Charidy Paige and Jeanine Finn

From Student Project to Research Agenda

How Libraries Facilitate GIS Education and Collaboration

Geographic information systems (GIS) have been a tool and methodology deeply intertwined with academic libraries since the initial efforts of ARL and ESRI to support the development of map librarians into geospatial data experts in the early 1990s.[1] Although GIS in libraries has been a source of successful collaborations, the demands are often overwhelming for library staff.[2] Over time, the scale, formats, and methods of data sharing have evolved significantly,[3] requiring skills beyond many traditional library competencies.

Exemplifying these trends, The Claremont Colleges Library (TCCL) has supported GIS through an Esri educational license and various supporting data subscription products since the late 1990s. Uniquely positioned as an academic library, TCCL supports seven separate educational institutions (five small liberal arts colleges and two graduate colleges) under the umbrella of a separate services organization. Between 2020 and 2022, following a major shift to online learning across all of our constituent colleges, our library experienced a dramatic increase in ArcGIS users, particularly users of ArcGIS Online, and sought to create a more sustainable support infrastructure. Toward that end, we created a graduate student position and hired a doctoral student from Claremont Graduate University's Center for Information Systems and Technology (CGU-CISAT) with substantial GIS experience to develop an ArcGIS Hub site. The goal was to establish the hub site as a central online presence for sharing data and educational resources.

Background

In the spring 2022 semester, Charidy Paige worked as a library GIS student assistant at TCCL under the guidance of Data Science and Digital Scholarship Coordinator Jeanine Finn. Her primary responsibility was to develop an ArcGIS Hub site to provide a centralized site for geospatial content for students and faculty from the colleges. Although the Esri Hub platform met the project's technical requirements, finding and curating the content for the site highlighted the organizational challenges in GIS support at the Claremont Colleges. We struggled to make GIS tools and data more accessible and useful for intercollegiate and interdisciplinary collaboration because of the limited understanding of the nature of these collaborations. Key issues such as cross-institutional access, platform maintenance, and ownership responsibilities created complexities that needed to be addressed within a

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multi-institutional framework. With eight different IT departments across our consortium and a growing number of departments and courses exploring GIS applications, we realized we didn't have a sufficient picture of our user community within this complex environment.

As we discussed these challenges, we found useful support for better understanding a path forward in two theoretical constructs from organizational studies and science and technology studies. First, Boundary Object Theory[4] proved useful in illustrating how shared tools or platforms, like ArcGIS, can successfully exist at the intersection of heterogeneous practices—if the shared understanding of them is both consistent and flexible. Similarly, Resource Dependency Theory explains how organizations reduce environmental interdependence and uncertainty.[5] It provides a framework to understand how limited resources, institutional dependencies, and priorities can create barriers to intercollegiate and interdisciplinary collaboration. Together, these theories help explain the systematic issues encountered during Paige's work and provide a foundation for her dissertation, "Unlocking Organizational Potential for GIS Collaboration in Higher Education."

Boundary Object Theory

As originally developed by Susan Leigh Star and James R. Griesemer, the theory of "boundary objects" has been used in understanding how different communities engaged in complex knowledge work can converge around a single object, even if each community has a different understanding and set of functions associated of the object.[6] As originally defined, "Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites."[7]

In our case, GIS tools are used and understood in various ways by the departments and researchers in our community, but "GIS" still serves a central coordinating function. Considering GIS as a boundary object allows us to engage across several communities (including instructional departments and IT support) that may be operating with diverging organizational goals and unique constraints to better understand the barriers to collaboration.

Resource Dependency Theory

Resource Dependency Theory recognizes the influence of external factors on organizational behavior. Jeffrey Pfeffer and Gerald R. Salancik emphasize that organizations must manage dependencies on external resources to mitigate uncertainty and exert control over their environment.[8] Although organizations are constrained by their context, managers can still act to reduce environmental uncertainty and dependence.[9]

Developing an ArcGIS Hub site to centralize geospatial content revealed several resource dependencies that hindered the library's ability to realize its role as a GIS support entity. TCCL benefits from an Esri educational site license (paid from the library's budget), which provides students and faculty access to many of Esri's suite of products. Although Esri is the leading GIS software globally, this reliance also creates limitations, leaving gaps in knowledge and skills related to alternative GIS software, such as open-source tools. Additionally, cross-institutional collaboration within the Claremont Colleges created interdependencies that further complicated support efforts, such as negotiating ownership of shared content, managing maintenance responsibilities, and ensuring access for all consortium members. These dependencies were often opaque to the library license administrators.

RDT provides a framework for understanding how these challenges manifest. Libraries, like other organizations, operate within a resource-dependent ecosystem where they must navigate relationships with external entities (that is, software vendors, funding agencies, and so on) while simultaneously addressing the needs of students and faculty. Furthermore, resource limitations such as staffing, funding, and technical expertise must be considered when establishing support levels for an institution.

First Steps: GIS Education Through Dialogue and Collaboration

Following these conversations, we began to develop a fuller picture of the difficulties in supporting GIS curriculum and instruction as we engaged with other researchers and scholars in this space. In the spring 2022 semester, we participated in workshops with Pomona College Professor Guillermo Douglass-Jaimes aimed at redesigning the *Just! GIS* course, which draws on Critical GIS principles to emphasize ethical and socially just applications of GIS tools. These workshops were instrumental in developing a Collective Learning Model (CLM) for GIS instruction, focusing on peer mentorship, technical problem solving, and the cocreation of GIS tutorials. During these sessions, collaboration with staff from the Claremont Colleges Library and Pomona College IT department revealed several key barriers to accessing GIS tools, particularly for non-Pomona students. Issues such as licensing, technical access to software, and integration of GIS services across different colleges were identified as central challenges.

Later that year, in December, we attended the first GIS Librarians for Open Workflows (GLOW) Forum at the University of Chicago, where librarians and GIS professionals from across North America convened to discuss best practices for GIS support in academic libraries. Our participation in this forum was directly related to Paige's work with the Claremont Colleges Library, as it provided insights into how GIS librarians can better support faculty and students across institutions. The forum covered several key topics that align with her research and work at the library, including the importance of resource identification, the integration of GIS with data science services, and setting clear expectations for GIS consultations. Additionally, a discussion on open educational resources (OERs) focused on the challenges of ensuring quality and consistency in GIS instruction when relying on freely available resources.

Participation in both of these initiatives shaped Paige's research and led her to develop her dissertation topic, which sought to understand the various challenges that arise during GIS collaboration. Her experience working on the ArcGIS Hub site and engaging with interdisciplinary teams highlighted organizational barriers and gaps in collaboration, prompting her to explore these issues in depth. To explore the challenges and practices associated with GIS collaboration in higher education, a survey was developed using Microsoft Forms. The primary objective of the survey was to gather information from GIS instructors on collaborating with GIS technologies outside their department and institutions. The survey aimed to validate and potentially discover technical and organizational challenges encountered during external collaborations. Additionally, it sought to uncover new approaches and best practices that GIS instructors used to navigate these challenges. The survey featured a mix of multiple-choice and short answers, organized into six categories: institutional and teaching background; GIS usage and support; GIS collaboration tools and applications; collaboration; internal and external challenges; and evaluation.

Ongoing Research

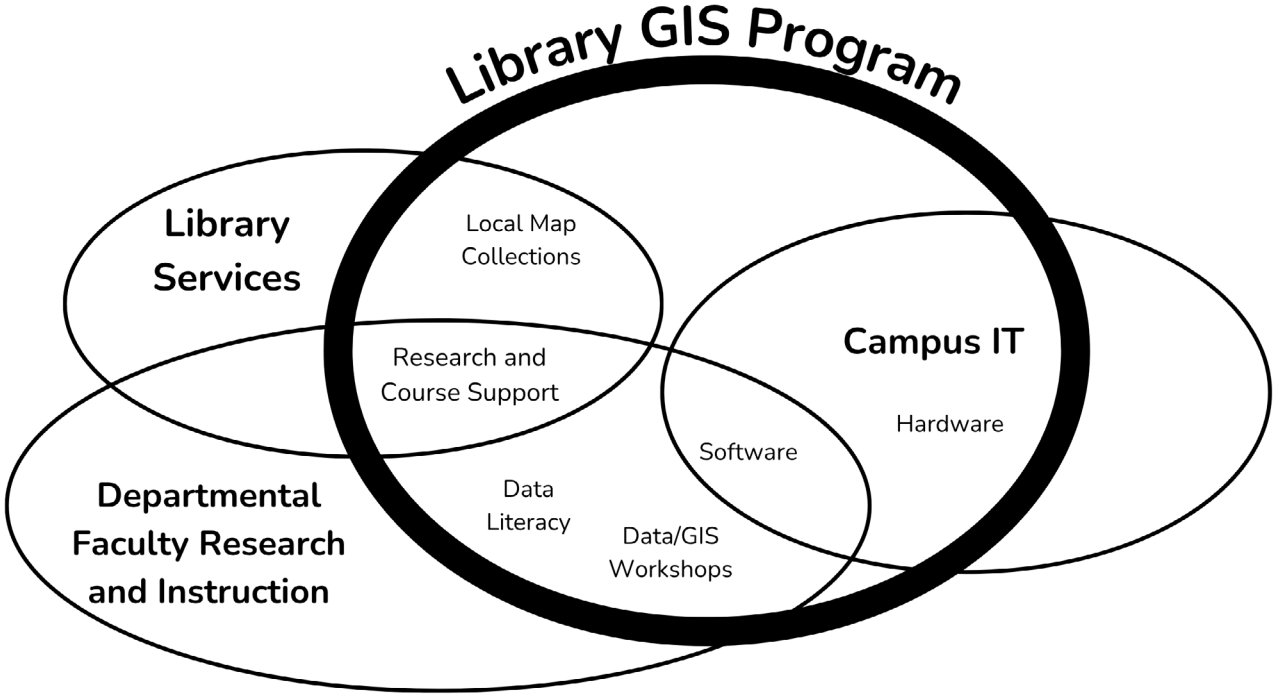
Paige's research originated from an exploration of intercollegiate collaboration within the Claremont Colleges, intending to foster stronger connections among GIS users. In May 2022, a virtual GIS faculty panel discussion was hosted to further explore the needs and priorities of GIS users. This discussion was guided by prepared questions and supplemented by three surveys addressing GIS training, collaboration, and data. The primary goal was to enhance intercollegiate collaboration and identify opportunities for more effective integration of GIS resources and expertise across the Claremont Colleges. The forum's discussion shed light on larger issues and challenges that extended beyond the initial focus, such as determining ownership and maintenance of the Hub site, identifying appropriate data sources, and defining the content. As the project progressed, it became evident that a more comprehensive understanding of GIS teaching perceptions and the barriers to adopting data-sharing platforms was necessary. As a result, the research shifted away from focusing on a specific solution (ArcGIS Hub) to foster intercollegiate collaboration and instead expanded to include a wider network of GIS instructors beyond the Claremont Colleges. The study now examines experiences of instructors across North America with GIS collaboration, particularly when working across departments and institutions.

Although Paige's research focuses on the broader experiences of GIS instructors, certain questions in her survey provide perspectives that can directly inform and support library services. For instance, when asked how students receive GIS support, respondents could select multiple options: Instructor support was reported thirty-six times, IT departments fifteen times, and libraries thirteen times. Although IT departments have traditionally played a role in GIS support and instructors remain the primary resource, this reflects the evolving role of librarians in providing and maintaining technology-driven resources, including geospatial data.[10]

In addition to examining how students receive support, the survey also asks participants to identify types of support that would help them collaborate better. The most frequently selected support type was increased funding and grants for collaboration, followed by the facilitation of interdepartmental and institutional partnerships. Although securing funding may fall outside of the traditional role of librarians, libraries are well positioned to support facilitation. By building on their existing strengths in making resources findable and accessible as a path to foster collaboration, libraries can help alleviate the burden on instructors, who are often inundated with preparing lectures, grading, and providing technical support to students, leaving little time to coordinate collaborations among peers. By bridging departmental silos, libraries can support the introduction of GIS to other disciplines while serving as central hubs through any of the following initiatives:

- Facilitate interdepartmental partnerships
- Facilitate cross-institutional partnerships
- Coordinate GIS events
- Host professional development opportunities
- Create collaborative projects

There are many other ways that libraries can partner with faculty. Libraries share a natural affinity with faculty and academic departments in that they all share in teaching and facilitating student learning.[11] Determining the level of support that a library will provide requires



A library GIS program at the center of areas of practice on campus.

case-by-case assessment and a strategic approach to align capacity and resources with the specific needs of instructors and departments.

Conclusion

The collaboration between the Claremont College Library and a graduate student provided a look into the challenges of GIS support within a multi-institutional framework, which can also be applied to understanding the complexities of library collaboration across departments. By leveraging theories such as Boundary Object Theory and Resource Dependency Theory, we can further explore new ways of understanding how libraries navigate resource dependencies, build connections, and spark innovation. There is so much potential for libraries not only to support GIS literacy and research but also to drive collaboration within academic institutions in ways that develop mutually beneficial relationships and skill building across communities of instructors, students, and library staff.

Notes

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2. John Watts and Sierra Laddusaw, "Robust to Overwhelming: A Case Study on Planned Abandonment for GIS Services," *Journal of Library Administration* 61, no. 3 (2021): 347–57, https://doi.org/10.1080/01930826.2021.1883371.

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4. Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations,' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39," *Social Studies of Science* 19, no. 3 (1989): 387–420.

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6. Star and Griesemer, "Institutional Ecology," 387–420.

7. Star and Griesemer, "Institutional Ecology," 393.

8. Jeffrey Pfeffer and Gerald R. Salancik, *The External Control of Organizations: A Resource Dependence Perspective* (Stanford Business Books, 2003).

9. Hillman, Withers, and Collins, "Resource Dependence Theory," 1410.

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11. Robert A. Seal, "Resource Sharing Begins at Home: Opportunities for Library Partnerships on a University Campus," *Interlending & Document Supply* 44, no. 3 (2016): 127–34.