



# Advancing Geospatial Thinking and Technologies in Grades 9-12: Citizen Mapping, Community Engagement, and Career Preparation in STEM



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## SUMMARY

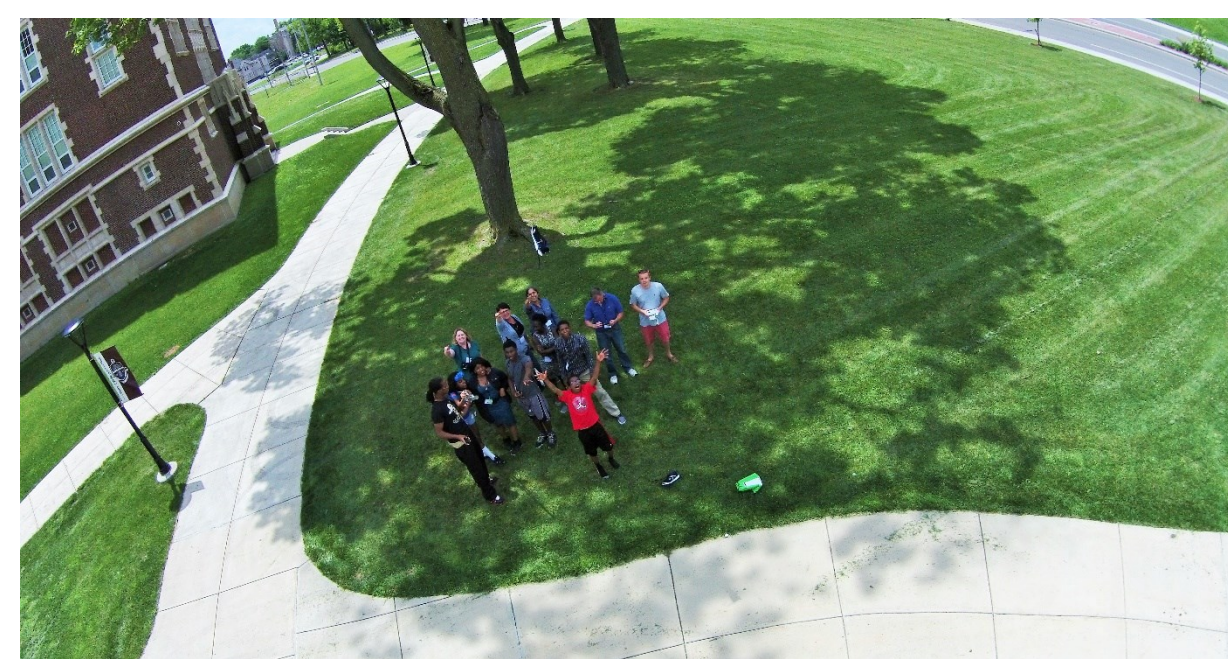
Supported by a grant from the National Science Foundation, we are focusing on advancing geospatial thinking and technologies in grades 9-12 through exploration of citizen mapping, community engagement, and career preparation. The project seeks to raise awareness of the application of emerging, dynamic technologies that are used in a range of social science and STEM disciplines as well as by citizens in their everyday lives. By engaging students in real world issues in the context of their own neighborhoods, they are gaining knowledge and tools for enhancing their communities as well as exposure to the many career possibilities in high growth STEM sectors.

This study engages students at an inner city public high school in the Toledo, Ohio, a diverse region facing numerous challenges. Using the inquiry method, high school students are participating in summer workshops designed to introduce them to recent advances in geospatial technology, especially in relation to understanding their communities and preparing them for the STEM workforce of the future. Students are guided through the scientific process of inquiry, synthesis, analysis, interpretation, and evaluation. They input data they have collected through fieldwork in the community and from secondary sources into open source mapping programs to produce maps that can guide civic action. Students then present their findings and recommendations to key individuals and organizations in the city.

## PROJECT FOCUS

### Key Research Questions:

- How can we improve students' spatial thinking and geospatial technology skills through citizen mapping while preparing them for the STEM workforce of the future?
- How does the use of spatial thinking, geospatial technologies, and citizen mapping enhance student engagement in and knowledge of their communities?



(Students' picture taken by a drone after each had a chance to fly it.)

### Related Questions:

- How can we increase awareness of career paths using geospatial technology and broaden participation of students in underrepresented groups in STEM?
- How do 21<sup>st</sup> century challenges relate to both the social and physical sciences, requiring a comprehensive and interdisciplinary approach to solutions?

## BROADENING PARTICIPATION

- Recent research on career aspirations suggests that having an opportunity to **give back and make a difference in their communities** was one goal of minority students considering various career paths.
- Jobs in both the geospatial technology industry and in geography in general are projected to grow 35% annually between 2010 and 2020 (U.S. Bureau of Labor Statistics, 2012).
- We seek to raise awareness of these career opportunities in the context of improving society, particularly among students of underrepresented groups.

## COMMUNITY ENGAGEMENT

- Community engagement has been identified as one indication of active and participatory citizenship. It offers the opportunity to apply knowledge, skills, and technology in a meaningful and productive way.
- It is our goal that students will be enabled to become agents of change and will benefit from learning more about the complex processes that shape communities through the use of geospatial technology.
- A number of socio-economic and environmental issues can be addressed by students while engaging in citizen mapping projects and utilizing geospatial technology to suggest potential improvements.
- Citizen mapping* includes gathering data to explore social and environmental issues by using GPS data, georeferenced photos, remotely sensed images, ground truthing, and other geographical sources, such as ArcGIS online to analyze, visualize, and present findings publicly.



A few slides from a student group's Citizen Mapping Project. Each presentation included methods, maps, images, and recommendations too.



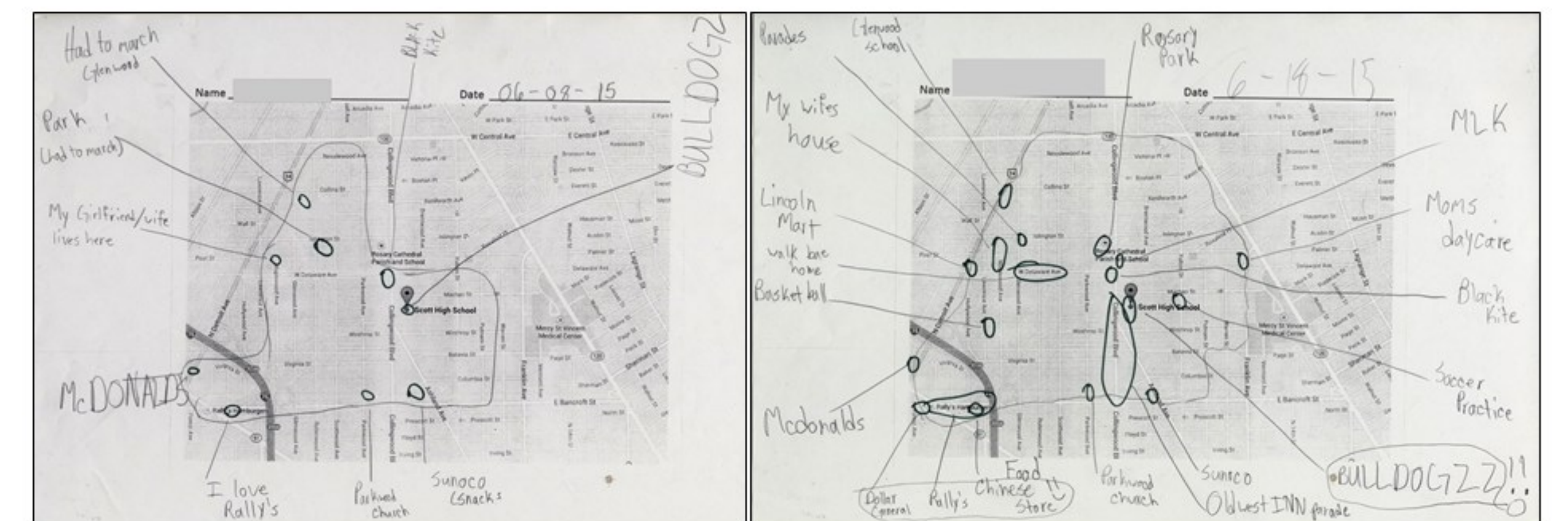
- High school students participating in the Summer 2015 workshop. They focused on neighborhood blight, housing, crime, and community needs by using technology to do fieldwork, collecting data to explore these topics, and presenting their findings to key stakeholders in the community, such as the Mayor of the City of Toledo, neighborhood organizations, and planners.

## AUTHENTIC LEARNING IN PRACTICE

- Authentic learning* works best when it is applied to real-world challenges that are relevant to students' lives and career opportunities.
- Asking students to draw sketch maps of their neighborhoods can reveal how they perceive and interact with this environment as well as how they feel about their place in it.
- Changes in students' perceptions and expansion of knowledge of their neighborhood were evident throughout the workshop.

## AUTHENTIC LEARNING IN PRACTICE

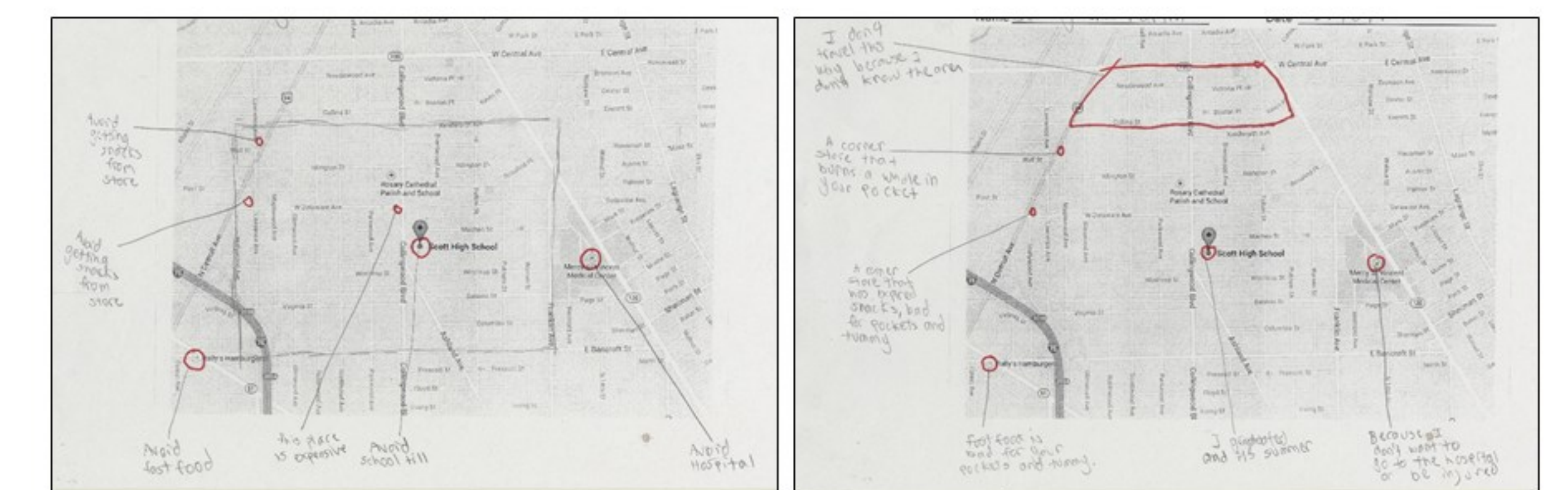
Familiar Areas of One Student Pre-Test



(Students were asked to circle areas they were familiar with in the neighborhood with a green marker and give a reason in the margin. This is one example of the same student's map at the beginning and end of the summer workshop.)

- Students' knowledge of their community expanded and became more complex.
- While both positive and negative perceptions persisted, students also observed differences in how residents interacted with them in certain neighborhoods.
- They included a number of new places and characteristics in describing the community at the end of the workshop.
- After the official workshop, they were invited by the Mayor's office to present their findings to the Department of Neighborhoods and also asked by the nonprofit Cherry Street Legacy Project to share at a community meeting. The students felt a sense of empowerment to make a difference in their neighborhoods by making recommendations to community leaders and organizations.

Avoided Areas of One Student Pre-Test



(Students were asked to circle areas they avoided in the neighborhood with a red marker and give a reason in the margin. This is one example of the same student's map at the beginning and end of the summer workshop.)

## CURRICULAR GOALS

- The result will be a curricular model that provides an effective and accessible way of introducing geospatial technologies to students through local issues, while providing them with the skills and motivation for pursuing STEM careers that utilize geospatial technology.
- Learning modules will include topics, such as neighborhood blight, community gardens & parks, crime, housing, and water & air quality. Critical thinking, technological tools & skills, civic engagement, and career paths will be integrated into each module that can be adapted to any school setting and community.
- The curriculum will provide a roadmap for the use of geospatial technologies in the context of place-based learning, citizen mapping, and open-source mapping programs. Through the geographical sciences, an interdisciplinary STEM field, the findings and curriculum can be used in related disciplines in the physical and social sciences to advance knowledge and career preparation for all students.