Investigative Questions underrepresented in STEM.

(1) Examine how SESI investigations and mentoring increase students’ interest in STEM and their motivation to pursue STEM-related careers
(2) Analyze how the geospatial curriculum approach, when combined with STEM-related mentoring, can improve students' interest in STEM and their motivation to pursue STEM-related careers

Inquiry-based investigations
Map-based mobile data collection
Analysis with Web-based mapping software
Pedagogical frameworks of place-based education and socio-scientific investigations
Local issues & field work in the local setting

Research Goals

About Our School

Public, urban high school
78% Hispanic or multi-racial
All students receive free breakfast and lunch
44% Do not complete tasks and avoid challenging work

The material in the activities was clearly taught.
I was motivated to learn during that investigation.
I succeeded in learning to use the iPad for data collection.

Findings

<table>
<thead>
<tr>
<th>TES</th>
<th>UHI</th>
<th>Zoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (SD)</td>
<td>Average (SD)</td>
<td>Average (SD)</td>
</tr>
<tr>
<td>2.73 (.761)</td>
<td>2.86 (.747)</td>
<td>2.90 (.735)</td>
</tr>
<tr>
<td>2.47 (.710)</td>
<td>2.45 (.859)</td>
<td>2.57 (.913)</td>
</tr>
<tr>
<td>2.90 (.784)</td>
<td>2.98 (.776)</td>
<td>2.93 (.815)</td>
</tr>
<tr>
<td>2.83 (.820)</td>
<td>2.88 (.808)</td>
<td>2.83 (.853)</td>
</tr>
<tr>
<td>2.39 (.887)</td>
<td>2.40 (.1012)</td>
<td>2.49 (.948)</td>
</tr>
<tr>
<td>2.08 (.829)</td>
<td>1.93 (.849)</td>
<td>2.17 (.928)</td>
</tr>
<tr>
<td>The use of ArcGIS helped me to better understand my community.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 5 point Likert Scale survey from 1 = SD to 5 = SA

Three student attitudes and perceptions surveys were completed after the Trees and Ecological Services (TES), Urban Heat Islands (UHI), and Zoning Investigations.

Student Summary:
Geospatial Data Analysis

<table>
<thead>
<tr>
<th>Rating</th>
<th>Range</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exemplary</td>
<td>8-9</td>
<td>8 (11.9%)</td>
</tr>
<tr>
<td>Proficient</td>
<td>5-7</td>
<td>31 (46.3%)</td>
</tr>
<tr>
<td>Adequate</td>
<td>2-4</td>
<td>22 (32.8%)</td>
</tr>
<tr>
<td>Needs Improvement</td>
<td>0-1</td>
<td>6 (9.0%)</td>
</tr>
</tbody>
</table>

Student Summary:
Geospatial Reasoning

<table>
<thead>
<tr>
<th>Rating</th>
<th>Range</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exemplary</td>
<td>8-9</td>
<td>6 (9.0%)</td>
</tr>
<tr>
<td>Proficient</td>
<td>5-7</td>
<td>30 (44.8%)</td>
</tr>
<tr>
<td>Adequate</td>
<td>2-4</td>
<td>14 (20.9%)</td>
</tr>
<tr>
<td>Needs Improvement</td>
<td>0-1</td>
<td>17 (25.3%)</td>
</tr>
</tbody>
</table>

Acknowledgments

We would like to thank William Farina, Joan Fu, Sara Kangas, Robson Junior, Scott Rutzmoser, Dork Sahagian, Shannon Salter Burghardt, Ernesto Lopez, Elainae Horan, and Jim Novak for their assistance with this program. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

Investigation Features

1) Students collect geospatial data in their local environment.
2) Students analyze data layers (both their own and others), using various tools and features in ArcGIS Online to explore patterns in the data.
3) Students identify and explain changes to the built environment to improve their city.

Examples of iPad student interface showing a custom tree identification iBook and Collector app interface. Also shown are students and a mentor collecting data in the field.

Classroom Data Analysis

Students are tasked with analyzing both freely available data and their own collected data. For example, Percent Tree Canopy, shown left, is freely available online.

*Tree Canopy Layers show regions of the city with high percentage of tree canopy (darker colors).

Students use GIS to develop a proposal to make a ward in their city more environmentally, socially, and economically sustainable.

A valid and reliable rubric was used to assess students’ geospatial data analysis and geospatial reasoning skills.

Geospatial Curriculum Framework

Geospatial Thinking and Reasoning

Investigative Questions
Geospatial Data Visualizations
Geospatial Data Analysis
Constructing Explanations and Claims

Earth, Environmental, and Social Science Content

Geospatial Science and Pedagogical Content Knowledge

Geospatial Science and Analysis Skills

Primary Investigators: Alec Bodzin, David Anastasio, Tom Hammond, Breena Holland, and Kate Popejoy

DRL #-1614216

High school level socio-environmental science investigations (SESI) in the students’ local community using a geospatial curriculum approach with STEM-related mentoring in high school classrooms comprised of under-represented students.

Field Data Collection

Students’ observations create their own data layer. Each dot represents an individual student observation and each color identifies a unique tree species. Classroom cumulative data is displayed in WebGIS (shown above).

Notes: 5 point Likert Scale survey from 1 = SD to 5 = SA

Earth, Environmental, and Social Science Content

Geospatial Science and Pedagogical Content Knowledge

Geospatial Science and Analysis Skills

About Our Project

Inquiry-based investigations
Map-based mobile data collection
Analysis with Web-based mapping software
Pedagogical frameworks of place-based education and socio-scientific investigations
Local issues & field work in the local setting