Abstract

Girls and underrepresented ethnic groups tend to disengage from STEM subjects throughout middle and high school. In order to increase their participation in STEM fields, something has to change before they’re deterred. Building on previous research showing individuals in these groups tend to respond more positively to STEM activities that connect to their lives or that can be used to help others, we have developed online GIS software for use with middle and high school students that blends social justice, mapping and data science. We created corresponding activities to spark an interest in math and computer science in all students. Activities ask students to compile and analyze real-world data to develop their own questions, critiques and conclusions with no wrong answers.

The software was developed in a small team using mostly open-source tools, including Django and AngularJS. Over one year, another student and I concurrently developed an interactive Google Maps GUI front end and a RESTful back end.

Sample Activity: Create An Infographic

Activity Outline
- In groups of 3 or 4
- Select a location, preferably one of the student’s homes
- Research the area 1 mile around this group member’s home using Social GIS
- Sketch 3 to 5 facts that tell a story of the neighborhood

Students will be able to...
- collect and analyze data using the SGIS tool
- collaborate in small teams
- express discoveries creatively

Sparkling interest in STEM

In girls
Female students respond positively to activities that have the following characteristics:
- design [2]
- communication [2]
- social relevancy [2]
- altruism [3]

In underrepresented ethnic groups

Gutstein’s [1] students gained a deep understanding of mathematics and the social context in which they live.

For all
- Majority of all students prefer working in groups [2]
- Questioning the meaning of data improves students media literacy
- Greater understanding of mathematical basis for social issues creates active agents of social justice

References


What do students need to become active agents of social justice?

Awareness

Students need to be aware of social issues and their possible causes. Gutstein’s project [1] asked middle school students to think about the relationship between race/ethnicity and housing prices and determine if they are related. Through discussion, the students learned how the very different data might be interpreted to show the same things.
- One student deduced that if prices were higher for similar homes purchased by ethnic groups at around the same time, this would be racism.
- Another deduced that if whites were purchasing similar homes at prices that were impossible for working class latinos in the area to afford, these prices may have been inflated to keep non-whites out of the neighborhood.
- A third student even described possible negative effects of gentrification on working class neighborhoods without having talked about this concept in class.

Skills

Along the way, students develop mathematical thought and the ability to really think critically about how data is aggregated and interpreted. If a student imagines she is writing a news article with her interpretation and her classmate is as well, how would these headlines compare? She would observe that it is possible to draw different conclusions using the same data.

Ownership

In Gutstein’s class [1], students felt a sense of ownership because it was based on something tangible to them — local data. They could see their roles in the project and how an issue like this might affect their lives, asking questions like: “Might my parents have been overcharged for their home because we’re latino?” With Social GIS, I take this one step further by allowing students to make an impact on the data through a user tagging system. This system allows the user to mark a point in an existing data set as one thing or another. For example, we’re using a NYS Retail Food Stores data set that includes supermarkets, small grocery stores, convenience stores and bodegas. If a teacher wants students to examine food access in a neighborhood, the differences between these types of stores is enormous. By giving this responsibility to the students, they gain a sense of ownership over the data.