

INTERDISCIPLINARY CAP STONE PROJECTS PROVIDE AUTHENTIC CAREER EXPERIENCE DURING SOCIO-ENVIRONMENTAL SCIENCE INVESTIGATIONS (SESI) USING A GEOSPATIAL CURRICULUM APPROACH



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Alec Bodzin, Education and Human Services and Environmental Initiative; William Farina, Robson Martins De Araujo Junior, and Thomas Hammond, Education and Human Services; Kate Popejoy, PhD, PopejoySTEM LLC
Dork Sahagian, Earth and Environmental Sciences and Environmental Initiative , James Carrigan, Earth and Environmental Sciences; Breena Holland, Political Science and Environmental Initiative; Scott Rutzmoser, Library and Technology Services



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

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

The research objectives designed to address the above goal include:

- (1) Examine how socio-environmental science 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 STEM-related skills with students from groups that are underrepresented in STEM.
- (3) Investigate how STEM mentors perceive their mentoring experience in terms of skill development, connection with youth, and personal satisfaction.

Fifteen mentors were recruited and worked with the students during the SESI investigations during the 2017-2018 school year to reinforce STEM career options.

Interdisciplinary team - interdisciplinary investigations

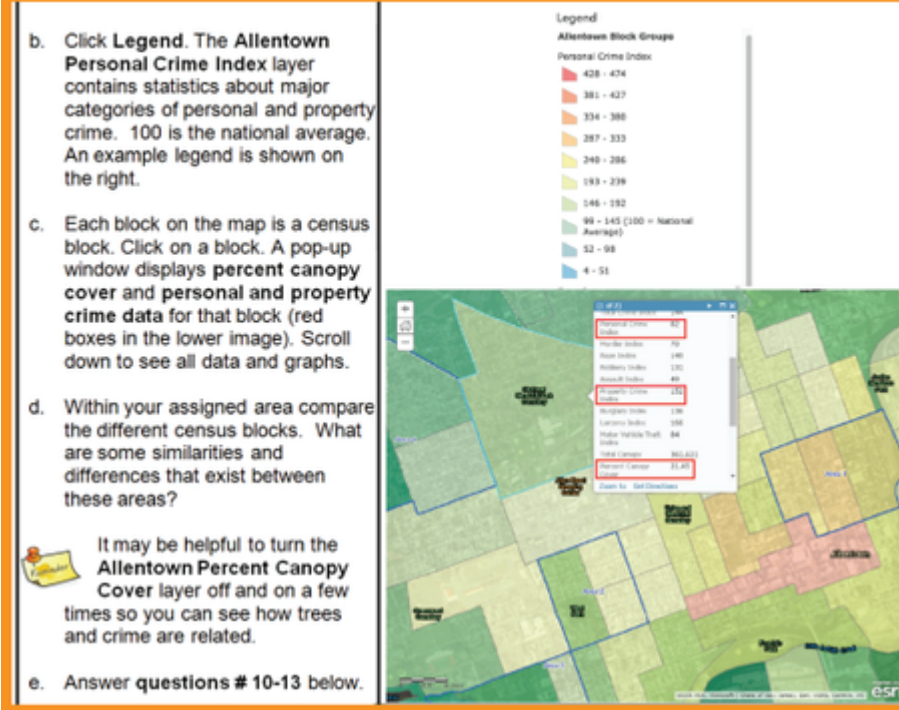
Specific Objectives

Design, develop and implement seven SESI investigations and three projects. This included conducting a usability analysis with the GPS-enabled iPads for data collection with the Collector App, using the ARCGIS.com interface for student analysis of data, and developing student learning materials to accommodate the differing academic ability levels and language abilities in a diverse urban high school.

Gather student data from all 9th grade students and from 9th grade control group students in business as normal instruction with our three attitudinal measures: Spatial Learning Attitudes Survey, STEM Career Interest Questionnaire, and Student Interest in Science, Technology and Geospatial Technology (STEM-GEO) Survey.

Implementation of a hybrid form of professional development for the participating teachers designed to promote teachers' geospatial science pedagogical content knowledge.

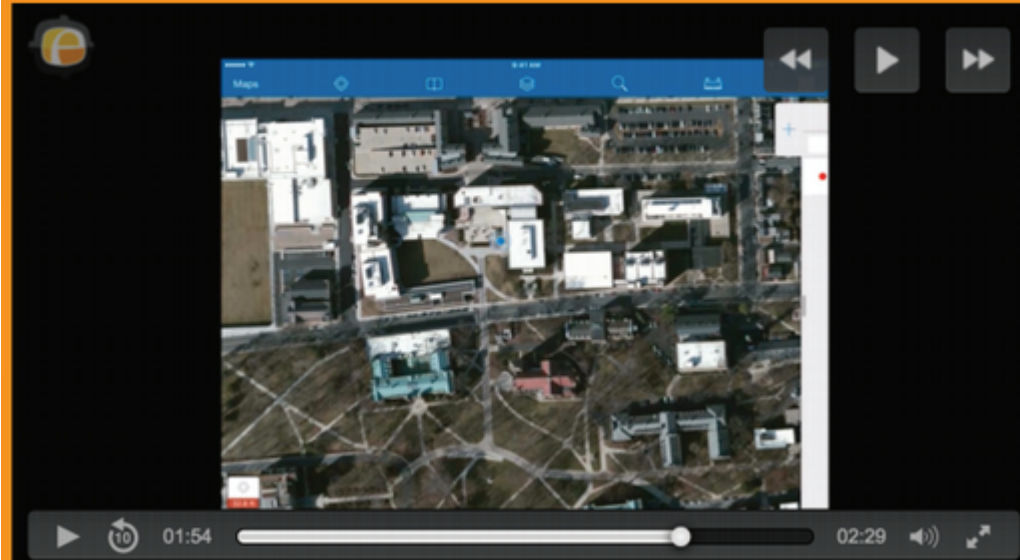
Support Materials



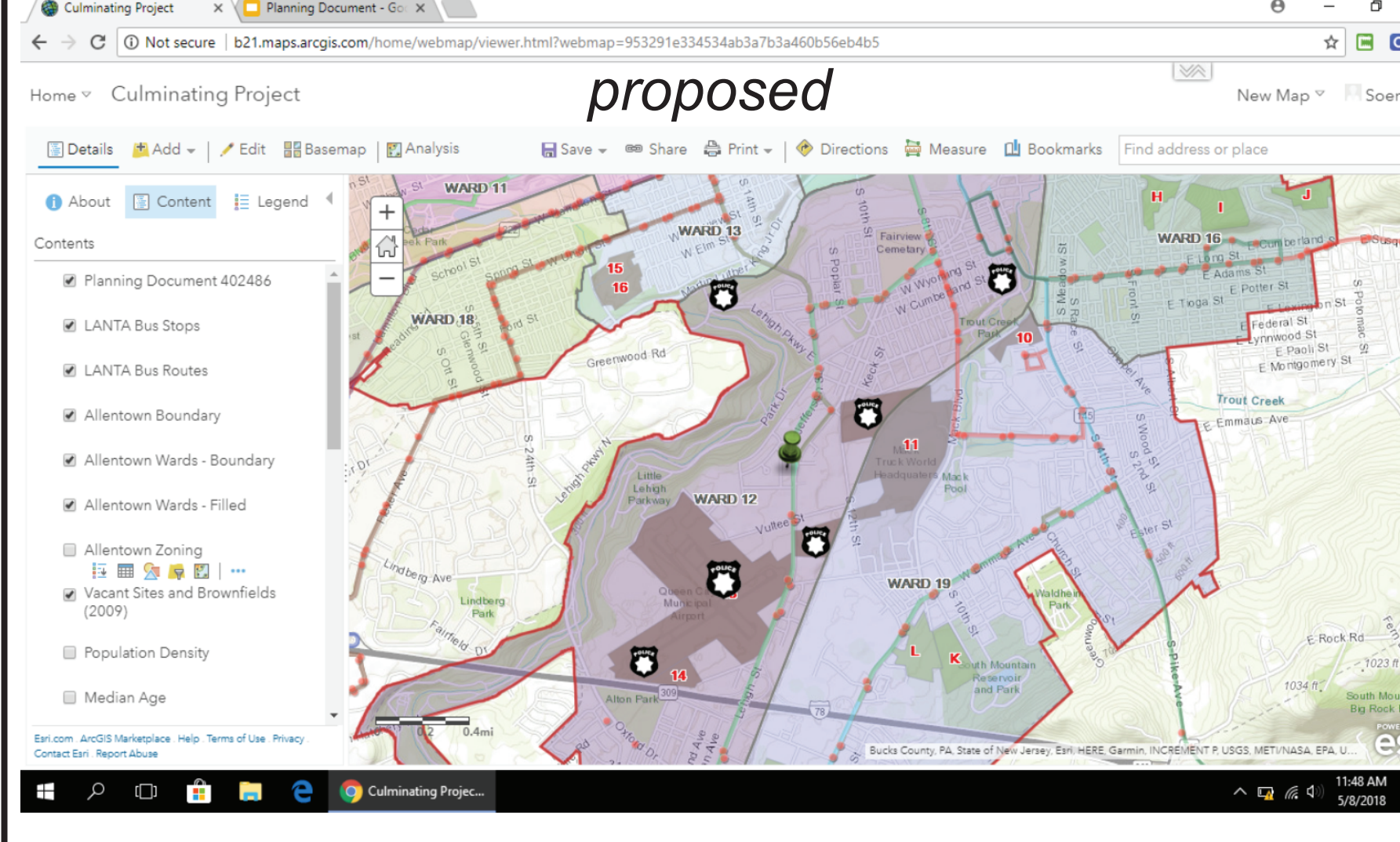
Student and Teacher Guides

Design features to assist English language learners and students with special needs.

Video Tutorials



Example of a student Culminating Project to use Smart Growth to transform Ward 12 by adding police stations and bus routes to make the area safer and more livable.



Excerpt from Valania Park Culminating Project

“Surfaces

Another thing that we can do to help the urban heat island effect is choosing the right surface types. Surface materials such as concrete and asphalt have higher temperatures. Adding porous surfaces help because, when it rains porous materials allow water to pass through resulting in the evaporation of the water that cools the surface. Surfaces such as concrete, metal and glass can raise the temperature in the park so choosing the right surface types is crucial.

Plant Life

In Valania Park, the trees are destroying the pavement and concrete. Because of this, we will need to replace the trees but trees do serve a purpose, trees help...
Reduce air temperature by blocking sunlight
Natural air conditioner
Fallen tree leaves can reduce soil temperature and soil moisture loss
Trees absorb carbon dioxide and potentially harmful gases such as sulfur.
Due to the stated above the trees will be removed due to the harm of the concrete.

Compencies

- 2.4 I can apply a range of deliberative and democratic strategies and procedures to make decisions and take action in my classroom, school, and out of school civic contexts.
- 3.2 I can use map, satellite images and other representations to explain relationship between the locations of places and regions and their political culture and economic dynamic.”

The Winning Tree Planting Proposal and Narrative Excerpt

‘My Tree Planting Proposal’ - 9th grade science class assignment

“In this world trees are very important they help us in our daily lives without us even knowing. Have you ever questioned why they are so important? You may know they help breath, but there's much

more to it. They are important to the natural and built environment because they are the biggest plants on earth and they give us lean oxygen, store carbon, help the soil, and give animals a home. To get clean oxygen it's because trees are like a filter to the earth. They take all the dust and absorb unnecessary things from the air and turn it into good clean air. As well they provide shade for us in any area they are at and help for solar radiation and reduce noises from the world. To us humans trees and green spaces help reduce our blood pressure and make stress levels calm down which benefit our health. How they benefit our environment is by absorbing carbon dioxide as they grow which helps with global warming. They help with floods by absorbing thousand of liters of water from storms or when raining they slow down the fall reducing risk of flooding and reduce wind speeds by cooling the air. Not only do they help us but for Socially beneficial they help places look more appealing and bring more people to places for example parks. When there are trees or geen life it looks more attractive to the eye.”

Project Scaffold Selection

How would adding trees to this area make it better?

“If adding trees in this area it'll make it better because it will provide shade to others and the pavement. Since we go out in the summer for gym outside it will help for the area to be cool and not so much heat from the sun. It will provide shade, help the soil, and absorb carbon dioxide, and give us more clean oxygen.”

How do your choices take into account existing trees and other features around the school?

“By planting these trees there it will improve the school look. Make it look even better and help to reduce hot temperature in the summer. Since we don't have a gym and go outside that will be a positive thing to us students. Where im planting these trees there aren't any other trees around which is why i decided to plant them there. By planting them neatly and putting mulch around them and on top it will make them and the school look clean and well put together.”

Data Summary for Culminating Project

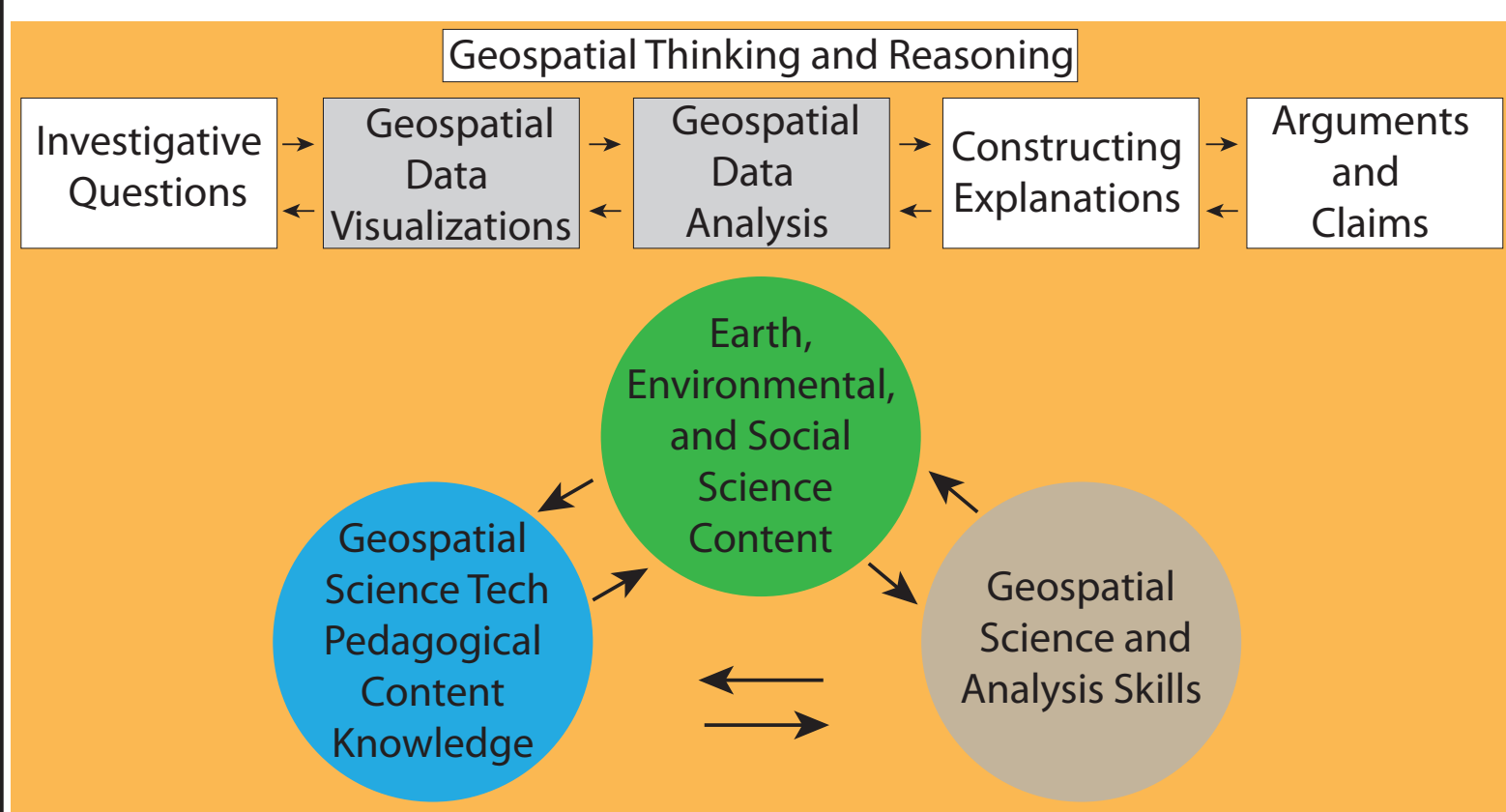
Two doctoral students individually graded each student's submitted presentation using the Culminating project rubric. There were at total of 77 students included in the data. The rubric consisted of six individual grades, three related to Geospatial Data Analysis and three related to Geospatial Reasoning. Individual scores were assigned on a scale of 0 – 3 with a maximum score of 9 for each section and 18 total. There was a total of 462 individual grades and 396 were initial identical resulting in an interrater reliability of 85.71%. The raters then discussed the remaining 66 grades and came to unanimous consensus. The unanimous grades are used to provide the data summaries below:

Student Summary - Total Project			Student Summary - Geospatial Data Analysis			Student Summary - Geospatial Reasoning		
Rating	Range	n (%)	Rating	Range	n (%)	Rating	Range	n (%)
Exemplary	16-18	5 (7.5%)	Exemplary	8-9	8 (11.9%)	Exemplary	8-9	6 (9.0%)
Proficient	10-15	22 (32.8%)	Proficient	5-7	31 (46.3%)	Proficient	5-7	14 (20.9%)
Adequate	4-9	29 (43.3%)	Adequate	2-4	22 (32.8%)	Adequate	2-4	30 (44.8%)
Needs Improvement	0-3	11 (16.4%)	Needs Improvement	0-1	6 (9.0%)	Needs Improvement	0-1	17 (25.3%)
Did Not Complete		10	Did Not Complete		10	Did Not Complete		10

Findings to Date

- 1) Strong growth in teacher's geospatial pedagogical content knowledge
- 2) Increased map use by teachers both within and outside SESI activities
- 3) Teacher use of maps as media for inquiry, not didactic instruction
- 4) Teacher modeling to guide students' analysis in GIS

Curriculum Approach



Develop geospatial learning activities in such a way that the software and hardware become transparent to the user.

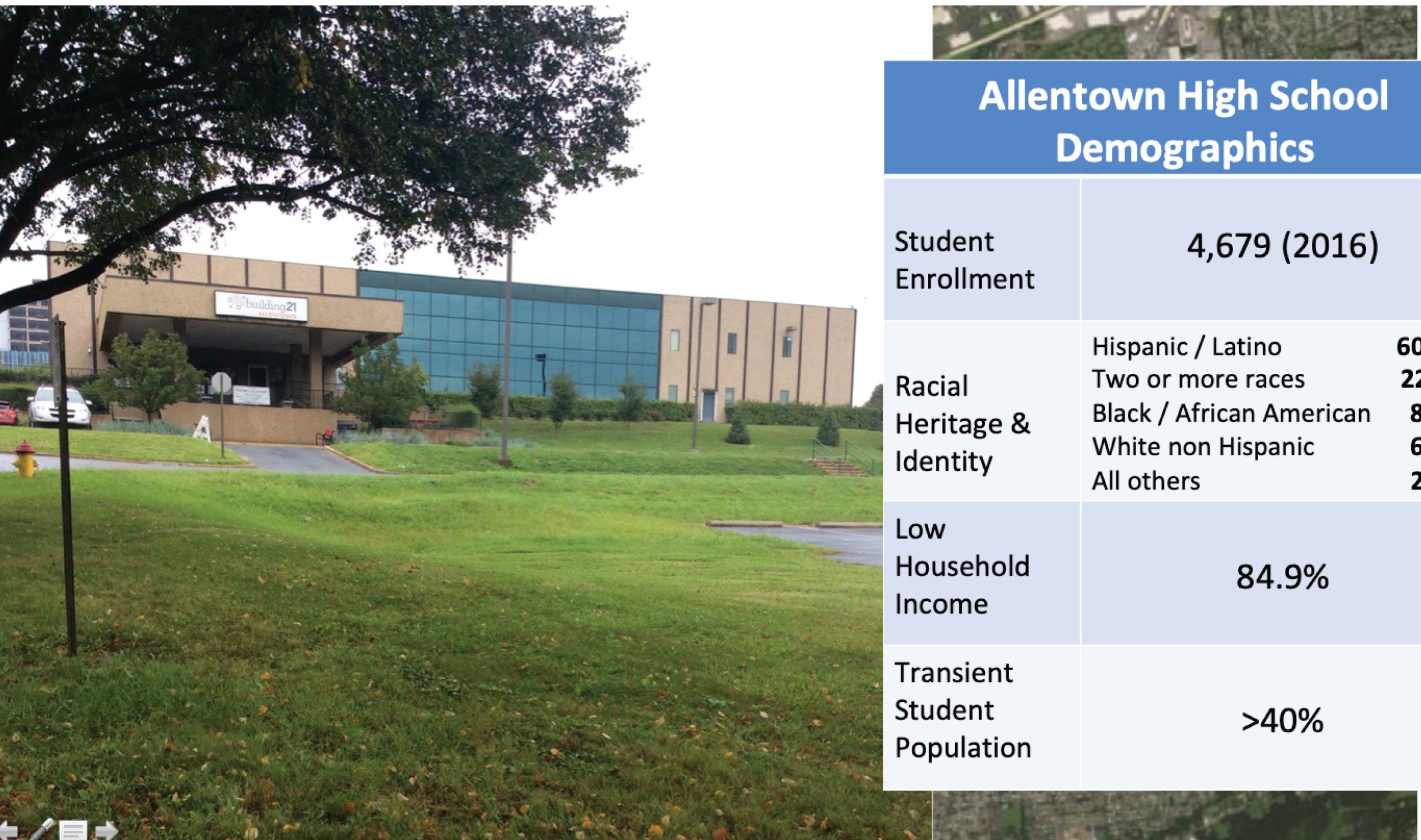
Visualizations are designed to be quick and intuitive for both students and teachers to use.

Novel form of hybrid professional development (PD), with both face-to-face and online learning.

Design partnership with classroom teachers.

- Incorporates design principles in each investigation to promote geospatial thinking and reasoning skills:
- (1) Use motivating contexts and personally relevant and meaningful examples to engage learners.
 - (2) Design image representations that illustrate visual aspects of social studies and Earth and environmental scientific knowledge.
 - (3) Design web GIS data to make geospatial relations readily apparent.
 - (4) Scaffold students to analyze geospatial relations.
 - (5) Develop curriculum materials that better accommodate the learning needs of all students, while also expanding the geospatial pedagogical content knowledge of teachers.

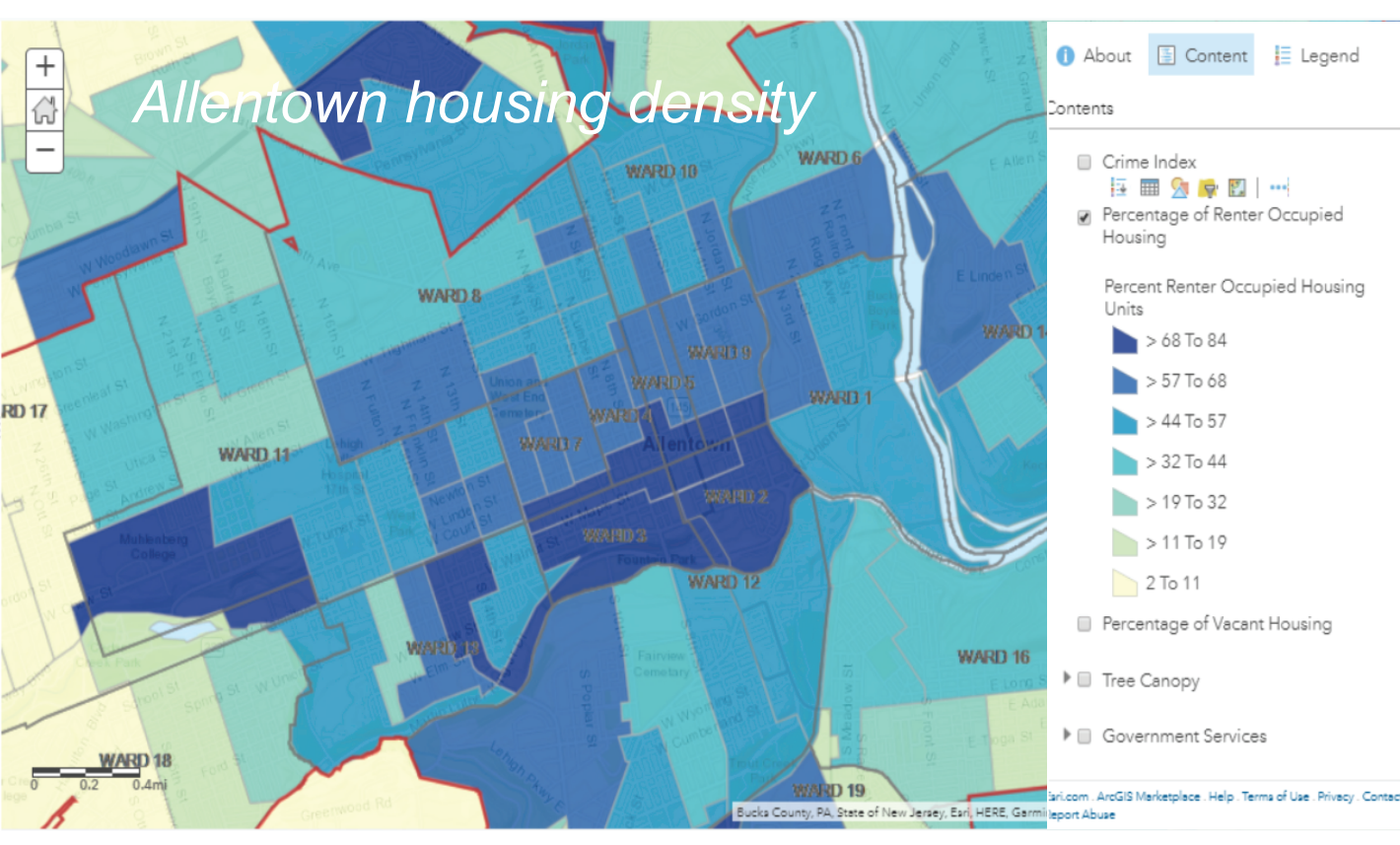
About Our School



Allentown High School Demographics		
Student Enrollment	4,679 (2016)	
Racial Heritage & Identity	Hispanic / Latino	60.4%
	Two or more races	22.2%
	Black / African American	8.7%
	White non Hispanic	6.7%
	All others	2.0%
Low Household Income	84.9%	
Transient Student Population	>40%	

Urban public high school
4 teachers of 9th grade students
Most students economically disadvantaged
21% English Language Learners
19% Individualized Education Programs
33% Unmotivated Learners-do not complete tasks, avoid challenging work

Examples of student artifacts from AY 2017-2018 for Tree Planting and Culminating projects



SESI materials are available

<https://eli.lehigh.edu/sesi/>

Papers available at

<https://eli.lehigh.edu/publications/research>

