

# Equity in Learning Opportunities for Middle School Students: Connecting Communities and Transportation Through GIS

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<b>16. Abstract</b> Geographic information systems (GIS) is part of an in-demand career skillset that can lead to safer streets in California communities. This project included a three-session bootcamp that introduced middle school students to transportation via GIS and gathered assessments on their awareness of transportation as a career pathway. The project built upon CSUTC TRANSPORTS' Year 4 project, "K-12 Special Investigation Project: Mapping E-Commerce Locally and Beyond." The bootcamp for this project was coordinated in partnership with Rio Hondo College, which provided the instructor and connection to the students at the Mountain View Unified School District in El Monte, CA. The bootcamp focused on developing safer communities and transportation systems as a context for the students to become familiar with GIS. The student feedback reported on student awareness of transportation and GIS prior to the bootcamp and how the curricular tools and activities impacted that awareness. Gathered data and feedback will inform the development of future middle school GIS curricula, an area that is underdeveloped.			
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# Executive Summary

This project included the development, coordination, and execution of a three-session bootcamp that introduced middle school students to transportation via geographic information systems (GIS) and gathered assessments over the course of the bootcamp on their changing awareness of transportation as a career pathway, as well as on the acquisition of key skills that are increasingly demanded by employers. Providing access to these skills to students of all socioeconomic backgrounds is an important part of the development of transportation as a component of STEM for All education. The bootcamp for this project was coordinated in partnership with Rio Hondo College, which provided the instructors and connection to the students at the Mountain View Unified School District in El Monte, CA. There were three four-hour sessions held over three Saturdays in April and May 2022. The students completed pre- and post-bootcamp surveys on their awareness of transportation, GIS, and career opportunities, and how the curricular tools impacted that awareness after the bootcamp. Survey results reported that most students had not heard of GIS prior to the bootcamp, but all were interested in learning more afterward.

Middle school is not too soon for students to expand their awareness of different skills and career opportunities connected to them. Working with research, funding, and K–12 education partners to create and implement accessible and viable curricula for middle school students will encourage them to explore new skills and start to consider their career pathways. Using GIS, students can learn skills to advocate for safer and better managed streets in their communities (SB-1 Objective 4).

# 1. Introduction

This project was a three-session bootcamp that introduced ten (10) middle school students to transportation via geographic information systems (GIS) and gathered assessments over the course of the bootcamp on the students' changing awareness of and interest in transportation as a career pathway. GIS and related skills are increasingly in demand by employers. Providing access to these skills to students of all socioeconomic backgrounds is an important part of the development of transportation as a component of STEM for All education. GIS technology remains a skill largely taught at the college and university level. The authors' prior work in both researching and introducing GIS to high school classrooms revealed the potential benefit of introducing the topic to middle school classrooms as well.<sup>1</sup> The objective of this project was to better understand the opportunities and constraints surrounding "GIS for Middle Schools" which include the institutional support needed for administrators and teachers. The bootcamp itself had two other key objectives:

- Students will demonstrate an understanding of their community transportation systems by integrating them into a GIS StoryMap using data, images, and text.
- Students will respond to pre- and post-bootcamp surveys to demonstrate their changing awareness of career pathways in transportation and GIS.

## 1.1 Project Background

The bootcamps built upon CSUTC TRANSPORTS' Year 4 project, "K-12 Special Investigation Project: Mapping E-Commerce Locally and Beyond," which developed a blueprint for teaching middle school teachers how to incorporate GIS into the classroom with an e-commerce focus. The blueprint was successfully piloted in summer 2021 in a one-day train-the-trainer workshop that middle school instructors attended.

## 1.2 Project Motivation

GIS skills are increasingly relevant in the workforce. Introduction to the technology and basic skills in K-12 allows for students to explore potential career opportunities and pathways, but training and awareness resources are underutilized. The bootcamps for this project were informed by previous research that has identified best practices for designing and implementing GIS curricula with the right organizational partners.<sup>2</sup>

The bootcamp for this project was coordinated in partnership with Rio Hondo College, which provided the instructor and connection to the students at the Mountain View Unified School District in El Monte, CA. There were three four-hour sessions held over three Saturdays in April and May 2022. Students filled out pre- and post-bootcamp surveys about their awareness of

transportation and GIS prior to the bootcamp and how the curricular tools impacted that awareness.

The weekend bootcamp approach allowed for longer sessions and self-selected participation by motivated students. The bootcamp was advertised as a “geographic information systems and drones” bootcamp at the recommendation of Rio Hondo College because drones are familiar and exciting to middle school students.

A follow-up webinar was held with teachers and administrators involved in integrating GIS in the classroom. The webinar served as a way for the project team to discuss observations from the bootcamp with middle school teachers, gather ideas and challenges, and to share GIS curricular resources from the project and other sources.

Figure 1. Instructor Warren Roberts During the First Day for the Bootcamp

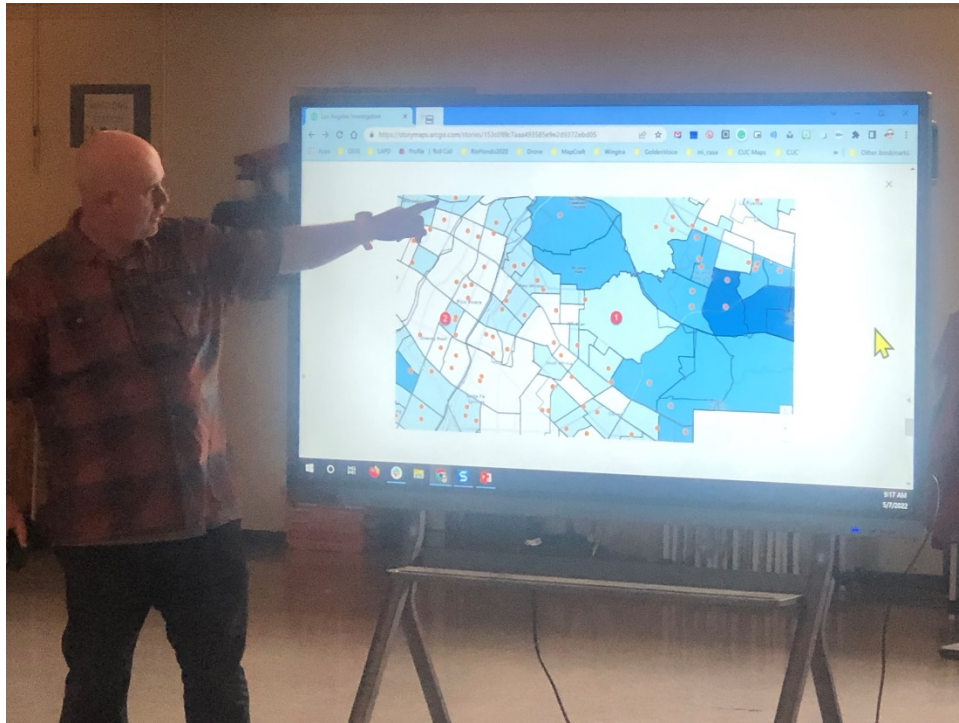


Figure 2. Drone and Remote Controller Used for Instruction that Students Piloted



## 2. Bootcamp Design and Coordination

The bootcamp was designed with coordination between four organizations and many team members. Each played a unique role that was critical to the success of the project. The table below outlines the names of the organizations involved in this project, as well as their contributions.

The partners included California State University, Long Beach (CSULB), Rio Hondo College (RHC), and the Mountain View School District in Los Angeles County. Team instructors Warren Roberts and William Chesher were provided by RHC. Roberts was the primary instructor that led the bootcamp, and Chesher was his partner in developing some of the course materials. Coordination was made possible by RHC’s Career and Technical Education and guided pathways professional, Claudia Romo. CSULB offered GIS (Ben Olson) and transportation (Tom O’Brien) expertise and conducted bootcamp observations and assessments. The Mountain View School District hosted the bootcamp (George Schonborn) and facilitated the follow up instructor webinar.

Table 1. Project Partners

Partner Organization	Type	Role
Center for International Trade and Transportation at California State University, Long Beach (CSULB)	University research center	Project management; curriculum advisement; assessment
Rio Hondo College (RHC)	Community college CTE and guided pathways division	Provide instructors; curriculum design; curriculum delivery
Mountain View School District (MVSD)	K–12 school district	Provide student audience; advertise and promote the bootcamp; provide facility
California State University Transportation Center CA Senate Bill 1 Funding (CSUTC)	Funding source	Provide funding for the program

### 3. Bootcamp Execution and Content

The bootcamp was held over three consecutive Saturdays. Each session was four hours and included classroom-based work as well as drone demonstrations and piloting which took place outdoors on the school campus. The students had laptops for hands-on activities. The students self-selected their participation in the bootcamp from a number of topics. The instructor, Warren Roberts from Rio Hondo College, brought prior experience with middle school students to curriculum design and delivery. The bootcamp started by introducing mapping to the students (without mention of “GIS” specifically). The pre-bootcamp survey results revealed that most students had heard of robotics prior to the bootcamp but not GIS, so subtly introducing GIS helped with the initial learning curve associated with GIS terminology and acronyms. The instructor discussed concepts of direction and scale, as well as governance and political jurisdictions (e.g., city vs. county vs. state), which are concepts the students were familiar with beforehand.

Various technologies and platforms kept the students engaged throughout the four-hour sessions. As mentioned, drones were used to demonstrate how to capture images that can be turned into data to better understand the students’ surroundings. In the classroom, use of the Kahootz live quiz platform and interactive maps visualizing interesting or offbeat topics kept the lesson portions engaging. The Map Craft resources linked below were used as instructional tools during the bootcamp lessons. Map Craft is a “spatial detective” GIS curriculum developed at Rio Hondo College.<sup>3</sup>

- London's Deadly Disease Epidemic
- Investigating LA
- Investigating San Francisco Poop Problem
- New York Investigation

Figure 3. Screenshot from a Storymap Shown As Part of the Bootcamp



The individual sessions allowed the students to move from observation to application. O'Brien provided an overview of transportation careers in the first session so that the students were able to begin visualizing workplace applications of the transportation-related tools they were going to be using. Lead instructor Roberts began by presenting data on a map that showed community environmental hotspots which led to an exercise where students connected data to mapping tools as the first step in building a StoryMap.

The drone demonstrations first involved an instructor-led presentation on operations as well as the restrictions and regulations concerning the use of drones. This included a discussion of FAA regulations. By the end of the third session, students were using the drones to capture aerial images and navigating them around an obstacle course. The bootcamp was designed with the end goal of providing the students with an understanding of the language of GIS and providing base knowledge to understand maps and problem solving. These skills better prepare students for GIS courses at the college level, which are more technical and software-focused, or any field of study or training.

The surveys found that students' awareness of transportation concepts and careers was limited both before and even after the bootcamp. When asked about career interests, students reported what might be considered traditional responses: engineer, lawyer, teacher, and veterinarian. Students were also varied on their reported post-high school plans. Some plan on working immediately, some plan on attending a community college, and some plan on applying to universities.

The bootcamp was successful in generating interest in transportation and GIS. All students expressed an interest in learning more about GIS in the post-bootcamp surveys, and more than half felt comfortable creating a StoryMap, a narrative-mapping hybrid GIS product, after participating in the bootcamp.



- Pre-bootcamp survey questions
- Post-bootcamp survey questions

Figure 4. Bootcamp Days Two and Three

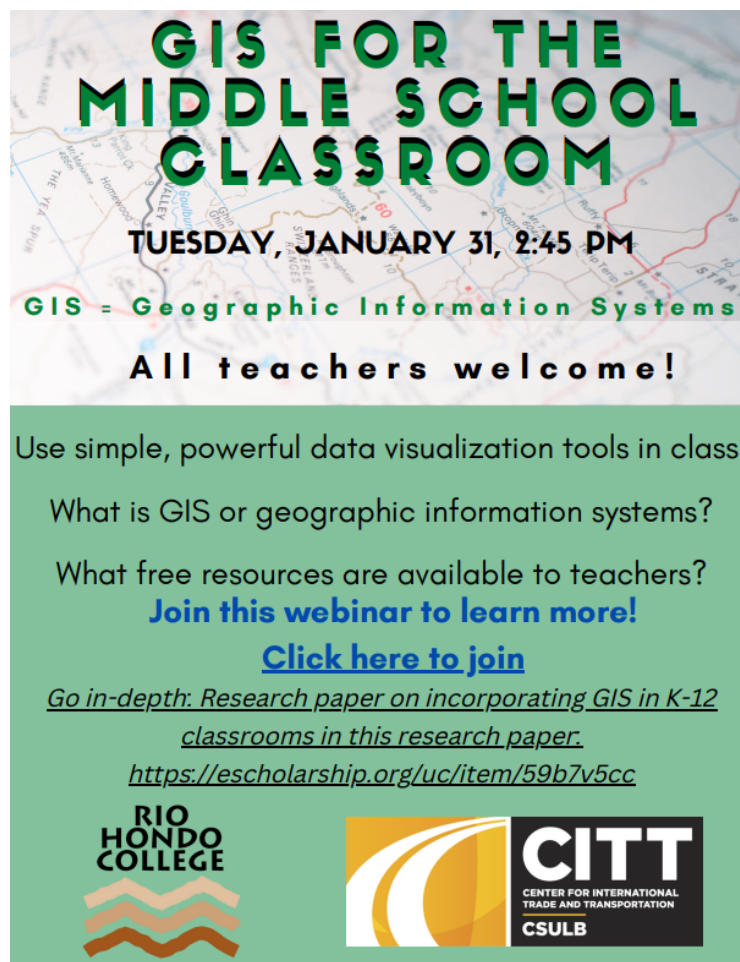


## 4. Follow-Up Teacher Webinar

While the observations of the bootcamp itself and the student surveys contributed to our understanding of the potential for GIS in middle school classrooms, the research team was interested in the response teachers had to the class's content. We were also interested in better understanding possible opportunities to incorporate the content into a regular class, in particular in the Mountain View School District, as well as any institutional barriers.

As a result, we held a follow-up one-hour webinar promoted through the Mountain View School District and Rio Hondo College. There were five total participants, including instructors and administrators from the Mountain View School District and others representing community colleges. It was held on January 31, 2023. The small participation allowed for a more in-depth discussion. Project P.I. Tom O'Brien and project manager Ben Olson, hosted the webinar. The hour started with a review of the course materials, introducing GIS to the participants in the process. The agenda also included student responses to the experience, a discussion of the benefits involved with bringing GIS to middle school classrooms, and creative approaches to any barriers.

Figure 5. Promotional Flyer for the Follow-Up Teacher Webinar



The flyer features a map background with the title "GIS FOR THE MIDDLE SCHOOL CLASSROOM" in large green letters. Below the title, it states "TUESDAY, JANUARY 31, 2:45 PM" and "GIS = Geographic Information Systems". A green banner at the bottom contains the text: "All teachers welcome! Use simple, powerful data visualization tools in class! What is GIS or geographic information systems? What free resources are available to teachers? Join this webinar to learn more! Click here to join Go in-depth: Research paper on incorporating GIS in K-12 classrooms in this research paper. https://escholarship.org/uc/item/59b7v5cc". Logos for Rio Hondo College and CITT (Center for International Trade and Transportation) at CSULB are at the bottom.

**GIS FOR THE  
MIDDLE SCHOOL  
CLASSROOM**

**TUESDAY, JANUARY 31, 2:45 PM**

**GIS = Geographic Information Systems**

**All teachers welcome!**

Use simple, powerful data visualization tools in class!

What is GIS or geographic information systems?

What free resources are available to teachers?

**Join this webinar to learn more!**

**[Click here to join](#)**

*Go in-depth: Research paper on incorporating GIS in K-12 classrooms in this research paper.*

*<https://escholarship.org/uc/item/59b7v5cc>*

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## 4.1 Benefits and Opportunities to GIS in Middle School

Participants said that they saw the benefits of GIS for bringing real-world examples to the classroom. Many of these examples plug into contexts that students understand, such as Amazon deliveries or mapping fast food locations around town. Young people understand why it matters to see locations related to these and other common examples on a map. Participants also shared that GIS provides a “guaranteed and viable curriculum,” which is a broad education goal that means the skill is part of curriculum that is essential and necessary for students.<sup>4</sup> Finally, GIS is a tangible post-high school career goal: one participant, a community college instructor who teaches GIS, shared that students take her class because they see job postings asking for it as a skill.

## 4.2 Barriers to Implementing to GIS in Middle School

Despite teacher, administrator, and student enthusiasm, there are some barriers to implementing GIS more broadly in middle school classrooms. Webinar participants shared that teachers may be interested and enthusiastic about the content, but they are busy and stretched thin; many are still weary from the challenges of teaching during the COVID-19 pandemic quarantine. Motivated teachers may bring GIS to their curriculum themselves, but broad adoption will likely require direct curriculum and/or standardized score requirements. GIS is hard to introduce because it is pathway-adjacent, rather than a pathway itself. There is, however, a benefit to this in that it can plug into any other career and technical education (CTE) pathway.<sup>5</sup>

Given these problems, introducing GIS in after-school activities may be more feasible than doing so in the core classroom. Webinar participants also shared that after-school programs can be good when they work, but many are difficult because students are very busy with other activities. Participants shared that the problems are not necessarily funding and facilities. Finally, administrative personnel are often excited about opportunities for teaching technology skills, such as GIS, but do not always see an opportunity for students as young as middle school.

## 4.3 Participant Insights

Webinar participants were active in the discussion and shared some novel ideas. Administrator participants suggested that to work around teacher overwork and exhaustion, curriculum researchers and designers could interface with curriculum vendors about integrating GIS into their products. There are also existing state programs into which GIS instruction could possibly be integrated. One is Career and Technical Student Organizations (CTSOs) which align with the 16 career clusters and 79 career pathways recognized as part of the National Career Cluster Framework.<sup>6</sup> Another are the Advanced Via Individual Determination (AVID) programs, which are electives geared toward the average student.<sup>7</sup>

Another idea mentioned was that there is an apparent difficulty with a didactic introduction to GIS as a concept, so perhaps it may be easier to introduce geographic and spatial concepts without

using the term “GIS.” A way to hook students could be to ask “Are you visual? Do you like solving problems?”, both of which can be satisfied by learning and using GIS. Starting with acronyms and multi-syllabic definitions can be less engaging. This approach mirrors the one taken by the lead instructor in the bootcamp.

Finally, some other ideas shared as ways to engage students were to introduce GIS by showing job postings that ask for GIS as a skill and also by tying GIS into their interests such as sports and social media.

## 5. Summary & Conclusions

The bootcamp and follow-up webinar were successful as a pilot to gauge the impact and potential of introductory GIS and drone instruction, and activities on student awareness of transportation and career opportunities. All student participants reported interest in learning more about GIS, despite "drone marketing" being the primary reason for enrollment in the bootcamp.

The teacher webinar held after the bootcamp gave insight into how to best engage students. Some ideas shared during the session were tying the skill into sports or social media, or introducing basic concepts before bringing in the term "GIS." Teacher participation in the webinar demonstrated that there is a willingness from educators to bring in new skills, but many teachers are overburdened with teaching and testing requirements and need to see the connection between the technology being taught and student assessment. There was discussion that there may be potential to implement GIS as a requirement or perhaps more easily as an elective.

The partner infrastructure that was developed as part of this project and outlined earlier in this report can be repeated and replicated. The curriculum can be refined via this process. Future iterations of this bootcamp would benefit from surveying teachers as well as students. Teacher understanding of GIS, transportation, and career concepts is important for the success of the curriculum. There was, however, potential to tie the skill more explicitly to transportation concepts and career opportunities.

GIS is a skillset that is needed in the workforce to support current and future transportation systems. This leads to advocacy for safer and better managed streets in California's communities, addressing CA SB-1 Objective 4. The outcome of this pilot and the earlier SB1-funded teacher-focused training is a series of ready-to-go lesson plans and exercises that, if implemented, extend the reach of the project to additional classrooms, students, and teachers.

Middle school is not too soon for students to expand their awareness of different skills and career opportunities connected to them. Working with research, funding, and K-12 education partners to create and implement accessible and viable curricula to deliver to middle school students will encourage them to explore new skills and to start to consider their career pathways.

# Endnotes

<sup>1</sup> Orr, M., Olson, B., Carballo, A., Garcia, A., and O'Brien, T. (2021). Building a GIS Workshop for High School Students. *UC Davis: National Center for Sustainable Transportation*. <http://dx.doi.org/10.7922/G20G3HF9> Retrieved from <https://escholarship.org/uc/item/59b7v5cc>.

<sup>2</sup> Orr, M., Olson, B., Carballo, A., Garcia, A., and O'Brien, T. (2021). Building a GIS Workshop for High School Students. *UC Davis: National Center for Sustainable Transportation*. <http://dx.doi.org/10.7922/G20G3HF9> Retrieved from <https://escholarship.org/uc/item/59b7v5cc>.

<sup>3</sup> Roberts, W. and Chesher, W. (2020). Welcome to #MapCraft. *Rio Hondo College*. <https://arcg.is/0T1vjT>.

<sup>4</sup> A Guaranteed and Viable Curriculum (GVC). (2023). Arlington Public Schools. *Intrado Corporation*. [https://www.asd.wednet.edu/administration/teaching\\_\\_\\_learning/guaranteed\\_and\\_viable\\_curriculum](https://www.asd.wednet.edu/administration/teaching___learning/guaranteed_and_viable_curriculum).

<sup>5</sup> CTE Model Curriculum Standards. (2022). CTE Model Curriculum Standards—Standards & Framework. *California Department of Education*. <https://www.cde.ca.gov/ci/ct/sf/ctemstandards.asp>.

<sup>6</sup> Career Technical Student Organizations (CTSO). (2012). CTSO. *California Department of Education*. <https://www.cde.ca.gov/fg/fo/profile.asp?id=2330>.

<sup>7</sup> Advancement Via Individual Determination (AVID). (2008). AVID. *California Department of Education*. <https://www.cde.ca.gov/fg/fo/profile.asp?id=1226>.

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