ED11B-0731

What do Geoscience Novices Look at and What do They See when Viewing and Interpreting Data Visualizations?

Kim A. Kastens (EDC Learning & Teaching Division, kkastens@edc.org)
Thomas F. Shipley and Alexander Boone (Temple University, Department of Psychology

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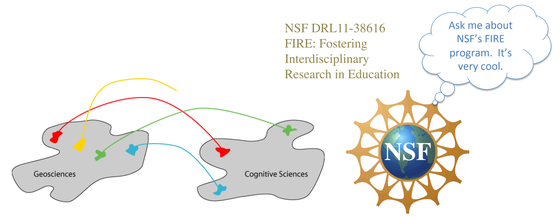
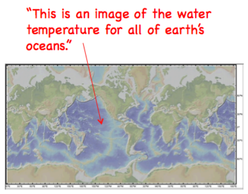
FIRE: Fostering Interdisciplinary Research in Education



Context

What we know:

- Interpreting data visualizations is central to the professional practice of most kinds of geoscientists
- Geoscientists can make inferences about structures, processes and history from data representations--even when they didn't see the causal event, and even when they have not personally experienced the place depicted
- Many students cannot do this—even when the data visualization is highly iconic, resembling the referent

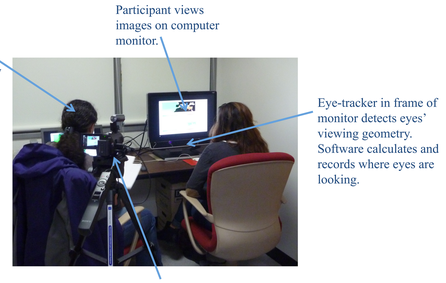


From prior study:
Swenson, S., & Kastens, K. A. (2011). Student Interpretation of a Global Elevation Map: What it is, How it was Made, and What it is Useful for. In A. Feig & A. Stokes (Eds.), *Qualitative Inquiry in Geoscience Education Research (pp. 189-211): Geological Society of America Special Paper 474.*

What we wish to find out:

- How do experts do this?
- How can we help students move towards this ability?
- How do students approach the task of interpreting a data visualization?

Methods:

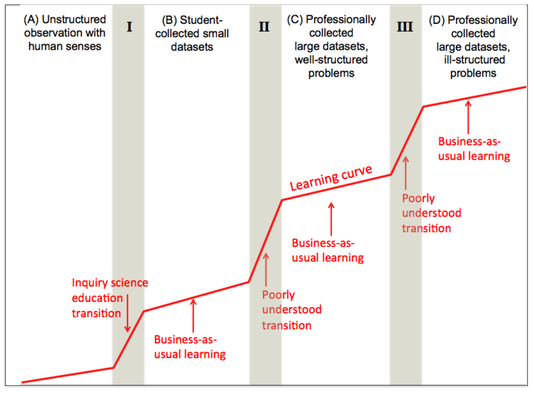


Full Research Plan, this project:

Study #1: Expert/novice comparison of what individuals attend to and what they report seeing in bathymetric/topographic data

- Study #2: Intervention study: Does providing a "hypothesis template" improve students' ability to visualize and interpret a 3-D data volume, and if so, how?

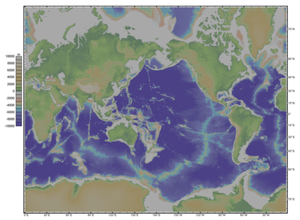
Towards a Ten-year Research Agenda:



Protocol

- Temple University undergrads in psychology participant pool, mostly female
- We ask if they have taken any earth science in college; most have not
- 41 useable participants, after omitting some incomplete data files

Everyone saw global map first:



(2.1) What do you think this is?

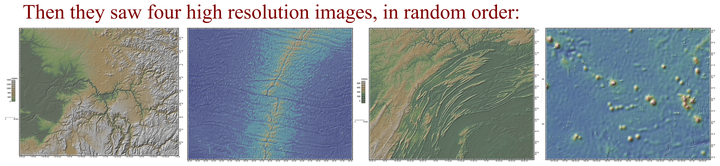
[follow up questions, until they commit to an interpretation]

(2.2) OK, good, so you have told me that you think this is a [*map/image/picture*] of [*interpretation*]. What clues in the image led you to think that it shows [*interpretation*]?

(2.3) Was there anything else in the image that led you to that interpretation?

(2.4) Could you please point to an example of where you think the image is showing [*interpretation*]?

Then they saw four high resolution images, in random order:



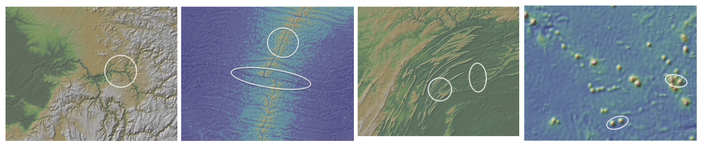
(3.1) What do you think this image is showing? [follow-up questions]

(3.2) What processes do you think might have shaped this part of the Earth's surface? [follow-up]

(3.3) Can you give me any more detail about what you think is going on in this image?

(3.4) What do you think you would see if you could see a larger area of the Earth than we are seeing here, if you could see outside the frame of this image? [follow-up]

On each hi-res image, specific areas were highlighted for further questioning:



(3.5) Please describe to me what you see in and around the area that was just marked. While you are answering this question, please pretend that I'm in another room and can't see the image; just use words to describe the marked part of the image as best you can.

Follow up questions depend on whether the answer is:

- *Flat answer:* e.g. I see two brownish parts surrounding a blue strip
- *Thing answer:* e.g. I see the Great Wall of China
- *Geomorphology answer:* e.g. I see a broad ridge that has a narrow notch in the middle
- *Process answer:* e.g. I see a transform fault; I see a divergent plate margin

Wrap up Questions:

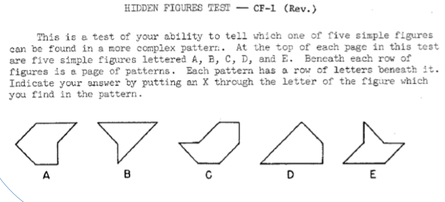
(4.1) How do you think these images that we've been looking at were made?

(4.2) What do you think these images are useful for?

(4.3) Think back over all the images. As you were trying to come up with the answers to my questions, what sources of knowledge did you draw on?

(4.4) Now I'm going to read you a list of sources of knowledge that some people use as they try to interpret these types of images. For each choice, tell me whether that was one of the sources of knowledge you used….

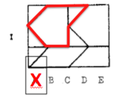
Spatial Abilities Assessment:



HIDDEN FIGURES TEST — CF-1 (Rev.)

This is a test of your ability to tell which one of five simple figures can be found in a more complex pattern. At the top of each page in this test are five simple figures lettered A, B, C, D, and E. Beneath each row of figures is a page of patterns. Each pattern has a row of letters beneath it. Indicate your answer by putting an X through the letter of the figure which you find in the pattern.

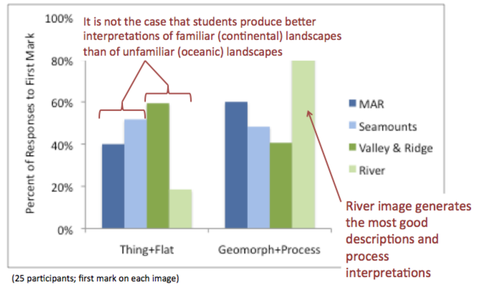
A B C D E



(sixteen items like this)

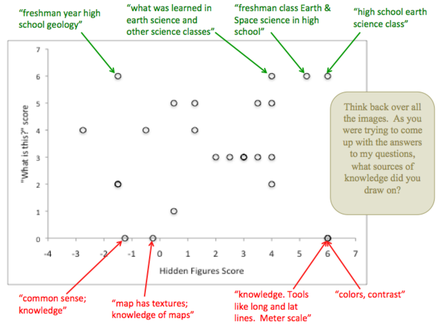
Findings

Familiar versus unfamiliar landscape

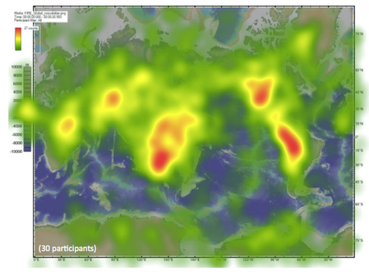


(25 participants; first mark on each image)

Prior study of Earth Science

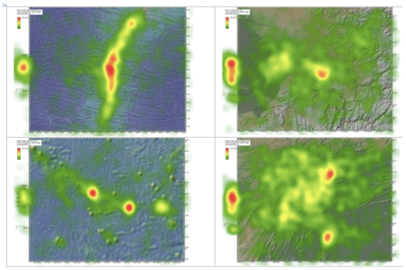


Eye-tracking data: Heat maps based on first 20 seconds before questions began



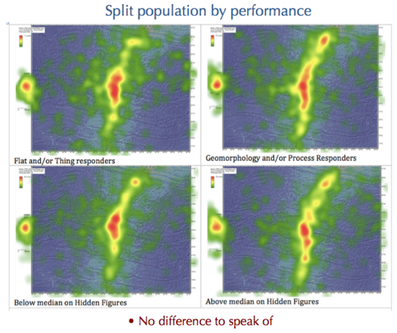
On the global map, they are drawn to the continents and avoid the oceans.

Ocean versus Continent



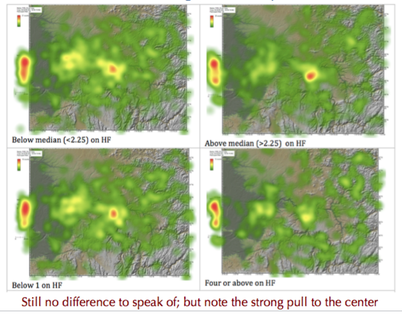
- Oceans are different from land: land data is more diffuse; ocean more focused
- Strong pull towards the center of the image

Split population by performance



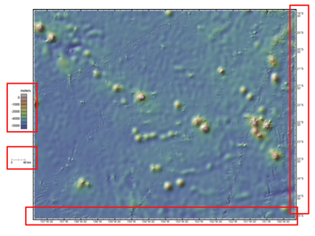
- No difference to speak of

Different image, different split



Still no difference to speak of; but note the strong pull to the center

Eye-tracking data: "Areas of Interest"



Most students are taking advantage of the color bar (depth scale)