Introduction

Students struggle to interpret diagrams in understanding geology concepts because they visually complex and represent spatially challenging concepts. This study examines non-scientific majors’ spatial thinking patterns and conceptual challenges in introductory geology course. We compare pre-course to end-course performance in diagram reasoning tests, six clicker question responses.

In Spring 2018, 126 undergraduate students enrolled in an introductory geology course at a large Canadian university; conducted to participate in the research study and completed the pre and end of course questions using the Top Hat classroom response system. Student responses for each question are plotted on the diagram using ArcGIS. Regions of correct and incorrect responses are identified using polygons. There are significant differences in pre and end of course responses.

This study demonstrates that clicks are a useful tool for documenting learning. Instructors can use the Top Hat tool to measure relative or absolute differences in students pre- and end of course responses, and ArcGIS analysis can identify common, alternative, and incorrect responses for research purposes.

Methods

1. Sample Population

126 undergraduate non-geology majors

Top Hat Clicker Questions

Pre-Instruction & End-of-Course

“Click where you expect humans appeared on Earth.”

Spatial Frame of Reference

Hot Spots Relative to Plate Movement

“South America rode the hot spot and...”

Scalar Relationships: Geologic Time

Spatial Integration

The conceptual challenges observed here need to be verified through qualitative data collection to understand the scale and nature of conceptual errors. Next steps include a mixed-methods approach.

Background

This study provides evidence that clicker questions may reveal students’ conceptual challenges. Top Hat is an excellent tool for the type of research. ArcGIS was used to select high region of student responses and identify which students selected correct versus incorrect responses. Further research is needed to see significant improvement in questions in pre-

Results

Spatial Frame of Reference

Pre-Instruction Heat Map

End of Course Heat Map

Hot Spots Relative to Plate Movement

Pre-Instruction Heat Map

End of Course Heat Map

Scalar Relationships: Geologic Time

Pre-Instruction Heat Map

End of Course Heat Map

Spatial Integration

Pre-Instruction Heat Map

End of Course Heat Map

Correlation

Erosion in a River Bend

“Click in the area where you expect to find the greatest rate of erosion.”

Isostasy

“Click where you expect to find the bottom of the hotspots after the mountains have eroded away.”

Spatial Integration: correlation and isostasy.

Scalar Relationships: Geologic Time

0.22

Effect size: Φ = √(X2/n)

0.49

Visualization & Geoscience Education

Acknowledgements

If this research interests you, consider applying to be a post-doctoral researcher in graduate availability with the NIH Visualization and Geosciences Education Research Lab. Funding is available now. Inquiry: Dr. Nicole LaDue, nlaudev@niu.edu

Conclusions

Growth was not observed in the lateral continuity of lateral, growth, likely because these two topics were not covered in the course.

Limitations

This study is proprietary and students pay for the service. Alternative tools for instructors include: Free online resources, such as Hot Spots (an alternative research tool, as if it were the same data output). Top Hat (i.e., ArcGIS coordinates of clicks).

 GIS Analysis of Spatial Conceptions in Introductory Geology: Engaging Students with Diagrams using Clickers

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1. Methods

Top Hat classroom response system (Top Hat, 2018). There were 31 clicks over the Top Hat interface in the classroom with 126 undergraduate students who participated in the study.

2. Results

To measure the relative and absolute differences in students’ pre- and end of course responses, we compared pre-course to end-course performance in diagram reasoning tests, six clicker question responses.

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