

# **Innovative Pedagogy Through Big Data and ArcGIS: Perspectives on the Collaboration Among First-Generation Students, Nonprofits, and Open Data in Los Angeles**

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## **Abstract**

This article focuses on the innovative teaching practices using big data that arose from a 4-year collaboration between faculty, first-generation students at California State University, Los Angeles (CSULA), and local communities. The aim of the National Science Foundation–funded Big Data Project at CSULA was to engage students and faculty in using big data to tackle social issues such as racial violence, poverty, environmental inequalities, urban ecology, and structural barriers in Los Angeles, while preserving the cultural richness of the communities in East Los Angeles and surrounding areas. Once a year, faculty members applied to the program to incorporate data projects into their courses, received training, adapted their curricula, and worked with nonprofits. Our experience showed that the students who participated in this semester-long, hands-on learning experience exceeded the learning objectives of the program and specific courses. They were key contributors in generating new insights using big data, fostering meaningful dialogue, and creating research and scholarship opportunities that positively impacted their communities.

As educators and teacher-scholars, we regularly leverage data in the course of our work. In today's world, data are an integral part of our daily routines; they shape voting decisions, work, purchasing behavior, and solutions to economic, social, and political issues in our communities. Big data has a significant impact on our lives, yet many of us remain unaware of its pervasive influence. Our project sought to make these structures visible to students, explore the possibilities of teaching big data, and dismantle technological barriers and inequalities in our communities. In 2018, we collaborated with the Center for Engagement, Service, and Public Good at California State University, Los Angeles (CSULA), as well as local nonprofit organizations and the City of Los Angeles with funding from a 3-year National Science Foundation grant. The goal was to promote community civic engagement and big data literacy.

The Big Data Project utilized the City of Los Angeles's LA GeoHub, which is a public-facing website for exploring and mapping location-based open data. With the help of this resource, faculty and students designed and implemented projects that addressed the goals of local nonprofits. The grant engaged both the university and the community in using ArcGIS (a geographic information system [GIS] software) to map open data relevant to three focus areas: social justice, urban environment, and the arts. As part of the National Science

Foundation's Big Data West Innovation Hub, the Big Data Project created access to data, taught students how to use ArcGIS to create maps, and supported cross-disciplinary faculty and course projects. These projects were immersive, collaborative, and high impact and aimed to create meaningful change in the community.

Working with city data, and open data in general, presents significant challenges. While city data portals are technically open to the public, they are often inaccessible because the average person may lack the necessary familiarity and training to use raw data or mapping software like ArcGIS, which is the most frequently used mapping software and houses most city data programs (Gebre & Morales, 2020). This is particularly true for the City of Los Angeles's open data portal, where most available information is in large, unmapped, and unprocessed formats. Although LA GeoHub provides some previsualized data, raw data requires significant processing and analysis before it can be used. To address this issue, our project funded new pedagogical support and development to enable faculty and students from any discipline to learn ArcGIS, access the LA GeoHub, and process data for their projects. Through this initiative, we aimed to help students clean and simplify data, visualize data in unique ways, curate data variables, perform data analysis, and work with nonprofits and their communities.

Over the course of 3 years, our project had several key outputs. First, we created nine course models spanning different disciplines across the university. These models integrated the City of Los Angeles's data application into classroom learning activities and service-learning projects. Second, we provided hands-on experiences using Los Angeles's open data to 60 nonprofit organizations and 225 students. Third, we trained 24 Social Equity Engagement Geo-Data Scholars (SEEDS) to become experts in city data. Fourth, we introduced 375 students to LA GeoHub and taught them how to access, analyze, and apply city data to civic engagement projects. This was done as part of the NSS 1001 "Introduction to Higher Education" courses at CSULA. Finally, in the fall of 2020, our natural and social sciences course, "Introduction to Higher Education," taught over 2,500 first-year students introductory big data skills.

## **Background**

CSULA is a designated Hispanic Serving Institution, and 85.6% of students live within 5 miles of the university and commute to campus (Cal State LA, 2020). Our students most often come from a working-class background, are first-generation college students, are ethnically and racially diverse, and represent a range of academic skills (Cal State LA, 2020). CSULA's commitment to community-centered research and teaching is central to the university's mission (Gomez et al., 2019).

This collaborative project created both access to data and digital literacy skills. The project aimed to educate motivated, diverse, and civic-minded students through civic and service-learning courses on the LA GeoHub and open data portal as research and decision-making tools. Through the SEEDS paid summer internship program, it also allowed students to further work begun during the semester with their faculty supervisors and nonprofit organizations.

This project saw participation across four colleges and many disciplines; faculty participants came from criminal justice, biological sciences, art, and marketing departments, among others. However, we had a greater share of participation from the social sciences, especially sociology. Sociology, particularly public sociology, engages with the community and aligns with the mission of this grant and the types of research that open data makes possible (Greenberg et al., 2019). One of sociology's central concerns is identifying how local communities can be involved in solving

social problems in their own neighborhoods. As Yosso (2005) reminded us, respecting the importance of community cultural wealth not only is essential to student-centered pedagogy but also develops a relationship grounded in equity that is inclusive of all stakeholders. Past research has shown that engaging community members in the research process can elicit more impactful research findings (Simon et al., 2014). Other research has illustrated the benefits to students that come from civic engagement projects; by reframing project-based learning to center students as "coproducers" in their knowledge, students' voices are amplified (Battistoni & Longo, 2011). Additionally, undergraduate community-based research enhances the possibility for resident-driven social action (Clark, 2021).

Students used Los Angeles open data to construct maps of different neighborhoods, applying quantitative reasoning by analyzing different types of variables in their data visualization. Open data portals are intended to allow researchers and community members to collaborate by making all steps of the research process open and transparent (Woteki, 2022). The Los Angeles open data portal and ArcGIS mapping allowed students across disciplines to practice quantitative reasoning in a collaborative digitized learning environment. We found that our students thrived in this environment.

## **Faculty Communities of Practice and Student Learning Communities**

Cox's research on the scholarship of teaching and learning encompasses three main concepts: faculty learning communities, student learning communities, and faculty communities of practice. The work we describe here aligns with this scholarship tradition established by Cox and colleagues (Cox, 2004, 2013; Richlin & Cox, 2004). Although our Big Data Project was not explicitly designed with the faculty learning community framework in mind, it does conform with the definition of such a community:

cross-disciplinary faculty and staff of six to fifteen members who engage in active collaborative, yearlong program with a curriculum about enhancing teaching and learning and with frequent seminars and activities that provide learning, development, the scholarship of teaching, and community building. (Cox, 2004, p. 8)

Cox defines faculty communities of practice as spaces where faculty, students, staff, and community members with shared interests frequently interact to deepen their knowledge and expertise in a specific area (2013, p. 18). Our Big Data Project successfully brought together faculty from many disciplines, graduate and undergraduate students, community partners, and local city officials to collectively address distinct issues affecting neighborhoods throughout Los Angeles.

We harnessed our students' knowledge and insights regarding their communities. This approach allowed us to establish a more meaningful connection between the university and diverse communities within Los Angeles. Our collaboration through the Big Data Project was specifically designed to prioritize student-centered learning and a multidisciplinary curriculum. In line with the principles of communities of practice as outlined by Cox, we furthered a collaborative ethos in which students actively participated in knowledge production and community engagement. Student-centered learning and multidisciplinary collaboration aimed to enhance students' experience and empower them to be active participants in the broader Los Angeles community. This approach aligned with Cox's vision of communities of practice in which the exchange of knowledge and expertise within a community leads to deeper understanding and more effective problem solving, ensuring our university served as a hub for collaborative learning and community engagement.

### **Student Empowerment Through Data Literacy and Partnerships With Los Angeles–Based Nonprofit Organizations**

We at CSULA cultivate students' individual talents, diverse life experiences, and intellect through engaged teaching, research, and public service that support their overall success, well-being, and the greater good. This project was designed to introduce first-year and transfer students to the world of big data. The project covered a range of topics, from identifying community needs and learning about how data is collected to interpreting data and creating one's own community story.

Due to the incompatibility of the university's institutional review board (IRB) process with the Big Data Project's focus on course design and pedagogy, we are unable to mention the names of specific nonprofit organizations or provide

detailed information about the community participants who collaborated with us in our research and course redesigns. We did not request approval from the IRB because our project's focus was not on data collection and analysis. While we discuss the general nature of the community engagement in our project, this project's primary purpose was to strengthen big data literacy among our students and to give them an opportunity to learn 21st century skills in collaboration with local nonprofits.

The grant team and community stakeholders outlined three major project goals: (a) to build an effective structure for collaboration among CSULA, the City of Los Angeles, and Los Angeles–based nonprofit organizations; (b) to introduce the city's GeoHub and open data portal as research and decision-making tools to highly motivated, ethnically diverse, and civic-minded students through civic- and service-learning courses and the SEEDS program; and (c) to bring big data to citizens through engagement with nonprofit organizations, thus fulfilling the vast potential of Los Angeles's open data collection.

As part of the National Science Foundation's grant to enrich and expand civic engagement programs for colleges and universities, the Big Data Project provided local and underserved communities with access to the city's big data. The project team created a model for diverse disciplines across art, business, education, and social and natural sciences to incorporate data literacy and skill development in their curricula. Finally, we introduced new tools and skills to faculty and students in quantitative reasoning and have significantly expanded their research skills, especially for disciplines in which qualitative research is the dominant method.

### *Faculty Course Redesign*

Each fall semester, faculty applied to the Big Data Project course redesign for spring semester participation. Prior to the start of the semester, accepted faculty received technical training and created data projects to implement in their existing courses. Training included four sessions with ArcGIS and LA GeoHub, pedagogical support workshops for course redesign, an online "faculty support" center for the development of syllabi, and specific big data curricula, such as readings, low-stakes quizzes, and project-based activities. Some faculty came in with existing Los Angeles–based nonprofit partners, and other faculty were matched with nonprofits through the project's

external partner. Still others were matched through the university's Center for Engagement, Service and the Public Good, which serves to cultivate relationships between faculty and nonprofit organizations across the city and region.

Faculty participated in training workshops to learn ArcGIS and met with members of the education department at ESRI, the tech company behind ArcGIS, to learn how to map data and redesign assignments and activities to support the goals of the project. After the training workshops, faculty were better prepared to teach students how to communicate large amounts of information through data visualization in maps, graphs, charts, story maps, and dashboards. By redesigning their courses to expose students to mapping technology, faculty provided essential skills for students to become agents of change in their communities. We found the training workshops to be beneficial to faculty across multiple disciplines, as well.

As an example, students in the first author's sociology internships course capably used story maps; they learned what data were readily available, how to select data that answered compelling questions, how to visualize a variable and make multiple variables work together, and how to build a story map that was coherent, inclusive, and told a complete story. They navigated their urban environment and designed and created visualizations of their data to tell stories that benefited their nonprofit community organizations. One example (Figure 1, from the first author's course in 2019) shows several variables around gentrification in El Sereno, a neighborhood bordering CSULA in East Los Angeles.

The first author also discovered some personal and practical developments in his own teaching practice. He gained community via a cohort of faculty across disciplines through the training program, developed technological skills himself by learning and teaching ArcGIS in the classroom, reenvisioned his pedagogical practices of teaching student-led research through the new tools provided, and integrated theory and background literature in new and meaningful ways by demonstrating their relevance to local and community-based data.

#### *Overview of Two Course Models Integrating Big Data Mapping*

Three faculty applied to repeat their participation in the project's course redesign program. These faculty expressed that they not only enjoyed using the technology in their classroom

but also utilized it in their own scholarship and research, fulfilling the true teacher-scholar model whereby faculty research is accessible to students who can partake in high-impact research practices in their classrooms. The course model examples that follow come from the first author, who participated in the project in both the first and fourth years of the project (2019 and 2022) and used two different courses with two different foci under the grant. The first course was a project smaller in scope, as he learned his way around integrating the technology into his own practice. In the second course, students gained a more immersive experience as the faculty member was more experienced with ArcGIS and comfortable leading students through their research experience.

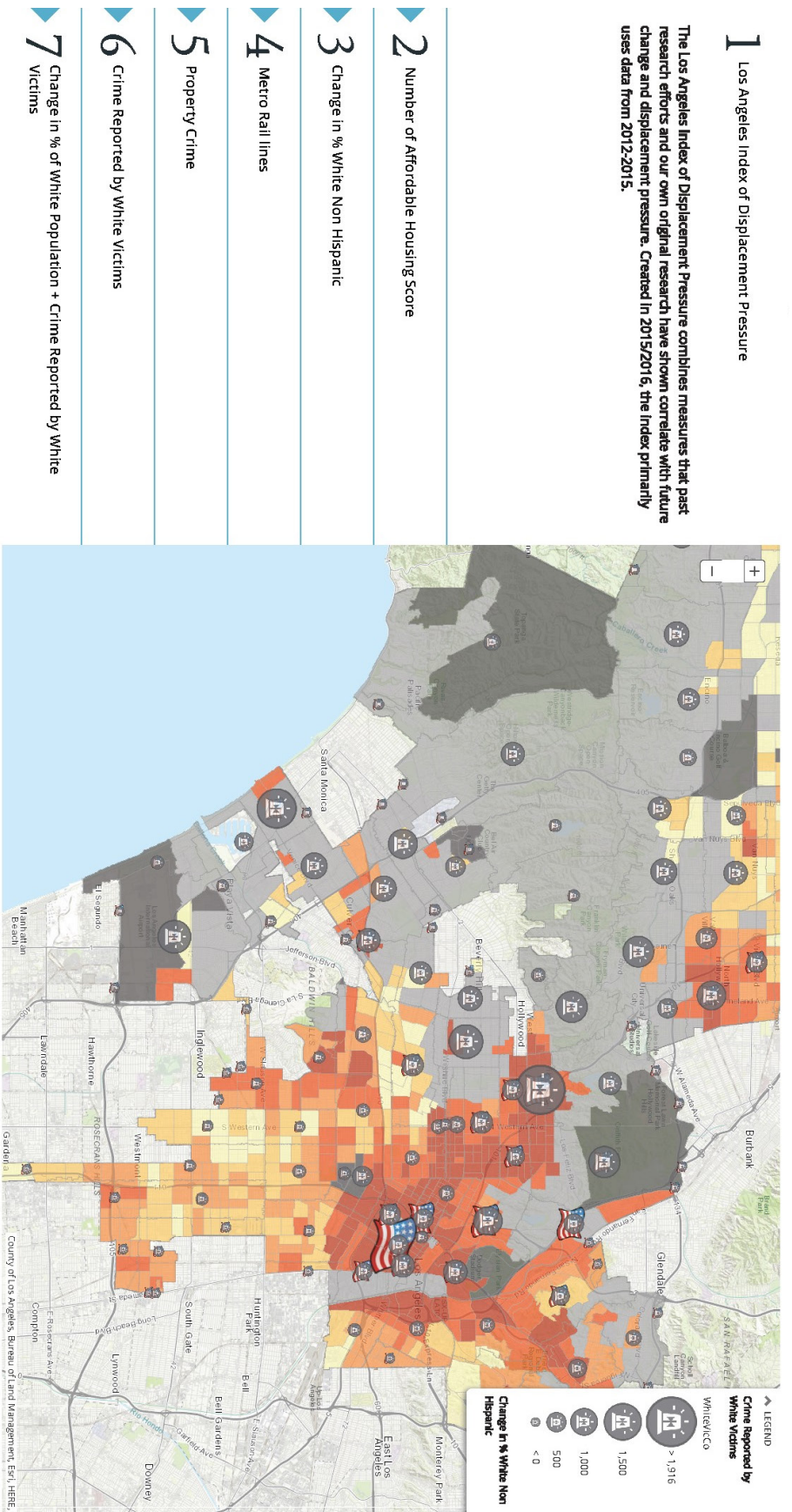
#### *Sociology Internships Course*

In spring 2019, the first author taught a sociology internship course in which students learned to use city data to convey the lived experiences of residents across different neighborhoods in Los Angeles. Each enrolled student identified a neighborhood where they wanted to spend the semester and chose a nonprofit serving the area to partner with. As their pitch to the nonprofit, students communicated that they would use data maps to help the organization identify problems and develop solutions to issues affecting the community. The focus of the internship would be to serve the needs of community stakeholders. At the beginning of the semester, GIS technicians provided hands-on training in working with geocoded data sets and using GIS mapping software. Throughout the term, representatives from nonprofit organizations were invited to attend class as guest lecturers.

The central theme of the course was analysis of police-citizen interactions. Class sessions included in-depth discussions based on readings about a range of factors influencing these interactions. Utilizing the LA GeoHub, students had access to extensive data sets of residents' 911 service call requests from across the city. They learned how to analyze the information contained in these calls and how to understand the resolution process. A key aspect of the class was not just locating data but also demystifying it by uncovering the methods of data creation and the variables involved in that data creation. The students aimed to determine the nature of the residents' 911 service call requests and attempted to uncover the outcome of service calls, including whether the police left without taking any action or if the call resulted in an arrest. In



**Figure 1.** Gentrification in Northeast Los Angeles



cases where an arrest was made, students sought to determine whether it was for a property-related or violent offense. By utilizing GIS mapping software and geocoded data sets, the students were able to address these questions and categorize the data for further analysis.

Throughout the semester, students worked in small groups to create maps and support community projects in collaboration with nonprofits and other community stakeholders. In pairs, students developed technology-related skills such as GIS mapping, data cleaning, and interpretation of big data, and they used these skills to bring stories about their communities to life. Community stakeholders and nonprofit partners prioritized topics such as immigration, gang diversion, social justice, housing, and democratic governance. This experience was particularly enlightening for students as they learned how to balance the demands of academic research, limitations in data, and the needs of serving a client who would utilize these data.

To protect the identities of the organizations and students, we have enumerated the student groups and used pseudonyms for the organizations, highlighting the nonprofits’ area of focus in the table above. The outputs presented in the table are data visualization projects.

Both students and instructors learned valuable lessons from this course. We discovered that providing the faculty cohort with sufficient time before the semester to collaborate and evaluate ways of streamlining technology trainings, pedagogical tools, and analytics allowed them to feel more confident in the modifications they made to their courses.

Near the end of the semester, students shared their story maps in a community town hall sponsored by the university. In their final term papers, students described community life in their neighborhood in Los Angeles through the lens of the big data that they used to construct their story maps. Some students documented the risk of displacement and shared data on population

**Table 1.** Sociology Internships Course Projects, Spring 2019

Name	Neighborhood	Nonprofit Focus	Project Title
Student Group 1	McArthur Park, Westlake, and City Terrace	Immigrant Rights	Policing Immigrants
Student Group 2	Boyle Heights	Big Data for Human Rights	Policing Holes in Data
Student Group 3	Highland Park	Gang Intervention	Policing in Highland Park
Student Group 4	Pasadena	Gang Intervention	Youth Interactions with Police
Student Group 5	Leimert Park	Gang Intervention	Police Patrol in the Neighborhood
Student Group 6	San Fernando City	Gang Intervention	Police Profiling and Delinquency
Student Group 7	Harvard Park	Peace for the Future	Crimes in Harvard Park
Student Group 8	Maywood	Pride and Influence	Arrests in Maywood
Student Group 9	Bell Gardens	Pride and Influence	Arrests in Bell Gardens
Student Group 10	Hawthorne	Social Justice	Police Brutality
Student Group 11	Alhambra	Social Justice	Policing in Alhambra
Student Group 12	Koreatown	Social Justice	Policing in Koreatown
Student Group 13	El Sereno	Social Justice	Gentrification and Policing
Student Group 14	South Central	Social Justice	Crimes After the Riots

turnover in the neighborhoods of Boyle Heights, Little Tokyo, and El Sereno in Northeast Los Angeles. Other students traced characteristics of property and violent offending and victimization in Compton and Watts in South and Central Los Angeles. Another group of students partnered with Breaking Through Barriers to Success to examine gang diversion strategies in the neighborhood of Highland Park in Northeast Los Angeles.

### *Urban Sociology Course*

In spring 2022, the first author taught a graduate seminar in urban sociology. This course's unifying theme was the topic of gentrification. To analyze the state of local communities, students were tasked with quantitative analysis of social change in a handful of neighborhoods that make up South Los Angeles, including a few neighborhoods north and west of Downtown Los Angeles. Students used the *Los Angeles Times* Neighborhood Mapping layer in the LA GeoHub to identify specific neighborhood boundaries; these neighborhoods were preidentified by the *Times* as gentrified, gentrifying, and nongentrified.

Sun and shade were marks of privilege during the “booster period” of Los Angeles, which had become a burgeoning metropolis by the 1900s. Redlining, implemented by the 1930s, sustained a long history of segregated urban spaces in the city (Sanchez, 2019). Restrictive covenants were overturned by two landmark Supreme Court cases: *Shelley v. Kramer* (1948) and *Barrows v. Jackson* (1953). Yet during the Cold War era, discriminatory housing policies and economic obstacles persisted in the city, leading to at least two violent uprisings. The first occurred in Watts in 1965, and the second took place across Los Angeles in 1992 in response to the acquittal of the police officers responsible for the beating of Rodney King. In years since, Los Angeles has seen a continuation of police violence directed at ethnoracial minority communities across the city, most famously the Rampart scandal at the end of the 1990s and start of the 21st century (*Rampart scandal timeline*, n.d.).

The demographic and social changes across the urban landscape in South Los Angeles reflect the transformation of urban space driven by political and economic factors. Between 1990 and 2000, the neighborhoods in South Los Angeles changed from majority Black to majority Latina/o. Students analyzed data sets for years 2000, 2010, and 2020 to quantitatively measure social and geographic migration into and out of fourteen different neighborhoods in South Los Angeles. We

hypothesized that there was more than a simple name change when “South Central” became “South LA.” The rebranding of South Central to South LA seems to represent the process of “Black erasure” in and “Latinization” of South Central together with the marketing of South LA to attract wealthy corporate investors, such as the National Football League and National Basketball Association to Inglewood.

Urban sociology offered students an opportunity to build neighborhood maps with open data sources. Prior to the start of the spring semester, the first author requested data sets from the Los Angeles open data portal to be processed for mapping. Because he had previously participated in the Big Data Project, he was already knowledgeable about the technological aspects of the project and was able to work ahead to expand the class's pedagogical framework and course projects. The course was then able to utilize more advanced techniques, such as building in data collection. The emphasis on trends related to gentrification allowed students to explore several different map layers in ArcGIS: population turnover, city permit requests, pedestrian and automobile traffic, crime and arrest data, recreational facilities, and location of nightclubs and coffee shops, among other data sets that were more specific to each neighborhood. To complement the quantitative data, students explored their assigned neighborhood by taking a walking tour and gathering visual and qualitative data through surveys and interviews.

### *City-University-Community Collaboration*

Participatory democratic action begins with informed residents. Civic engagement through big data starts with teaching students about access to information in the Los Angeles open data portal. The CSULA Big Data Project provided opportunities for faculty, students, and Los Angeles-based nonprofit organizations to gain digital literacy skills and technological and analytical skills in ArcGIS. After 3 years of working on this project and leading faculty and students through the trainings, we believe that this partnership model between local government, higher education, and nonprofit organizations can be successfully adopted by other cities and higher education institutions across disciplines.

LA GeoHub is a space for students to engage with government information and data about residents across and within the city. Big data projects prepare students to adapt and learn emerging information-gathering strategies.

Applying varied, discipline-specific academic concepts and theory to big data projects prepares students for employment in many growing industries, such as health care, immigration, public-private partnerships, and nonprofits. Big data literacy activates a multidisciplinary approach to analyzing and interpreting information and information-sharing technologies to promote quantitative and analytical reasoning. Data analysis using ArcGIS taught students how to communicate large amounts of information through visualization. Using story maps<sup>1</sup>, students were able to create presentations of varying forms of data combining maps, graphs, charts, images, and text.

### **Lessons Learned Teaching and Learning Community Engagement Through ArcGIS**

Program assessments conducted by an external evaluator, which included periodic surveys of students and faculty involved in the Big Data Project, showed that the learning goals of faculty in the Big Data Project course redesigns were met. In both the Introduction to Higher Education courses and the spring course redesigns, faculty expressed that they became more aware of their ability to influence student advocacy through big data and to consider these projects as research opportunities. Additionally, faculty noticed an increase in undergraduate student engagement and increased use of soft skills like teamwork and collaboration. Students also showed an overall greater interest in big data throughout the courses.

#### *Lesson 1. Ability to Adapt*

As the first COVID-19 infections were detected in the spring of 2020, the functioning of public universities across the United States, including the LA GeoHub project in California, abruptly changed. The growing community uncertainty due to news of the impending pandemic necessitated a transition to online teaching and learning, offering a chance to reevaluate communication and collaboration with Los Angeles-based nonprofit organizations.

The pandemic presented an unexpected occasion to practice building a better world by tapping into big data. Prior to the pandemic shutdown in the 2019–2020 academic year, faculty and students met with nonprofits in person to observe their day-to-day operations. This allowed

students to form partnerships in a conventional manner. After the shift to remote learning, the whole project went remote. Because the lead author's project was based on data and technology, however, it was unaffected. The annual student symposium was moved from in-person to online and saw increased audience participation and visibility of students' work in public spaces. The shift to remote operations brought a new emphasis on accessibility in collaboration. Story maps were prominently displayed on the university website and shared with nonprofit organizations through email. Despite the transition to fully online teaching and learning, the mapping and data components of the collaboration remained unaffected due to the technical proficiency of both college students and nonprofit staff in accessing and utilizing online resources.

#### *Lesson 2. Building Partnerships With Community Stakeholders*

Internal evaluations collected positive feedback from nonprofit organizations about the partnership through the LA GeoHub course, with some expressing interest in future collaborations. However, participants voiced a need for more preparation time due to the pandemic-related challenges faced by many nonprofit organizations serving the community. Furthermore, the nonprofit organizations stressed the importance of having dedicated staff members who would oversee their participation in the partnership. The most significant impacts of the big data collaborations were seen in the areas of engagement and the convergence of digital design, nonprofits, and community involvement.

The external evaluator's findings showed that the collaboration between GIS technicians and faculty enhanced digital literacy, proficiency with ArcGIS, comfort with big data, and civic engagement leadership among both faculty and students. The students also gained a deeper understanding of the relationships among digital design, nonprofits, and communities. Additionally, the graduate students working as GIS technicians on the project experienced a boost in their self-efficacy.

This project provided select Los Angeles-based nonprofit organizations free access to ArcGIS software so that they could continue to work with Los Angeles city data. These nonprofits

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<sup>1</sup>To view the "Crimes in Highland Park" story map, please visit <https://arcg.is/1Xi01f1>



organized workshops for other local service-based organizations to highlight the advantages of utilizing data to fulfill their objectives and meet their requirements. Students learned to access and use data to determine further information they would need to better serve their communities, increasing their awareness of the amount and value of the data available to them. The project achieved its goal of promoting the use of data to drive positive impact and advance the public good.

### *Lesson 3. On the Messiness of Big Data*

As educators, we aim to start the academic term with a clear lesson plan and course map, but by Week 5 of a 15-week term, the project's progress was slower than expected. This was due in part to the messiness of working with big data, which often required adjustments to the original plan. Mid-semester, faculty encountered challenges in keeping projects on track and centering the focus on overall goals. A constant challenge was balancing technology skill building with delivering course content. To foster a collaborative and supportive learning environment, we encouraged faculty to be authentic with students and embrace the imperfections of integrating digital literacy skills into a course project. This shift in approach helped balance power and created a more equitable learning experience. Emphasizing that teachers are also learners helped students realize that we were all navigating the experience together. This approach to teaching and learning improved collaboration and discussion about the complexities of big data between faculty and students.

A second challenge revolved around two fundamental questions: What is the purpose of collecting copious amounts of data? And what are our plans for utilizing this data? The LA GeoHub holds a vast amount of data collected by the City of Los Angeles. Although residents have unlimited access to the data, they may struggle to derive valuable insights from them. The lack of a clear course map or structured assignment can make big data overwhelming for those new to learning about and teaching it. And while incorporating data mining and analytics can aid in identifying patterns for research topics, it is crucial for students and faculty to understand that the LA GeoHub data may not always be accurate, complete, or accessible in the desired format. Despite these weaknesses, the students appreciated seeing how the city's advanced technology and digital reporting enables residents to evaluate local government operations. They also recognized the potential for the same data to reveal

biases and systemic inequalities. It is important to keep in mind that as researchers and educators, we rely on data collected by the government to address inequalities and obstacles created by the same local governments, which often lack transparency in their data collection methods, how the data are used, and by whom they are used (Winter, 2018).

### *Limitations*

Throughout this Big Data Project, we recognized that this organic partnership with multiple external partners was not without limitations. First, one of the most glaring was the lack of access to and experience with technology and the use of large data in a new digital environment that students may not have been exposed to in high school. Research shows that Latina/o and Black Americans have low representation in the fields of big data and data science (Funk & Parker, 2018; Goins et al., 2021). Although our project supplied a meaningful introduction for these undergraduate students, much work is still needed to bridge the gap and bring equity into the digital landscape.

Second, we found that it takes a partnership with a municipality to obtain clean data and gather geocoded data ready for analysis. For example, data on fire accidents did not reveal the location and/or types of business affected, so these important layers could not be included in community story maps.

Third, our program assessments, which asked faculty about their experience in teaching with big data, improved steadily every year as we refined aspects of our big data and LA GeoHub training and methods to combat teacher fatigue. Yet one of the issues raised by faculty across the discipline was time: the amount of time needed to create new course content and adapt to challenges faced during the semester. Project-based learning requires a high level of commitment from faculty and students that is always clear on paper; however, in praxis, collaborative group work is challenging due to time management considerations and students' familial and work obligations.

Additionally, we found that data were not housed in a single accessible space. Government entities restrict and inhibit data collection by municipal boundaries such as city, county, and others, leading to geographic holes in maps that cannot be immediately remedied.

As educators, we meet students where they are, and teaching digital literacy skills with specialized software like ArcGIS has highlighted the existing inequalities and barriers that our first-generation students face in education.

## Conclusions and Future Directions

CSULA remains committed to community engagement and scholarship, as it is a primary part of our university mission. Through this Big Data Project, we learned that students and faculty both benefited from using big data in project-based learning, nonprofit organizations received valuable technological training, and our summer SEED interns adapted their projects to meet the specific data needs of nonprofits. Our partnership with the City of Los Angeles has led to improved data collection methods by the city. Furthermore, our program data requests have enabled us to clean new data and make it available for others to use. By partnering with organizations like the City of Los Angeles and nonprofits, we have been able to connect classroom learning with real-life job experiences, create awareness for first-year students, and provide our students with a pipeline of insight and opportunities into a changing job market. Community-based research is a bridge between academic disciplines and community stakeholders to address existing barriers and challenges, such as those related to the natural and built environment in our urban areas (Corbett & Lydon, 2014; Powell, 2010).

We utilized ArcGIS and open data to create new teaching and learning tools for civic engagement. Faculty members contacted nonprofits and requested that they provide our students a space to practice collaboration by accessing anonymized geocoded data sets available in the LA GeoHub portal and sharing their findings with the community. Subsequently, students applied the tools they developed in the classroom to their civic engagement projects in the community. This experience enabled students to connect with their communities in ways they had not imagined before their exposure to GIS mapping software and nonprofits.

In November 2020, faculty members were surveyed by an external evaluator regarding their participation with the Big Data Project, and several significant outcomes were identified. First, the evaluation reported an improved level of comfort with digital literacy and a greater familiarity with the LA GeoHub portal. Second, faculty members demonstrated an enhanced awareness of resources available to them through the collaborative partnership between the university and the City of Los Angeles. Lastly, faculty expressed a commitment to course redesign with a strong focus on community-engaged teaching. In sum, participating in the Big Data Project course

redesign enhanced community partnership ties between the faculty, students, community, and city.

A separate survey of students conducted by an external evaluator in July 2022 revealed similar trends, but with an added dimension of increased self-efficacy. The students surveyed displayed increased confidence in their ability to effectively address challenges and achieve a desired goal. In addition to improved digital literacy and enhanced awareness of resources, students were more reflexive about their roles as stakeholders in their own communities. Community-engaged teaching and learning creates opportunities for students to contemplate their roles as learners, active contributors to, and stakeholders in their communities and the university. As teacher-scholars we advocate for building stronger bonds between our university and the local communities that we are connected to.

Faculty advanced their professional growth as teacher-scholars by teaching and learning the skills of data mining through visualization with ArcGIS. By serving as facilitators connecting students with nonprofits, we have built more bridges connecting the university to the surrounding community. During our town hall, students and faculty shared the outcomes of their collective efforts with representatives from the Los Angeles mayor's office, further strengthening the ties between the university, the surrounding community, and decision-makers who influence the day-to-day life of residents of Los Angeles.

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