Collaborative Learning Environments in VR

Authenticity, Interactivity, And Collaboration

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Agenda
VR and AR
Authenticity
Interactivity
Collaboration
Design and Create New Experiences
We use games and other tools help kids experiment, explore, and build math and science skills.

Implement and Scale Experiences
We use technology to create powerful learning environments in schools, in the home, and in the community.

Develop Capacity for New Experiences
We work with schools, governments, NGOs and other organizations to help them learn new design and development skills and build teacher support capacity.
AR & VR

“Virtual Reality can take you anywhere. Augmented Reality can bring anything to you” - Clay Bavor, Google AR/VR VP

Virtual Reality helps you to experience new worlds. Augmented Reality helps you experience this world in new ways.
Affordances of Technology

- Affordance ≠ Use
- Affordance = Possibility
Affordances of Mixed Reality

- Reality
- Virtual Reality
- Augmented Reality
- Augmented Virtuality
- Building
- Landscape
- Room
- Tabletop
Affordances of Mobile Devices/AR

Klopfer & Squire

- **Portability**—can take the computer to different sites and move around within a location

- **Social Interactivity**—can exchange data and collaborate with other people face to face

- **Context Sensitivity**—can gather data unique to the current location, environment, and time, including both real and simulated data

- **Connectivity**—can connect handhelds to data collection devices, other handhelds, and to a common network that creates a true shared environment

- **Individuality**—can provide unique scaffolding that is customized to the individual’s path of investigation.
Taleblazer Mobile Games

Play games

Make games

Featured Partner: Explore history

iCSI Project

Playing Games
- How to Play
- Featured Games
- Supported Devices

Making Games
- Getting Started
- Demo Games/Tutorials
- TaleBlazer Editor

Using Games
- For Organizations
- For Education
- Research

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Affordances of Mixed Reality
...instead of playing video games, students will enter a fully immersive and *scientifically accurate virtual reality chemistry lab*

Does adding salt affect the boiling point of water? The student would reach out with hand controllers, take a graduated cylinder, fill it with water, measure out the salt, light a Bunsen burner, add a thermometer, track the boiling point — and then repeat the experiment without adding salt.
…instead of playing video games, students will enter a fully immersive and scientifically accurate virtual reality chemistry lab.

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Affordances of (full) Virtual Reality

- **Immersion** - can make the participant feel like they are actually there within the place or system being modeled (situated)
- **Perspective** - can provide points of view to the participant, either from another person or arbitrary objects
- **Interaction** - can facilitate natural interactions through movement of the head, body and hands
- **Sensation** - can create visceral and emotional feelings at a subconscious level
- **Spatial Representation** - can show 3D spatial relations and 360 degree views
VR Applications for Education

Collaboration/Communication

Keep Talking and Nobody Explodes PC/Mac Launch Trailer
VR Applications for Education

Scale
Cellverse
Authenticity
Cells
Cells are complex
Yet we teach this.....
Yet we teach this.....

So kids think of this.....
Illustration of a generalized animal cell.
New Lung Cell Type Discovered

A previously unknown airway cell type may be a key to efforts to cure cystic fibrosis

By KEVIN JIANG | August 1, 2018 | Research
Wonderful! You're a natural.
Size and scale
What do they learn?
Cell Drawings- GLTS

- Total # of labeled organelles in pre-drawings: 138
- Total # of labeled organelles in post-drawings: 234
- More texture, more organelles with labels were drawn in post cell drawings. Sizes and shapes changed.
Cell drawings pre and post comparison

- Nucleus: Pre # vs Post #
- Mitochondria: Pre # vs Post #
- Ribosomes: Pre # vs Post #
- Lysosomes: Pre # vs Post #
- Rough ER: Pre # vs Post #
- Smooth ER: Pre # vs Post #
- Cell Membrane: Pre # vs Post #
- Vacuoles / Vesicles: Pre # vs Post #

Bar chart showing comparison of cell structures pre and post.
Cell drawings pre and post comparison

Highlighted in game

- Nucleus
- Mitochondria
- Ribosomes
- Lysosomes
- Rough ER
- Smooth ER
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Interactivity
Strong sense of spatial presence in the game.
Hands on
I usually just like listen to a teacher read about it. But now like we actually like got like a hands on experience of like what we're supposed to learn about
Navigation
There were tubes, it looked like I was traveling down a tube of some kind to the nucleus, um... I didn’t think a cell would be like that. I thought it would be more simple and would only have so many parts as was displayed in diagrams.
Environment
It actually lets us go in depth of the cell and then every piece so we know the layers and every part and what's it called and the name so it actually leaves the image in our head.
Perspective
VR it gave me a better look of it from up close, rather than looking at it from a diagram, like from above. Like I said, there were a lot more parts of a cell than I thought there would be, from other ways that I’ve learned it.
Why did you feel like you were there? (N=63)

- Immersion in environment: 19.00%
- Interaction with environment: 20.00%
- Disorientation: 4.00%
- Not specified: 57.00%
Collaboration
Collaboration: Logistically helpful in classrooms
UNIDENTIFIABLE. You need to turn on the microscope for this organelle.
Mitochondria - Also known as "the powerhouse of the cell", the mitochondria is responsible for generating energy in the form of ATP.
Cystic Fibrosis: Class IV

The transcription, translation, and folding of the CFTR protein is successful, but once the protein reaches the membrane, the protein channel is faulty. Only a small percentage of chloride or sodium ions needed are allowed to pass in or out of the cell.

The image above depicts a channel protein that only allows passage for a few chloride ions.
Data Collection

- Audio & Video Recording
- Transcription & Coding
- Pre- & Post-Game Interviews
- Cell Drawings
Epistemic Network Analysis

Connections between ideas in conversation
Epistemic Network Analysis

Clarification

Collaborative cluefinding
User study 2017
N=60
Expert and novice input helps design

Qual study 2018
N=26
High spatial presence
collaboration changes over time

Quan study 2019
2 urban high-needs schools (N=130)

CMU’s ETC Press
Thank you!