Using Web GIS to Support Geospatial Thinking and Reasoning

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Environmental Literacy and Inquiry Group
http://www.ei.lehigh.edu/eli

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Denise Bressler – Science Education
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Violet Kulo – Instructional Design and Web Development
Laura Turner – Web Development
Farah Vallera– Data management
Middle school science teachers
ELI middle school curriculum

- Energy (40 days)
- Climate Change (21 days)
- Land Use Change (20 days)
- Tectonics (7 Web GIS investigations)

ELI middle school curriculum

- Geospatial curriculum approach:
  - Curriculum framework
  - Design principles
  - Instructional model for the development of learning activities with GT
  - Educative materials to support teacher enactment

- Align instructional materials and assessments with science and environmental literacy learning goals.

- Use geospatial technology as a tool for learners to explore and investigate problems.

- Iterative stages of development: Prototype, pilot test, and field test with diverse 8th grade urban classrooms.
Design Principles

1. Design curriculum materials to align with the demand of classroom contexts.
2. Design activities to apply to diverse contexts.
3. Use motivating entry points to engage learners.
4. Provide personally relevant and meaningful examples.
5. Promote spatial thinking skills with easy to use geospatial learning technologies.
6. Design image representations that illustrate visual aspects of scientific knowledge.
7. Develop curriculum materials to better accommodate the learning needs of diverse students.
8. Scaffold students to explain their ideas.

http://www.ei.lehigh.edu/eli/energy/
Where is the best place to locate a new wind farm?

http://gisweb.cc.lehigh.edu/energy/  ArcGIS viewer for Flex

“Educative” Support Materials

- Pedagogical and content support for teachers
- Instructional Web GIS handouts: teacher guide, student handout, investigation sheet, assessment information
- WebGIS video tutorials

http://www.ei.lehigh.edu/eli/energy/support
Energy Culminating Investigation: Island of Navitas

http://gisweb.cc.lehigh.edu/navitas/

ArcGIS viewer for Flex
Where would be the best location to build both a coal and petroleum (crude oil) power plant?

A. Location A  
B. Location C  
C. Location E  
D. Location F  

What is a disadvantage to building a hydroelectric power plant at Location A?

A. A dam at this location could provide recreation opportunities.  
B. Hydroelectric power generation does not create water pollution.  
C. This location could not be used to build a tidal power plant.  
D. Infrastructure is needed to connect to the electrical grid.

Findings

Geospatial technology integrated curriculum increased student’s knowledge of Energy concepts and spatial thinking and reasoning skills.

*Energy achievement and achievement by subscale for pre/post test.*

<table>
<thead>
<tr>
<th></th>
<th>Pre-test Mean (SD)</th>
<th>Post-test Mean (SD)</th>
<th>Gain (SD)</th>
<th>Standard Effect</th>
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<td>6.94 (6.04)</td>
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***p<0.001  
N=928

http://www.ei.lehigh.edu/eli/research/pubs
**Tectonics Project Features**

- Tectonics investigations for curriculum enhancement
- Javascript Web GIS to be platform independent (i.e. tablets, laptops, cellphones)
- Interface design and customized data display
- Visualizations and tool features designed to enable spatial thinking
- Content and pedagogical supports for teachers to implement geospatial learning investigations

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**Environmental Literacy & Inquiry**

[Tectonics Home](http://www.ei.lehigh.edu/eli/tectonics)
Menus

To access assessments:
Login: elitteacher
Password: 87dja92

Where’s the nearest hazard to my location?

from Investigation 1
Where’s the nearest hazard to my location?

Custom GIS For Each Investigation

How do we recognize plate boundaries?

- Click the button below to prepare the map image to export.
- To download your map image.
- Macintosh users: Control-click on the image and select "Save Image as..."
- PC users: Right-click on the image and select "Save Image as..."
- Click the button below to return to map navigation.
How does thermal energy move around in the Earth?

Continental Boundaries

passive continental margin
continental crust
Subduction zone profiles

Investigating the San Andreas Fault Zone
Web GIS investigations increased student’s knowledge of tectonics concepts and spatial thinking and reasoning skills.

### Findings

**Overall achievement and achievement by subscale for pre/post test.**

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<thead>
<tr>
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<th>Pre-test Mean (SD)</th>
<th>Post-test Mean (SD)</th>
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***p<0.001
N=1025
Questions or Comments

http://www.ei.lehigh.edu/eli

Presentation available at:
http://www.ei.lehigh.edu/eli/research/pubs.html

To access assessments:
Login: eliteacher
Password: 87dja92