Voting with Your Hands: GIS and Experiential Learning

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Abstract
Experiential learning is a trend in liberal arts colleges. Students are increasingly asked to learn by tackling problems beyond the classroom, often in the context of the local community. This can mean knowing how to apply technology and quantitative data to analyze and understand a problem, and GIS is a powerful tool for place- and data-based analysis. In concert with the chairs of the Political Science and Sociology departments, the GIS librarian at Trinity University developed a plan for teaching GIS in a semester-long flagship course on election statistics and redistricting in Bexar county. Course design provided users with early success in using GIS applications and geospatial data. Emphasis was placed on learning the conceptual aspects of investigating data, from issues such as data integrity and geodatabase design to application of the scientific method in such a context. Giving students experience to take into real-world situations is the ultimate goal.

Mapping the skills and qualities of the Millennials to the strengths of GIS.

This paper will discuss the integration of GIS into a political science course, recognizing that there are significant barriers to adopting GIS as a teaching tool, and addressing those barriers in turn. It will be found that the barriers many instructors anticipate are actually significant advantages: in most cases they are a strong match for the characteristics and learning preferences of the Millennial generation, and those same barriers are often the very qualities that make GIS an effective component of experiential learning in disguise.

Three of the most significant challenges in creating a GIS project or component in the classroom will not be addressed here. These are: obtaining the software and lab space; learning the software; and figuring out how to apply GIS in the context of the course's subject matter. However, I can give some easy advice in these areas: get help. Software vendors are typically eager to have their product used in institutes of higher education, and will offer deep discounts for educational users as well as a sales representative specializing in educational customers.

Obtaining lab space for GIS is no different than obtaining computer seats for any other software (see http://facultyacademy.wlu.edu/mark_rush_aug20.html for the text of a 2002 presentation by political science professor Mark Rush of Washington & Lee University on the technological challenges of teaching with GIS). In some institutions it will be the responsibility of the IT department; in others, it will be the library or the political science department that takes responsibility for GIS software and lab space.

Lastly, GIS in higher education almost always requires support in the form of a staff member or librarian who knows the software (or is willing to learn it) and can make the technical and machine-related aspects of GIS easy. As far as receiving GIS training for instructors, most GIS software vendors will offer training, and organizations that address technology use in education (such as the National Institute for Technology in Liberal Education, www.nitle.org) are excellent sources of context-specific GIS training for university faculty.

To make a GIS component successful, the following barriers must be addressed:

- The famous steep learning curve of GIS software.
- Engaging students with both the subject matter and the software as active learners, with the goal of seeing themselves as participants and, ultimately, as agents in the political process.
- Teaching students to apply research methods and analytical skills, and use GIS as a tool within this skill set.

The Learning Curve

Anyone familiar with GIS in the context of higher education is accustomed to hearing the phrase "steep learning curve" in all conversations where teaching GIS is involved. A quick Google search of "learning curve" + GIS will illustrate the prevalence of the association of difficulty with the acquisition of GIS software skills.

Luckily, there is very good news about this apparent barrier to teaching with GIS.

First, much of the software has improved tremendously in providing help, tutorials, and documentation. ESRI, for example, has made many of the basic and intermediate functions of their software available as help topics, and the interface, while not exactly intuitive, is designed to provide some documentation for the tools and features it presents.

Second, the supporting literature—books with step-by-step instruction and accompanying data CDs—is excellent and growing fast. With this growing literature comes expanded library holdings of GIS-related titles that offer guidance on which titles use, purchase, and refer to. Always look to intermediaries—librarians, IT wonks, GIS experts in the faculty—for guidance in selecting literature to help understand GIS software and gain technical skills.

Third--and most important--the skills demanded by GIS are a perfect match for the strengths and preferences of today's students. Here I'm referring to the skills required to learn a complex digital interface, locate and in some cases convert data, and in to use the software to display, query and analyze that data and put it into a critical context. According to management consultant Claire Raines (2002), the so-called Millennial generation is comfortable with technology, confident in their abilities, and eager to be challenged. They are also goal-oriented, collaborative, and excellent multi-taskers. Each of these qualities exploits what GIS has to offer. Thus, that steep learning curve becomes an asset; it challenges students, and shows that their instructors have high expectations of them. The very fact that GIS is a digital technology with a complex interface will be seen as a plus by most students, who are quick, confident and self-reliant learners when computers are involved. For those on the other side of the digital divide, the chance to learn such a technology in a supportive and directed environment will be a welcome opportunity to expand their digital skill set. The pairings continue: the difficulty of handling data engages Millennials' ability to multi-task, and the emphasis on analyzing it appeals to their own emphasis on goal over process. The collaborative nature of most GIS projects taps the sociability and inclusiveness of your students, and helps to counteract their potential to be impatient.

Lastly, GIS is reaching a level of prevalence in the workplace and in higher education that helps with overcoming that learning curve. As the concepts of spatial analysis become more and more familiar, and competent users of GIS proliferate, the challenge of teaching people to use the software grows more manageable. Instead of changing the way people think about the world, you only have to show them how to make the software perform. Further, college students require a *meaningful* context in which to apply the software. They must care about what they're studying and be intellectually challenged as well.

Engaging Students

There are two assumptions in this section on student engagement:

One: Getting students to care and be curious about a project is crucial to giving them a valuable learning experience.

Two: Apart from compelling subject matter, students need to have content presented in ways that match their learning styles.

Dealing with the first assumption seems daunting. Millennials have a tendency to be politically apathetic (Sandfort and Haworth, 2005). However, as a subset of their generational cohort, political science students are more likely to both care and be curious about a political topic, like redistricting, that works well with spatial analysis. While they are disillusioned about the ability of politicians to foster progressive change, they are optimistic about their own capability to produce change at the local or community level (Sandfort and Haworth, 2005). This is reinforced by Raines (2002), who tells us that Millennials are civic-minded: "They were taught to think in terms of the greater good. They have a high rate of volunteerism". GIS facilitates a place-based inquiry which involves people identified, among other things, by where they live. In other words, it tends to focus on communities. This could mean the community local to your classroom, or the community of a student's hometown, or anywhere that people have a shared concern. Because a compelling political issue is--through the introduction of a spatial component--brought literally close to home by involving place, students have a way to identify with the subject of their study and make it personal. So, what do we have? We have a group self-selected to the discipline and, by extension, the topic of the project; the incorporation of a spatial component that adds a local interest to the content; and an audience inclined toward civic projects, especially those that might address a social or political problem.

The second assumption is where the challenges—and the rewards—come in. While students in the Millennial generation have some remarkable advantages when it comes to learning new computer skills and applying technology, they are no different than other generations in the range of learning styles they collectively bring to the classroom. Political science students in particular are likely to encounter instruction skewed towards abstract and reflective learning (Fox, Ronkowski 1997). However, the same study shows that students' learning styles were evenly distributed across the Kolb inventory (Fox, Ronkowski 1997). They go on to recommend that instructors follow Kolb's Experiential Learning Cycle in planning curriculum, as this will systematically address each of Kolb's four learning styles.

Kolb's Experiential Learning Cycle involves four stages of acquiring understanding: concrete experience, followed by reflective observation, then abstract conceptualization, and finally active experimentation. Simplified, this cycle becomes experiencing, reflecting, thinking, and doing. The four learning styles identified in the Kolb inventory involve contiguous pairs of these stages: The divergent style favors concrete experience and reflective observation; the assimilative style favors reflective observation and abstract conceptualization; the convergent style favors abstract conceptualization and active experimentation; lastly, the accommodative style favors active experimentation and concrete experience (Kolb, 1984).

A successful learning experience will teach to each of these learning styles by including components that represent each stage of the cycle. It is my contention that *even a poorly-conceived* GIS project will include components that match each of the four stages of Kolb's model, because using GIS involves encountering information (experience), generating a question (reflection), finding relevant data and determining ways to manipulate it (thinking), using software to create a result, and looking at the results to learn something new about the data (doing) (ESRI, 2005). A *well-conceived* GIS project will give equal attention to each stage of the Experiential Learning Cycle whether intentionally referring to Kolb or not, since each of the corresponding curricular components are of equal value to a practical and successful analysis of spatial data with GIS. A brief informal survey of instructors comments on the topic of teaching with GIS supports a balance between active (doing/experiencing) and passive (reflecting/thinking) instructional components: "…I emphasize the appropriate deployment of concepts and judgment rather than keyboard commands. Throughout, I stress that GIS [is a tool] that allows researchers to examine patterns in natural and built environments" (Schuurman, n.d.); "The optimal use of GIS is not as a prop for didactic instruction, but as a tool for supporting project-based learning" (Audet, Fitzpatrick, Gordin 1998); "GIS can position students as active agents in the process of learning, not as passive recipients of knowledge from teachers" (Foote, 2004). By ensuring that the "doing/experiencing" components receive as much instructional emphasis as the "reflecting/thinking" components, an instructor can both acknowledge and address the even distribution of learning styles discussed by Fox and Ronkowski (1997).

(As a successful example of teaching with GIS, see the webpages on Mark Rush's 2002 Politics 295 course at Washington & Lee University. http://itl.wlu.edu/gis/redistw02/ http://home.wlu.edu/~rushm/295w02syl.htm)

Concrete Experience and Reflective Observation:

The course that serves as the basis for this paper was conceived by Dr. L. Tucker Gibson, department of Political Science, and myself. The course--*GIS, The Census, and Politics*--begins by providing students with an experience of the Census as end-users. This initial exercise asks them to access and examine the kind of data they would need to understand the congressional district to which they belong, and to verify that their rights as voters are being preserved by the geography of their district.

Readings that highlight the methods and controversies of the Census as a component of political representation are assigned at this time, and students are asked to reflect on their experiences as end users of the Census in light of their readings. Class discussions, reflective writing, and a community blog are possible ways of facilitating this reflection and capturing students' observations.

Abstract Conceptualization and Active Experimentation:

At this point we move to lab instruction which introduces ArcView 9.1. Students will learn how to join Census data (race data at the block level) to voting precinct shapefiles, and learn how to use the software to display this data. Where data is available, county-level voting data aggregated at the precinct level will be incorporated as well. While students will be learning software skills during this section of the course, they will also be asked to conceptualize use of the ArcView software as a tool for addressing some of the questions that arose from their experiences with the Census. In this stage they begin to synthesize their experience as end-users of the Census with their reflections on the readings and with their emerging understanding of GIS as an analytical tool for examining spatial relationships.

Finally, students are asked to use the software to generate new districts at the county level, based on their understanding of Census data, precinct-level voting data and GIS (this task will most likely take advantage of the redistricting extension available for ArcView 9). Since each student or group of students is likely both to generate several possible district maps, and to manipulate variables that will affect the final appearance of their maps, this stage will be both active and experimental. Students will put into practice the knowledge, skills, and information they have acquired from the preceding parts of the course.

To simplify the correlations of the project components with Kolb's model, I will list them below:

Experiencing: Students encounter the Census as an end-user: a voter seeking to be informed.

Reflecting: Students express observations about the Census and reflect on their experience in light of what they learn from the reading.
Thinking: Students plan research questions and methods of data analysis after being introduced to ArcView.
Doing: Students use the software to answer questions, perform and display analyses, and create new information (i.e. district lines). Such activities have a potential real-world application.

The Research Context

Teaching GIS as an analytical tool in a political science course requires a context of research methods and statistical analysis. As one of the potential barriers to a successful implementation of a GIS project, providing this context is perhaps the easiest to deal with, as it generally does not require new training or software skills on the part of the instructor. Such a context would be required for any use of quantitative data in a research setting.

While instructors may fear that introducing statistical rigor and research methods may demoralize students already daunted by quantitative data, this author takes the position that insistence on these aspects of the course is necessary for two reasons. First, a foundation in the scientific method and statistical analysis is a powerful key to conveying the value of the project to students and to securing their intellectual and emotional investments in the subject matter. Writer J.C. Herz asserts that providing context to information is essential to giving it value in the eyes of its users (Herz, 2005). Statistical methods of analysis *are* this context, in the case of a GIS project analyzing voting behavior and districts. Herz locates 'context' in other users, in the flow and use of information, rather than in its essential qualities and what a given piece of information may signify on its own. By teaching statistical methods and research parameters alongside the specific content of the project and its subject, instructors impart worth to data and spatial components by making it part of a flow and exchange of information in the digital realm—much like working towards the publication of a scholarly work, though on a more modest and accessible scale, and one appropriate for undergraduates.

Second, spatial analysis produces valid results only when done scientifically. Like any data, spatial data is susceptible to easy misinterpretation and misrepresentation, especially with a visual medium like a map display. Rigorous, useful results are only possible when the method used for analysis is valid and strictly adhered to. GIS is only a tool for employing these methods, not a replacement for teaching them and requiring students to use them conscientiously.

Conclusions

There are considerable challenges involved in creating a GIS learning experience in a political science class. However, the strengths of GIS as an educational tool make those challenges easy to overcome, and contribute substantial benefits as well.

Many of the barriers to adopting GIS as a teaching tool in political science are greatly reduced and in some cases rendered as assets by the unique qualities of the Millennial generation, who bring to the classroom the confidence and comfort with technology, the eagerness to be challenged, and the optimism and motivation to be a force for change that are in fact a perfect match for the 'difficulties' of GIS.

Moreover, a GIS project or assignment lends itself well to addressing the learning styles aligned with Kolb's Experiential Learning Model. Designing a GIS project this way allows all of the learning styles in Kolb's inventory to be significantly included in both the content and tools of a GIS project, adding value to the educational effort and worth to the overall experience with which students come away from the course.

I will end with a proposition for a new model of the role of experiential learning in higher education, contrasted with the model found in Kolb:

Old Experiential model: We must give students skills and experiences to add value to their degrees (Kolb, 1984)

New Millennial Model: We must provide experiential learning in order to measure up to students' digital skills and expectations for being challenged in contexts they find meaningful.

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