Developing and Testing Materials to Improve Spatial Skills in Upper Division Geoscience Courses

Context

Spatial thinking skills are critical to success in many subdisciplines of the geosciences, as well as in other STEM disciplines (and beyond). Undergraduate students in introductory and upper-level geoscience courses bring a wide range of spatial thinking skills to the classroom:

Goals of the project

Students with strong spatial skills are more likely to persist in STEM fields. Penetrative thinking – imagining the interior of an object – is one of the key spatial skills in the geosciences. We are working to expand the pool of students who can succeed in geoscience by helping students with poor penetrative thinking skills overcome that barrier to success. If effective, this approach to improving students’ spatial skills will provide a model for other disciplines.

Methods: Research-Based Curricular Materials

Progressive alignment is the process of moving from the comparison of very similar to less similar objects, in order to identify salient differences. Visualizing a slice through the interior of an object requires imagining how it differs from the exterior. We are using progressive alignment to help students move from visualizing near-surface slices through an object to visualizing slices farther away from the visible surfaces, and to visualizing slices through increasingly complex structures. Directed gesturing has proven effective in moving K-12 students from incorrect to correct problem-solving strategies in other disciplines. We are testing its efficacy in undergraduate geoscience courses.

Project Timeline & Evaluation

Evaluation of the curricular materials is based on pre- and post-tests of spatial thinking skills administered in each of three classrooms, throughout the project. In year 1 (2011-2012), we collected baseline data on the improvement of spatial thinking skills over the course of our semester in each of our target classrooms, without intervention. In years 2 & 3 (2012-2014), we are collecting comparable data on the improvement of students’ spatial thinking skills, using our curricular materials in the same courses. If we see statistically greater improvement, we will be able to quantify the effectiveness of the curricular materials. Evaluation of this project, conducted by our external evaluator, focuses on validating the research plan and the methods of evaluating our classroom data, and providing a summative evaluation at the conclusion of the project.

http://serc.carleton.edu/spatialworkbook/index.html