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Visualization for Spatial Comprehension

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Visualization for Spatial Comprehension

The practice and the need it addresses

Spatial Instruction Challenge

Mapping and understanding spatial data are fundamental necessities for geographers, yet challenging for many students (Rapp et al. 2007)

Spatial is a separate category of mental ability (Ishikawa and Kastens 2005)

- I. Representational correspondence (Ability to find locations on a map)
- II. Configurational correspondence (Ability to ID relationships among objects on a map and the real world)
- III. Directional Correspondence (Ability to align a map with directionality in the real world)

Augmented Reality Sandbox

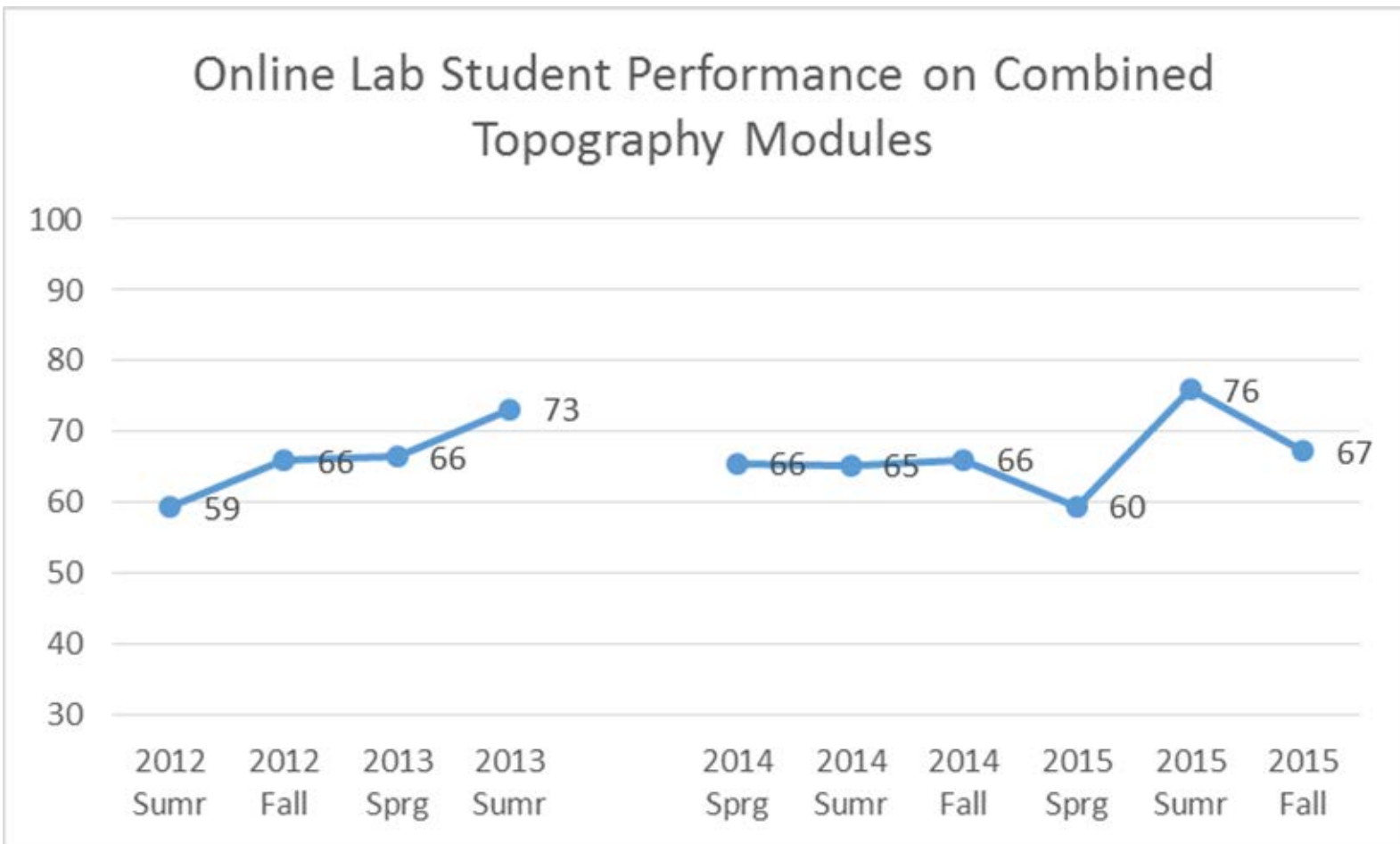
I developed an innovative augmented reality sandbox to help students connect form with representation on an enhanced and interactive sand surface

- Manipulated by students (hands-on)
- Vivid projection of colorful topographic map on sand surface in real-time
- Computer-run simulation software, Xbox 360 Kinect and projector



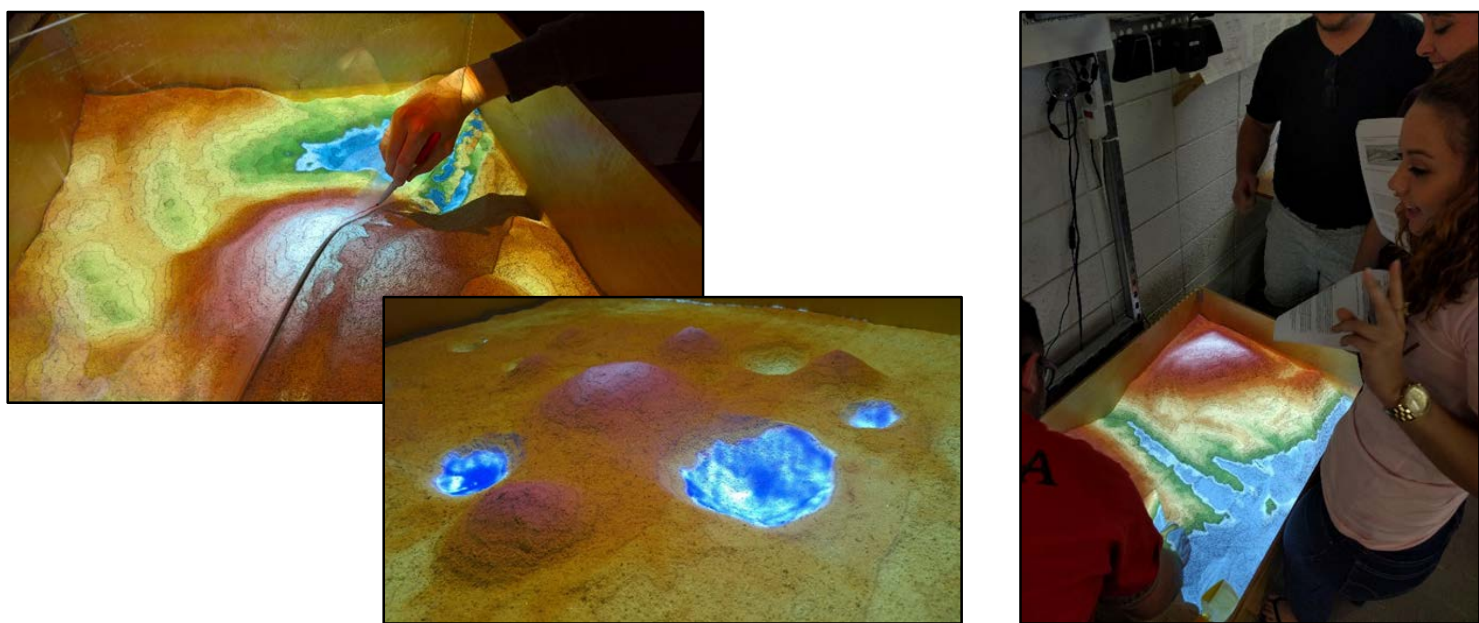
Evidence this practice benefits UNLV Students

Spatial Struggle



Graduate Assistant Response

“Every student...showed enthusiasm... This made teaching the lab a much better experience....answering questions and watching them enjoy geography.”



Student Response

What was the most difficult part?

- “...stopping playing with the sandbox.”
- "Nothing. We enjoyed the exercise.”
- "It was easy to use.”

Making it engaging and employing 3D representation is known to assist with spatial instruction and learning (Rapp et al. 2007)

Resources and where to find them

Incorporating Visualization in Instruction Across Disciplines

- Use existing visualization techniques
 - Google Earth <https://www.google.com/earth/>
 - ArcGIS Explorer <http://www.esri.com/software/arcgis/explorer>
 - Data graphing programs, iterations illustrating change over space and time
- Construct your own use-specific tool
 - Physical materials like images, objects or models
 - Other digital programming

Social-science example (poverty): <https://www.one.org/us/2014/05/20/12-data-visualizations-that-illustrate-povertys-biggest-challenges/>

BYO AR Sandbox

UC Davis KeckCAVES

<https://arsandbox.ucdavis.edu/>
<http://idav.ucdavis.edu/~okreylos/ResDev/SARndbox/Instructions.html>

Component	Purpose	Device	Cost
Computer <ul style="list-style-type: none">• Intel Core i5, 2 GB memory, 20 GB HD• NVIDIA GeForce GTX 970M• Linux Mint wit Mate (17.2)	Processing and simulation	Alienware 17 ANW17-2136SLV <ul style="list-style-type: none">• Laptop for mobility• Core i7, 8 GB memory, NVIDIA GeForce GTX 970M	~\$1300
Microsoft Kinect 3D camera <ul style="list-style-type: none">• 1st generation support only• Kinect for Xbox 360 1414 and Kinect for Windows 1473	Active depth mapping of sand's surface, providing inputs for software	Xbox 360 Kinect 1414	~\$40 (used)
Projector <ul style="list-style-type: none">• Short throw length and 4:3 aspect ratio	Display of the colored contour lines across the sand's surface	BenQMx620ST	~\$490
Sandbox <ul style="list-style-type: none">• 4:3 aspect ratio	Accessible sand surface	Baltic birch (40x30) Channel construction Casters	~\$300

How other UNLV teachers might adopt this practice

Bringing Visualization Techniques to the Students

Consider where the students might benefit from an interactive and hands-on experience with visualization for learning.

Our sandbox visualization unit was designed to be mobile to come to the students on a wheeled base, with a laptop and a overall design to allow for easy entry and exit from most classrooms.

Types of Applications for an Augmented Reality Sandbox

- Recruitment and promotion of sciences
- Enhancement of student engagement
- Topography education (contour lines)
- Landform studies
- Mass wasting events
- Rainfall and runoff simulations
- Stream flow simulations
- Watersheds and catchment areas

Broader Applications of General Visualization Techniques

Use of visualization techniques, particularly the interactive technologies of augmented and virtual realities opens new educational opportunities to address curricular deficiencies and enhance engagement.

- Addresses separate spatial abilities
- More natural and “easy” interaction
- Disruptive pedagogy and engaging