GIS as a Web 2.0 Education Tool

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This paper represents a work in progress, and is subject to future edits and revisions.

Abstract

This talk will present the results of a partnership between university and middle school students who will learn basic techniques for representing demographic and political boundary data with GIS software, and then create one or more projects focused on encouraging and facilitating the use of public information by the local community. GIS, in combination with Web 2.0 tools, will be used as a medium for communicating the data that serves as the basis for political representation and policy decisions.

Goals and objectives will be to increase political awareness, dialogue, and participation among the community and provide opportunities for civic engagement and awareness among both (university & middle school) groups of students. Emphasis will be on promoting political dialogue informed with public data wherever possible, such that constituents are not only an audience to communication media, but producers of media content as well (as in Web 2.0 supported maps and commentary).

Introduction

This paper presents a model for a semester-long (14 week) beginning-level GIS course for political science and urban studies undergraduates. The instructors sought to present GIS to learners as an information medium with an emerging community of practice, and to apply the standards of information literacy to this practice. An emphasis on teaching by experience was addressed by combining the pedagogical approaches of information literacy instruction, problem-based learning, public participation GIS (PPGIS), and service learning. Web 2.0 technology was blended with ESRI's ArcGIS desktop throughout the course in an attempt to connect classroom GIS work with 'real world' information use. Emerging from this discussion are the assertions that college-level GIS

instruction in the social sciences should address (and thereby improve) “GIS” as a community of practice centered on the communication of information, with the goal of training students to be information literate practitioners within this community. This goal will be shown to be consistent with published standards for information literacy. Lastly, I will discuss the value to our learning goal of asking students to create a web-based tool (a GIS viewer) that lets public users produce spatial information.

Choosing from the many approaches to GIS course design and instruction in the college classroom can be both daunting and inspiring: there are lots of options, many of them intended as improvements on traditional “chalk & talk” instruction. Beginning with the notion that GIS is a variety of new media that supports both the production and consumption of information (Sui & Goodchild 2003), the instructors (a librarian and a political science professor) decided to balance the learning outcome of inquiry and analysis with that of information literacy. In other words, we wanted students to be both effective analysts of geospatial data *and* literate participants in the larger information cycle to which geospatial data and GIS practice belong.

Information literacy (IL) has been defined by the ACRL Information Literacy Competency Standards for Higher Education, which address information behavior ranging from determining the nature and extent of needed information to “understanding the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally” (ACRL, 2000). It is the quoted portion above that we felt would address our concerns about developing students as GIS practitioners.

IL is usually taught by instruction librarians in “one-shot” library instruction sessions for existing courses, but has been the subject of semester-long courses taught librarians. A recent trend is that of librarians collaborating with teaching faculty to build information literacy into a course’s activities and assignments, and librarians have participated as co-instructors (“embedded librarians”) representing information literacy along side teaching faculty representing their own disciplines for an entire course (Hearn, 2005). Increasingly, IL is incorporated into the curricula of whole departments, most often when adopted by one or more members of the teaching faculty (McGuiness, 2007). Our model, with librarian and academic as co-creators and co-instructors of the course, saw IL not only as a valuable learning outcome in its own right, but as one inseparable from the more ‘disciplinary’ goals of having our liberal arts students learn to be effective and

informed producers and consumers of geospatial and demographic data and related information.

Placing information literacy per se in the context of GIS education is not well-represented in the literature, but the importance of metadata and its role in information literate behavior has been explored. Information literacy instruction can be incorporated into undergraduate GIS course design, with the outcome of making students information literate with regards to finding, evaluating, and correctly using spatial data and metadata (Jablonski 2004). Metadata awareness can also help students become more vocal and active consumers of spatial data by demanding more complete metadata from public and private data sources (Hermansen, 2006). I argue that information literate GIS use could certainly be exemplified by metadata literacy, but that there are other common information skills and conventions associated with GIS use that an information literate GIS user should have and practice. (This paper will not attempt to address or catalog GIS competencies —many of which deal directly with data practices—generally, but will attempt to describe the conventions typical to GIS data and functionality in the online information environment with which non-specialist GIS users would be well-served by gaining familiarity.)

My experience in building my own information literacy in the context of GIS librarianship led me to believe that the producers and consumers of geospatial data represent an emerging community of practice. Defined by Wenger (1998, p. 45) as the outcomes of collective learning that "reflect both the pursuit of our enterprises and the attendant social relations," communities of practice are discussed in the IL literature as important considerations in considering IL instruction (Lloyd, 2005 and Huwe, 2006). We sought to prepare students to be information-literate (by ACRL standards) participants in the GIS community of practice. I will informally define the "GIS community of practice" here by giving its participants the following characteristics, based solely on casual observation.

They:

> Consistently make use of public data and geographic boundary sources such as the U.S. Census, U.S.G.S, state and local agencies and governments, and on free and for-pay commercial providers like ESRI.
>
> Use ESRI software.

Seek and require metadata for GIS shapefiles, but rarely author or provide metadata for files they create.

Seek and require explanations of field names and attributes, and often include this information in data they make public.

Share a wide array of intermediate software skills.

Tend to be spatially auto-correlated for attributes such as willingness to share data, preferred coordinate systems, interest in networking with other users, and willingness to share standards regionally and across agencies.

N.B. Finding a research-based discussion of GIS data practices is a necessity for subsequent versions of this paper.

Pedagogical Approaches

The choice of pedagogical approach(es) to our learning goals was guided by our desire to engage students with more than course readings, software and data. Clearly established in GIS-related fields is the trend towards a "real-life experience" approach to instruction, which includes problem-based learning, service learning, and experiential learning (Kotval 2003). Problem-based approaches can provide non-geography students with effective habits of mind and practice in applying GIS to future academic and vocational challenges, not least because it encourages cross-disciplinary engagement (Drennon 2005). We saw PBL as having a conceptual and practical affinity with participatory GIS (or PPGIS: public participation GIS), which typically involves empowering grassroots groups as full participants in GIS-based planning and analysis, since community problems are often the focus of GIS-based inquiry in instances of PPGIS. This is particularly true in the university-community model formulated by Leitner (2002, quoted from Anonymous, 2006). PPGIS as an area of theoretical inquiry includes compelling debate about the power of reconsidered GIS practice to both correct and perpetuate access and use barriers to GIS by the public (Elwood 2006). We felt that encountering the discourse surrounding PPGIS would have its own value in shaping students as emerging practitioners. PPGIS can provide a valuable platform for GIS instruction in planning courses, particularly when it incorporates service-learning into university-community model of PPGIS (Anonymous, 2006).

GIS as a Web 2.0 Education Tool

We decided that information access was the main problem we would put at the center of our coursework. Course readings and discussions would introduce students to the principles of PPGIS, and they were told early in the semester that they would be asked to create an online information tool that would attempt to reduce information barriers for those affected by a particular issue. Students would research the area of the East Side of San Antonio (using the archives of the San Antonio Express-News) to identify and choose a major issue, and then determine which public data sources existed that could inform the conversations surrounding the issue. They would then design and create a site that would provide a narrative overview of the issue, state their research questions, provide links and descriptions of important sources and tools, present their data and static maps, describe their conclusions, and provide an interactive map with basic GIS functions with which users could create their own maps to explore the issue further and answer questions not addressed by the site.

We were fortunate to be offered the use of CartoGraph (www.Cartograph.com), an online GIS tool that presents GIS functionality online in a browser-based map viewer. Students were to work with ESRI's ArcGIS desktop in the classroom and on their own time, and were asked to prepare data files, analyses, and map layouts suited to a given assignment or to their final project. Much of their co-learning time with the middle school students involved using Cartograph to explore GIS representations of U.S. Census and field data in an online browser environment. Carroll Academy students used Cartograph at their school (they did not have ArcGIS in their computer lab) to query and display data as they learned about the U.S. Census. Trinity students were expected to present the files they used in the analysis portion of their final project in Cartograph, complete with metadata, documentation, well-considered attribute names, and notes on usage. (The GIS librarian took the responsibility of uploading the GIS data files to the Cartograph site outside of class time.)

Using web-based (Web 2.0) GIS to offer the results of PBL and/or community-university PPGIS projects was something we had not heard of at the time we planned the course, but web-based GIS is discussed in the literature of PPGIS and GIS instruction. Our research during the planning of the course was limited to Sui & Goodchild (2003) and Elwood (2006), though Wong & Chua rehearse the argument in favor of web-based PPGIS, enumerating tasks that a browser-based viewer can deliver to users, and outlining the plausibility of an intermediary role for web-based GIS. Caldeweyher et al (2006) discuss

the criteria involved in the design of a web-based GIS tool intended to promote "grassroots empowerment through GIS technology," focusing on addressing the "high cost and technical complexity" that make GIS access difficult for grassroots organizations. Carver et al (2004) look specifically at web-based GIS tools with focused functionality, i.e, that of "exploring the principles of GIS applied to spatial decision-making using map overlays," and Greiling et al discuss a downloadable Space-Time Information System viewer intended for researchers that offers sophisticated functionality in the form of statistical tools for calculating values for spatial autocorrelation equations.

The Course

PLSI 3329: GIS & Demographics is an upper-division political science course co-taught by Dr. L. Tucker Gibson and Jeremy Donald, MLS. First offered in spring 2006, the spring 2007 course sought to provide students with outcomes including enhanced information and statistical/numeric literacy, an introduction to [policy-related] GIS as a community of practice, basic GIS skills, and improved skills in interpersonal collaboration and communication. Specifically, the course combined elements of problem-based learning, service learning, statistical literacy, participatory GIS, media literacy, and experiential learning.

In the Spring 2007 offering, we decided that students were going to be asked to familiarize themselves with an area of the city (through visits and media), serve as occasional learning partners for a group of middle school students from that same area (San Antonio's East Side), and learn basic demographic and GIS skills. They would research an issue specific to that area, and ultimately create an online information resource that used public data, statistics, static maps, and web-based GIS functionality to provide information relevant to that problem. The emphasis would be on students' progress towards our learning goals, rather than on the success of their product in informing the community.

The course met for four hours per week for 14 weeks. While the course was still in the planning stages, we were approached by a middle school curriculum planner from an under-represented school on San Antonio's East Side. She proposed a partnership wherein students in our course would be paired with students hand-picked from the 5th and 6th grade to participate in an elective class that would mirror the content of our course. We decided that we would use an online GIS application to provide spatial data

and basic GIS functionality to the middle school students. The two groups (college and middle school) worked independently on their own assignments and projects, and met four times over the course of the semester to co-learn new course material, share their work, and discuss topics central to the course.

Course readings

Demographics: A Guide to Methods and Data Sources for Media, Business, and Government, by Steve H. Murdock, et al. Paradigm: Boulder, London, 2006, 193 p.

Elwood, Sarah. (2006) Critical Issues in Participatory GIS: deconstructions, reconstructions, and new research directions. *Transactions in GIS: TG 10*(5) 693-708

NITLE GIST GIS Tutorials (1-4). http://gis.nitle.org/resources/GIST.htm

Sui, Daniel Z. and Goodchild, Michael F. (2003) A tetradic analysis of GIS and society using McLuhan's law of the media. *The Canadian Geographer 47*(1), 5-17.

Assignments

Mental Mapping

A co-learning activity with the students of Carroll Academy. Students were asked to create a mental map of San Antonio, including their most familiar places, their choices of important landmarks, and whatever they knew about the East Side of San Antonio, where Carroll Academy is located. The Carroll Academy students did their own version of the assignment, focusing on their neighborhood, and the groups met to compare and discuss their respective maps.

Neighborhood Mapping

Part 1

Students were asked to travel back to the neighborhood of Carroll Academy on their own time, alone or in groups, and visit both commercial and residential areas. They were asked to take digital pictures, notes, and record locations for their observations. Students were asked to be observant of socio-economic characteristics, of political communication and types of media apparent, and of conditions that policy could improve. They were to use Web 2.0 map mash-up tools (YourGMap and ZeeMaps) to collect and present their observations and commentary.

Part 2

Using demographic techniques found in Murdock, each student chose a demographic equation to master. They were then oriented to the US Census custom table tools on the Census website, and asked to query the Census database for data specific to the neighborhood they visited. Each student then calculated the measure they learned, and presented their results and explained the equation and what it indicated to the class.

Media Literacy

Students were asked to complete a survey of the San Antonio Express-News coverage of San Antonio's East Side, back to 1990. They were to identify major issues affecting the community, and choose one from the past five years and summarize it, provide a timeline of events, and list the interested parties. They were also asked to note the use of quantitative data in the stories they read, and to analyze this communication of data using principles from the course reading. This assignment was intended to provide them with a topic for their final project.

Community portal (Final project)

Working in groups of four, students chose an issue of concern to the residents of the East Side, and worked to create a website that provided information to the public (residents of the East Side in particular) relevant to the chosen issue. The site was to be judged on its content and functionality, and was expected to communicate background information, data, and resources using the principles of effective communication of demographic and other quantitative data outlined by Murdock. The site was also to provide a link to an interactive map feature, for which each group would supply well-documented shapefiles.

Learning Outcome	**Assignments/activities**
Enhanced information/quantitative literacy	Media literacy assignments; individual demographic calculations and presentations based on course readings; service partnership; metadata requirements; web-based GIS
GIS as community of practice	Course readings; local data gathering; critiques by GIS practitioners; web-based GIS
Basic GIS skills	NITLE tutorials; neighborhood mapping assignment; web-based GIS; final project
Basic Demographic skills	Readings in Murdock; Neighborhood mapping

	assignment, part 2; final project.
Collaboration & communication	Group work in mapping assignment, final project, and service partnership

Table 1. Learning outcomes matched to coursework.

Outcomes:

Student Evaluations (see Appendix for full responses)

The highest rated aspects of the class (2.00 on a 1-5 scale) were the mental mapping/demographic data assignment and the final project. Lowest ratings (3.00 and 2.80. respectively) were given to the media literacy assignment and the time spent with the Carroll Academy students. Students reported the amount of desktop ArcGIS work to be challenging but ultimately satisfying. They appeared to be satisfied with the time spent on demographics, though some stated in person that they felt it difficult to connect the demographic data they learned to calculated and communicate to the issue they researched for their final project.

Narrative responses indicated the following: students found our learning partnership with Carroll Academy extremely stimulating at the beginning of the semester. They especially enjoyed working with the middle school students at the school, where the younger students were most comfortable and forthcoming. Enthusiasm for the partnership waned as the semester progressed, largely due to scheduling conflicts which prevent the groups from meeting as frequently as planned. While student performance in completing their final projects was mixed, those in the group which most successfully fulfilled the expectations of the instructors reported that they were thoroughly satisfied with the nature of the course and the final project.

Instructor reflections

This semester's offering represented our first attempt at the approaches detailed in this paper, and we hope to make many improvements in future versions of the course. At the time of this writing we have not made a complete catalog of our reflections and ideas for future improvements, but we do offer the following.

While it was the instructors' intention to teach GIS as a 'Web 2.0' information tool/communication medium within the larger information environment, we didn't make this goal explicit to the students. Rather, we sought to achieve our goal by contextualizing technology in activities and assignments. Our aspiration was to place these activities and assignments in the 'real' information environment—the one that goes beyond the campus network, classroom discussions, and even the social networking tools we used to communicate as a class, and involves real data, practitioners, and practices. When students located and evaluated data for use, they did so by direct encounter with the Web and often by phone with the agency staff that produced the data. When they prepared their final project to 'turn in' for a grade, they were in fact preparing a data product for the online public, and were expected to bring to bear on this work a host of principles and information literacy standards for communicating information in an online digital medium.

The 'white elephant' in the room is the digital divide. No course that purports to truck in PPGIS and service-learning centered on interactive online technology can ignore the reality that high-speed internet access is by no means a household item in communities like the one we focused on. Indeed, most of the middle school students in our partnership either didn't have an email address or had no easy way to check it if they did. We placed our emphasis on the goal of educating our students to be principled and conscientious information communicators *assuming* that the web would reach our audience. If this had been a course that emphasized direct engagement and collaboration with a community interest group, the issue of internet access and computer literacy would need to be emphasized.

Conclusion

Undergraduate beginning GIS instruction in the social sciences should address (and thereby improve) "GIS" as a community of practice centered on the communication of information, with the goal of training students to be information literate practitioners within this community. This goal is consistent with published standards for information literacy, especially that of "understanding the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally" (ACRL, 2000). Asking students to employ web-based (Web 2.0) GIS as a way to share the functions and data they have explored using desktop GIS with a real audience can bring the pedagogical benefits of PPGIS and problem-based learning to the course,

especially when students are connected to a community through a service-learning partnership. Web 2.0 GIS, when used in this manner, can also place students in the role of practitioners, making them contributing members to the "GIS community of practice" described herein, and allowing them to see geospatial and other forms of public data as the basis for both the consumption and the production of information on the part of themselves and the members of the online public.

It is the author's intention to continue the research and teaching that led to this initial draft in order to improve upon the course itself and upon subsequent drafts of this paper.

Appendix

Student evaluation comments

Were you satisfied with the outcomes of this course? Please explain.
Yeah, overall the experience was very good, and I learned a great deal throughout the course.
Yes. I now have an understanding of the types of questions I can answer and how to go about creating useful geographic data.
No if the east side wasn't focused on it would be more interesting
I did learn a lot about how to find data that is available. I am still unsure about how to use it effectively to make actual arguments.
Yes. I really enjoyed the final project. It was exactly what I wanted.

What changes or improvements would you recommend for how the course was planned?
Less having to do with the Carroll Students, It seemed disjointed and kinda of just thrown in there.
Syllabus, consolidate communications and online worksites.
More time for the final project
With the Carroll kids, I would have a project that was more interesting for the kids. I would have liked to have continued the mental map project to a more detailed level, possibly just making a wall sized map of the Carroll neighborhood. It could include pictures, information, and some basic demographic data that pertains to kids (age, education, total population, etc.).

The one thing that probably could be dropped was the Carroll students. While I enjoyed working with them, it was disappointing that we couldn't see their presentation.

What did you find the most challenging about this course?
The learning of GIS and all it entails!
Learning what was necessary to get along with ArcMap.
Learning GIS skills
The most challenging part of the course for me was learning how to use the ArcMap software. I was not aware that this course was so software intensive. The book was also very boring.
The GIS work was tough, but I really enjoyed it allot (the most).

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