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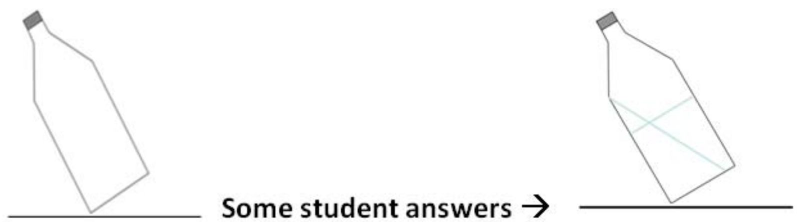
Geoscience Education News from G.S.A. 2009

Four of the EOS-SEI team recently attended and presented at the Geological Society of America (GSA) annual conference in Portland, Oregon. These short summaries of highlights were chosen by Sara, Brett, Josh & Alison.

FOR ALL WHO TEACH STRIKE AND DIP, IN CLASS OR IN THE FIELD...

1) Synthesis Of Research On Thinking & Learning In The Geosciences: The Importance Of Spatial Thinking For Geoscience Education, *Sarah Titus (geologist, Carleton College) and Lynn Liben (psychologist, Penn. State Univ).*

Student spatial skills were evaluated in the context of learning strike and dip. It turns out that many students can't identify what's horizontal, based on results from a common cognitive psychology test*: If this bottle were half-full, where would the water level be? Draw the water level. The line at the bottom is horizontal.*



Students also have difficulty estimating the orientation of something linear (e.g. a rod lying on the ground) within a given framework (e.g. a map with compass directions). The good news is that people get better at spatial visualization skills if they have ample opportunities to practice. Teaching dip (which is more intuitive) before strike is likely a good strategy.

2) Teaching Geologic Map Interpretation Using Google Earth,
David Tewksbury, and Barbara Tewksbury, Dept. of Geosciences, Hamilton College.

Teaching the concept of strike and dip is apparently notoriously tricky. The authors demonstrated exercises using Google Earth, specifically the ability to pan around topographic features. Students work through a variety of exercises that allow them to see strike and dip in logical and obvious ways that minimize confusion. Example:

> *Students start by observing inclined units and contacts near Yazd, Iran. They then make their own geologic map by tracing, inventing their own symbols to describe the three dimensional structures that are obviously visible, and create cross sections. As they work through these and other activities they are gradually shown the drawbacks of their own shorthand and introduced to the appropriate geologic symbols, which now seem like novel solutions to real problems instead of boring conventions which do not make sense. Labs are available on the SERC Website:*

http://serc.carleton.edu/NAGTWorkshops/structure/teaching_geo_map_interp.html
http://serc.carleton.edu/NAGTWorkshops/structure/visualizing_inclined.html
http://serc.carleton.edu/NAGTWorkshops/structure/visualizing_strike_dip.html

PHYSICAL MODELING OF FLUVIAL SYSTEMS

3) Use of Thermoplastic Sand in Physical Models of Fluvial Systems*, Steve Gough, Little River Research & Design*

Movable bed models are not new to geosciences education, however, they commonly use quartz sand as a modeling media. Thermoplastic sand offers a similar modeling capability, at a much lower density and cost. When using the models, students have the opportunity to watch to formation of a river system right in front of them, from a straight channel to a meander to a braided river. They also have the hands-on opportunity to set controls on velocity, sediment size, and even add man-made materials (e.g. a house) to the river area and note their effects on the transformation of the system (or the follies of putting a house on the eroding riverbank!). The modeling systems are produced by Little River as educational aids, and to a lesser extent, used for research and consulting (http://www.emriver.com/)

RELATED TO ALL TYPES OF FIELD SCHOOLS …

4) Assessing Learning Outcomes in Field Geology Instruction,
Eric M. Riggs, Department of Earth and Atmospheric Sciences, Purdue University

Riggs argues for carefully constructed learning outcomes that will justify the cost of field instruction, the time commitment and liability exposure. He suggests that the central challenge is a lack of directly observable student/expert behaviors or qualities that lead to success in the field.

To this end, Riggs reviews some of the procedures developed to assess expert behavior, describing the following methods: (***i***) navigation tracking (using GPS to track mappers), (***ii***) expertise studies (using both qualitative and quantitative methods such as GPS, map quality), (***iii***) eye-tracking studies (specialized cameras track eye movements of mappers as they work in a field area), (***iv***) visualization studies (getting students to interpret 3D images), (***v***) confidence and affective domain (looking at how novelty space affects students' ability to learn in the field), and (***vi***) pedagogical and curricular studies.

HOW DISTINCTIVE ARE SOME "EXPERT" GEOSCIENCE SKILLS?

5) Spatial Visualization and the Role of Working Memory*, Thomas Shipley, Psychologist at Temple University*

Psychologists suggest that mental abilities involving spatial working memory can be improved with targeted training. If **verbal working memory** involves remembering words and letters, and **spatial working memory** involves remembering drawings and surface details, then abilities to transfer between these two are particularly important.

To test whether visual transformation is a skill specific to experts in the geosciences, non-geologic situations that required this skill were created. English words were distorted - "faulted" - many times with cross-cutting faults.

Geoscientists were completely capable of reversing the faults in the words, while English professors were not able to do so. This suggests that the spatial skill of visual transformation is a universal skill that can be successfully done in any scenario, not just in geological settings. It might also suggest that these are not "natural" skills, and that we do have to teach them, or at least provide opportunities for students to practice them.

6) Examining Student Interactions With Distracters In Photographs Using Eye-Tracking Technology,
Joshua Coyan, Melanie Busch and Stephen Reynolds, School of Earth and Space Exploration, Arizona State University

This study looked at several aspects of how novices view geology images. Introductory geology students were assigned to one of three groups: 1) a group that listened to narration while viewing 16 images, 8 of which contained distracters; 2) a group that listened to narration while viewing the same 16 images with the opposite 8 containing distracters; and 3) a group that listened to narration but did not view images. In the context of this study, distracters are people and/or animals within an image.

Some resulting recommendations are:

- Avoid including animals and people in geology images – When such distracters are included, novice's attention is drawn heavily towards the distracter (or sometimes where the distracter is looking).
- Make sure the relevant feature is in the center of the frame.
- Include a simple scale off to the side of the photo.
- Teach students how they should look at a photo – two options of this are:
  - Show students a photo; add a balloon with descriptive text; then remove the balloon after they've read it; … or …
  - Start with a photo, overlay a simple cartoon, then go back to the photo.

One take-home message: Even the way we use images as an expert in the field is different than the way novices do.

Contact EOS-SEI: To talk about your course(s) or teaching and learning in general, visit EOS-South 361, or contact Francis Jones (fjones@eos.ubc.ca), Brett Gilley (bgilley@eos.ubc.ca), Erin Lane (elane@eos.ubc.ca), Josh Caulkins (jcaulkins@eos.ubc.ca) or Sara Harris (sharris@eos.ubc.ca). See also http://www.eos.ubc.ca/research/cwsei/.