Spatial Thinking Across the College Curriculum

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Stanford University is in the position not unlike many others across the United States in that it lacks a Geography Department. This absence has created both opportunities and challenges for those teaching spatial thinking and concepts to both undergraduate and graduate students. The most relevant opportunity is to include the ability to integrate spatial concepts directly into subject-specific classes making the examples and the work more relevant to the learner. Challenges emerge when there is a lack of coordination as to what should be taught to all students, the desire of students to jump into their research rather than to understand the theory, and the concern that spatial thinking is only presented to the students when the faculty thinks it relevant to do so.

It is clear from working with students in the map collections that most have little background in reading maps, much less understanding them as carriers of distilled information conveying a specific point of view. More so than with textual information, students seem to believe that what is presented on a map is factual and do not think to question it as they would with text. The same has been observed when they encounter geospatial data. Little has prepared them to understand the nature of the data with which they work. Students come to spatial data with scant knowledge of scale, projection, map reading, or spatial analysis skills. Without a systematic training program, the students pick up this knowledge in a haphazard, unstructured way, either on their own or through disparate teaching.

Stanford University presents an environment with entrenched silos of expertise. The culture encourages this even in the midst of a strong push towards interdisciplinary research. It is a culture of innovation and entrepreneurship that fosters independent thinking and the desire to quickly move into new areas of research. Over the past dozen years the campus has strongly embraced geospatial research and thinking in the curriculum. The sciences were the first to move in this direction followed by the social scientists and then the humanists. The classes offered throughout the university mirror this diversity.

- Civil and Environmental Engineering—Environmental and Water Resources Engineering Design
- Electrical Engineering: The Earth from Space—Introduction to Remote Sensing
- Geological and Environmental Sciences: Geostatistics for Spatial Phenomena
- Geophysics: Remote Sensing of the Oceans
- Political Science: Spatial Approaches to Social Science
- Anthropology: Cities in Comparative Perspective
- History: Spatial History—Concepts, Methods, Problems
- Classics: Modern Journeys in Ancient Lands—Building a Spatial History of the Grand Tour
While the classes all integrate aspects of spatial in their mix, they tend to focus on applied teaching rather than on understanding basic spatial concepts and analysis. The class “Fundamentals of Geographic Information Systems” taught by Patricia Carbajales, the library’s Geospatial Manager, counters this approach. The four unit class is the only one taught in the university (once a year) that provides a solid foundation in the principles of cartography, geographic data structures, statistical analysis of geographic data, spatial analysis, map design and GIS software. Students from across the schools take the course; it is required for urban studies students. While not required for students in Civil and Environmental Engineering, Earth Sciences, Political Science or History, many take it knowing they will need this background to do their work.

Branner Earth Sciences Library provides the backbone of support for geospatial data, teaching and software across the campus (lib.stanford.edu/gis). The program, run by Patricia in conjunction with 30 hours of assistant support a week, supports over 600 users on the campus. We offer numerous workshops on a regular basis including Introduction to ArcGIS; GIS Data Creation & Management; Basic Spatial Analysis; Google Earth, Maps & Fusion Tables; Spatial Statistics; and ArcGIS Online, Business Analyst & Community Analyst. After taking the Introduction to ArcGIS workshop (3 hours), the students may book individual appointments for reference help.

Clear trends have emerged over time as we have worked with hundreds of students and researchers. First, it is hard to persuade students as to the importance of taking time to learn and understand the fundamental concepts of spatial thinking that underpins GIS. They want a rapid turnaround for their time and are under pressure to do things quickly. This is combined with software that is getting easier to use and more accessible to a novice user. One may be able to click a button and get results, but without proper training one cannot critically analyze the results. It takes time to learn about datums, projections, coordinate systems, data management, and the difference between raster and vector models, the concept of scale and its effect on the structure of the data, classification methods, and the importance of solid metadata. It is a challenge to work with faculty to enforce these training concepts when they themselves have not been trained to think spatially. It makes it difficult for them to know what to ask for and, at times, expect things to be easier or faster to do.

What can the library do to help fill the gaps in the teaching curriculum? First we are in the final stages of hiring a dedicated GIS Instruction and Reference Specialist. This position will oversee the introductory workshop program that is required of all students and researchers who ask for support for our unit. This basic, introductory workshop has proven indispensable in equipping our students with their first exposure to the fundamentals of GIS and also to the software tools available in our lab. The person will also manage the support staff, often students from the San Jose State University Geography Department, who handle the bulk of the general reference interactions. This will give us 70 hours of dedicated support in addition to the Geospatial Manager.
Second, we are also starting to build out a highly specific training program structured around different disciplines. Patricia piloted this program over the summer in conjunction with faculty in Political Science and in History. One set of classes took place over the course of a week and the other stretched over a few months. Our goal is to work with faculty to create robust, relevant training specifically geared to their students that become required training when working with spatial data and spatial concepts. Questions remain as to the ability to scale such an operation or the willingness of the faculty in diverse disciplines to work with us to develop relevant training materials. So far, the response has been overwhelmingly positive.

Finally, the centralization of geospatial support in Branner Library has, in some ways, been a boon given the distributed, siloed nature of the campus. It allows us to create a suite of services that are distributed in a consistent way with a well-thought out strategy for support. We centralize the training of assistants giving us the ability to know that outreach will be competent, thorough, and relevant to student and researcher needs. It is clear we are providing a necessary piece of the puzzle for those working to integrate spatial thinking into their teaching and research.