Using Virtual Reality as a Design Input: Impacts on Collaboration in a University Design Studio Setting

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VR is a computer environment that provides a “convincing illusion and sensation of being inside an artificial [digital] world.” Nikolic, Liu & Messner (2013)
BACKGROUND

Immersive vs. semi-immersive

- Semi-immersive VR is an environment in which the user is not fully surrounded by the virtual world or the user is not able to actively interact with the virtual reality.
Immersive vs. semi-immersive

- Semi-immersive VR is an environment in which the user is not fully surrounded by the virtual world or the user is not able to actively interact with the virtual reality.
- Immersive VR is an environment in which the user is fully surrounded visually, audibly, and physically and in which the user is able to interact with and manipulate the virtual world.
Successful precedents for use of VR in design:

- Design Review:
  - Bullinger, Bauer, Wenzel, and Blach (2010)
  - Dunston, Arns, and McGlothlin (2011)
- Collaboration:
  - Gu, Kim, and Maher (2011)
- Improve spatial awareness:
  - Castronovo, et al. (2013); Rahimian and Ibrahimi (2011); Portman, et al. (2015); George (2016)
BACKGROUND

Why VR for design?

Disconnect between 2d and 3d
3D MODELING

Image: Daniel Tal
BACKGROUND

Disconnect between 2d and 3d

Working through filters
BACKGROUND

Disconnect between 2d and 3d

Working through filters

Students typically begin prototyping their designs in 2d
Potential benefits of immersive VR:

- Design in 3-D from the beginning of the design process
- Be unencumbered by many of the filters so they can intuitively express design ideas
- Students can digitally work in-situ
Utilizing VR will improve student’s design abilities by fully immersing them in their design and providing greater spatial awareness.
METHODS

Cohort drawn from recreational design course

n = 29

24 undergraduate students (12 male, 12 female)
5 graduate students (2 male, 3 female)
Groups of 5-6 students

Utilized HTC Vive

Create micro-park based on Park(ing) Day

Students designed for 20 minutes

Peers viewed large-monitor and provided verbal feedback
METHODS

Data collection
Recorded video as the students worked to analyze the impact of VR on their process

Conducted a semi-structured reflective discussion with the students regarding their perception of the impact of VR
FINDINGS

1. Very small learning curve

  Drawing with the controllers was intuitive
  Learning curve with 3d drawing, vs. 2d

  Difficulty with mastering the program interface
2. Collaborating on a design was less effective

Students outside the VR could only verbally communicate

Difficulty in explaining visual concepts
3. Students were more cognizant of how their design decisions impacted the 3-dimensional nature of the space.

Very positive about being able to quickly assess spatial impacts.

Believed this to be a substantial improvement over designing iterations in 2-D or through the use of 3-D modeling programs.
FINDINGS

4. Students believed they had a greater freedom of expression designing in VR
5. Students believed designing in VR led them to think about their design more holistically.
6. Responded positively to using VR and would, if available, utilize VR to design with in the future.
DISCUSSION

Designing in VR made students more aware of the spatial impacts of their design

Provided serendipitous moments in the design process

Improve student’s ability to assess spatial impacts
Reduced the cognitive load on students

Exert less mental energy extrapolating their design ideas from 2d or 3d modeling.

The threshold for 3-D designing is significantly lowered by VR programs that accurately mimic the natural gestures of drawing.
The ability to work at one-to-one scale

Digitally design in-situ
VR Design and Spatial Awareness:

– “much more aware of the space between the elements and the space they took up.”

– “feel [I’m] on the site”

– “This is so different than what I expected watching [other students] designing.”

– Mixed reality design
Current VR tools are limited in their level of fidelity

- Inability to accurately measure distances and objects
- Program tools limit ability to graphically refine design
DISCUSSION

Best suited to early conceptual design phases

Easy to quickly create a series of partis in VR
Impact of VR on student design decisions

– Students did not report such constraints to their thinking or process
– Open and flexible nature of Tilt Brush
– Broad array of design solutions created
DISCUSSION

Improved understanding of design decisions may enable students to advance to refining their design concepts more rapidly.
LIMITATIONS

Size of site:

Smaller sites

Multi-scale 3-D modeling programs are available (new version of TiltBrush and SculptrVR)
LIMITATIONS

Sites with significant grade changes may also be challenging

Topography will not match sensation of physical inputs
Collaboration:

- caused some frustration for students both inside and outside of VR
- Limited Horizon of Observation (Hutchins, 1995)
- Currently runs counter to design practices of visual expression
  - Expect this will change
LIMITATIONS

Technical:

Modest expertise for set up and maintenance

Space requirement for room-scale VR

Difficulty with running multiple sets in close proximity.
ONGOING WORK

Use of 3d models and drone captured data
Future

- Use of 3D models and drone captured data
ONGOING WORK

Additional software applications becoming available

Iris VR, Sansar

Custom made software applications
Additional software applications becoming available

Iris VR, Sansar

Custom made software applications
CONCLUSION

Demonstrated efficacy of VR for use in design generation

Technology does not yet support refined design

Collaboration needs to be better supported