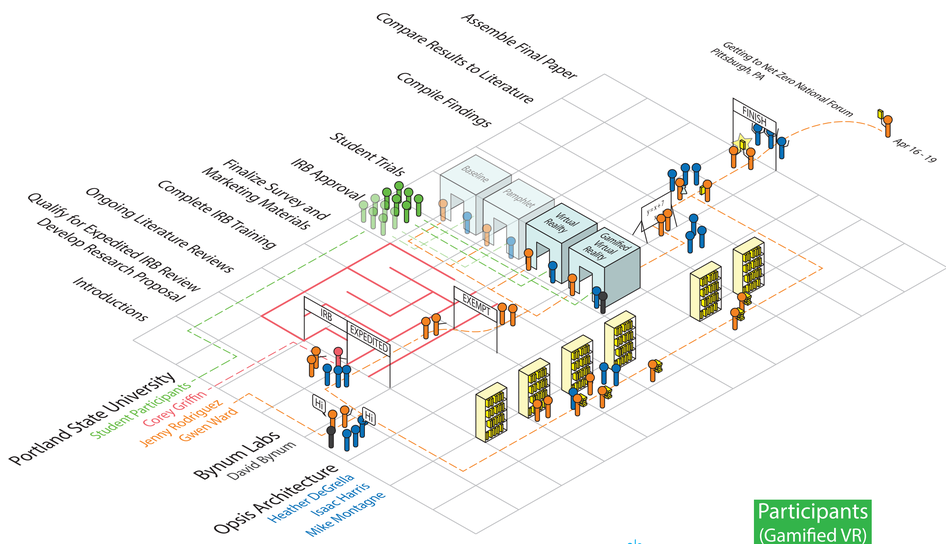
THE VR TRIALS

The trial was broken into two groups to test the gamified virtual reality and the non-gamified virtual reality and a standardized survey given to both groups was composed of open-ended questions prompting participants to list cooling features within the room, such as windows, doors, fans, shading devices, light switches and cross ventilation, as well as a plan of the room allowing participants to locate features in the space.



Using a foundation of of data gathered from literature reviews a trial of the **gamified virtual reality** game was lead at Portland State University. The participants were provided with a general overview of what to expect without elaborating on the learning objectives of the game. Using a secondary screen the user was monitored in play and observations were recorded of their interaction with the space and their level of success in balancing the rooms temperature and energy consumption. After finishing the simulation the participants were invited to fill out a survey that asked them to identify the cooling features of the space as well as to diagram the cross ventilation and locate the fans and light controls.

The **non-gamified virtual reality** experience required no extensive setup and trials were performed in social settings do to the difficulty of enlisting passerbys. The participants were handed an iPad as a viewer through which to view a 360 degree bubble view of the same classroom and were then asked to fill out an identical survey to those for the gamified trial.



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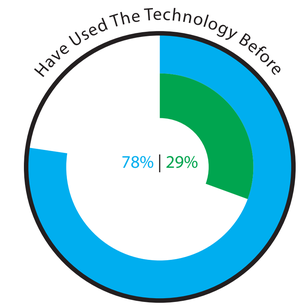

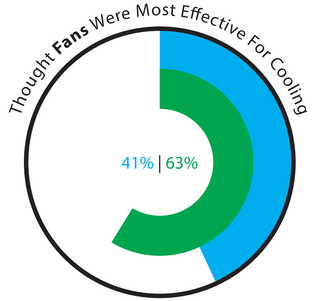

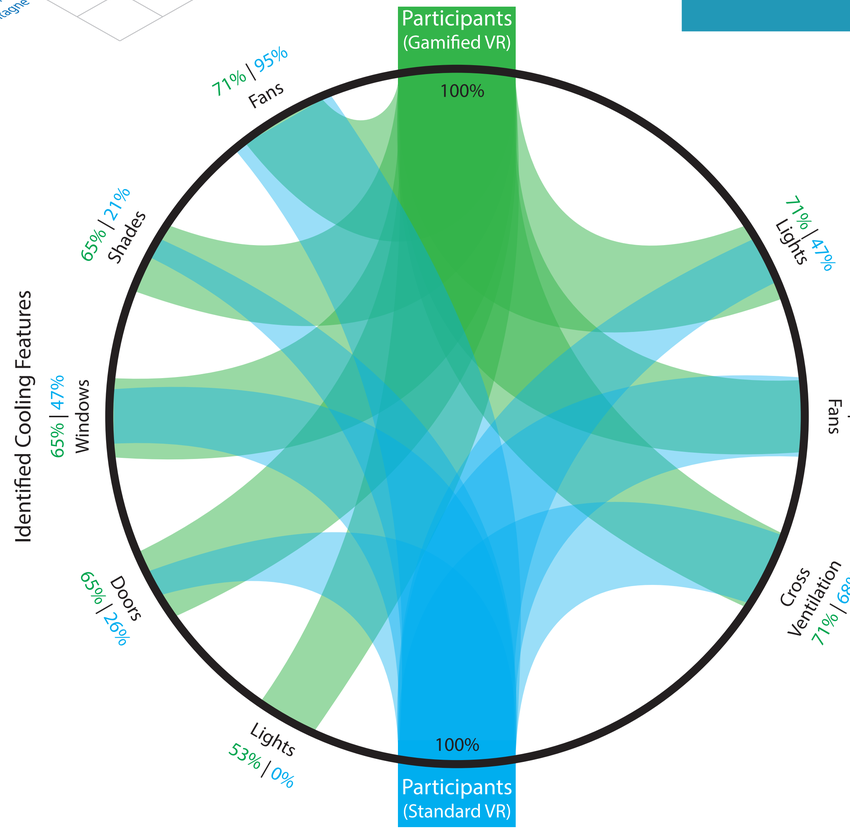

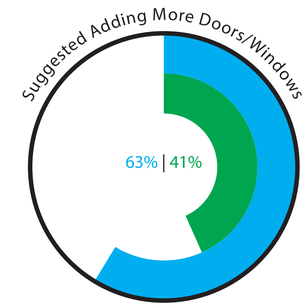

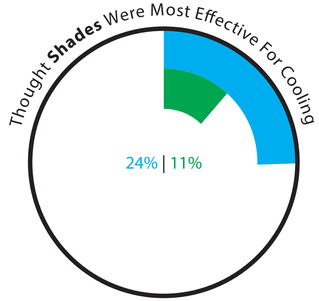

STUDY RESULTS

The results demonstrate that due to the non-gamified experience being a static, unanimated experience and as such the features that visually stand out the most are the fans and furniture. The data shows that the participants who experienced the gamified virtual reality were able to recognize, locate, and recall an average of 22% more of the environmental control features of the room than the participants of the non-gamified virtual reality.

This suggests that the non-gamified version is "read" more than experienced and as such the intuitive and immersive benefits of virtual reality are diminished. Despite 10.5% of non-gamified participants identifying shades as a cooling device, 15.8% of those participants reported them speculatively, being unable to visually identify them, but making an assumption that they would be there. This tells us that some amount of the data collected is based on pre-existing knowledge and assumptions about the operations of space.

CONCLUSIONS

Based on our trial data, gamified virtual reality is the more effective pre-occupancy training tool when compared to non-gamified virtual reality. Based on our literature review either one is more effective than the current lack of pre-occupancy training, based solely that the conversation is started and thus the participants now have at least started a conversation regarding the topic of passive building systems.

This technology and process of pre-occupancy training has the potential to create a new generation of building users that understand and can utilize the passive systems and manage their spaces more efficiently. The potential impacts of a more knowledgeable user base means that more of the knowledge regarding passive heating and cooling can be transferred beyond the modeled space and could potentially reduce energy consumption in other spaces occupied by the participants of these training systems.