Teaching by Doing: PPGIS and Classroom-Based Service Learning

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Abstract: *As geographic information systems (GIS) continue to be used as tools for participatory decision making, it becomes increasingly important to teach the next generation of GIS users about public participation GIS (PPGIS) ideas, concepts, and skills. This paper describes an effort to teach a GIS course that utilizes PPGIS, community-based research notions, and service-learning ideas as core concepts in teaching intermediate-level technical skills in GIS. The class, "Applied GIS and Social Planning," is a mixed undergraduate/graduate course that combines traditional, intermediate-level GIS labs with a neighborhood-based service-learning project and lectures on social change, PPGIS, and community-based research. Moreover, the class focuses on the use of new mobile GIS technology as a way to facilitate community-based participatory GIS, as well as to give students experience in an emerging GIS technology. This study utilized six different instruments to collect data from students to evaluate this applied approach toward learning GIS in general and PPGIS in particular. In general, students found that the community-based PPGIS project was an overall positive learning experience for both technical skill development and in applying PPGIS theory to practice, that more community interaction and involvement with project planning would enhance the experience, and that learning and applying PPGIS in a course context gives students an insight into the long-term and complex approaches needed to help facilitate local community change.*

INTRODUCTION

GIS is much more than making static maps or representing complex data in simple map form; it is also a tool that can facilitate bottom-up participatory decision making. Many organizations, mainly nonprofit and advocacy groups, have begun to utilize GIS in this way, but more mainstream GIS users, such as municipal governments, continue to view GIS in the same top-down data synthesis and presentation model of the past. Part of this disconnect in uses can be traced to the types of GIS education that most students receive that emphasize technical skills over the context within which those skills can be applied. Public participation and GIS (PPGIS) represents much more than a set of technical skills; it represents a suite of concepts that incorporates both the technical use of GIS and the larger contextual elements of participation, policy making, and social change. For these ideas to be successfully implemented in the workplace by knowledgeable practitioners who realize the potential of participatory decision making, this knowledge should be cultivated in students.

This paper describes the efforts of one course that strives to teach PPGIS to students from multiple perspectives. The class, "Applied GIS and Social Planning," is a five-credit, mixed undergraduate/graduate course that combines traditional, intermediate-level GIS labs with a neighborhood-based service-learning project and lectures on social change, PPGIS, and community-based research. Moreover, the class focuses on the use of new mobile GIS technology as a way to facilitate community-based participatory GIS, as well as to give students experience in an emerging GIS technology.

The remainder of this paper is organized into three primary components: the description and rationale that underpins this course, a discussion about the class and service-learning project, and the evaluation of the project's impact on student learning. Most service-learning evaluations focus on the benefits that accrue to the community, but given our interest in teaching PPGIS effectively to students, we were curious about the relative benefit of incorporating community-based GIS work as part of the normal course requirements in terms of teaching PPGIS concepts.

CONTEXT

Many professionals in the planning field have identified public participation as an important aspect of the planning process. This is particularly true at the local level where neighborhood residents need to be empowered to help develop ideas and plans that reflect the wishes of the community (Jones 1990). Many different approaches to participation have been taken in the past, but recently there has been an interest in a bottom-up approach that puts more of the planning process in the hands of the residents. This bottom-up approach to planning has helped to generate an increase in research surrounding the topics of public participation GIS (PPGIS) and community-based research (CBR). An aspect of PPGIS seeks to make GIS technology and training accessible to local residents as an empowering tool to use in the decision-making process, while CBR emphasizes the inclusion of community members as research partners to improve the practicality and responsiveness to local needs.

Public Participation GIS

The phrase *public participation GIS (PPGIS)* comes to the GIS community from the planning profession (Obermeyer 1998). The

phrase can be used to describe a "variety of approaches to making GIS and other spatial decision-making tools available and accessible to all those with a stake in official decisions" (Obermeyer 1998). PPGIS embodies the desire to utilize the capacity of GIS to engage and empower the public because planners realize the critical importance of community input in decision making. However, PPGIS approaches often differ from project to project, from Internet-based map servers to field-based development methods. Because of this variability, Schlossberg and Shuford (2005) recommend that "understanding how specific publics are linked to specific types of participation is an important effort to undertake so that users of PPGIS ideas can appropriately characterize, utilize, implement, and evaluate their PPGIS efforts" (15).

Although no consensus has been reached on a clear definition of PPGIS, the debate has progressed into a more constructive research engagement in which community empowerment through GIS is a stated intention (Harris and Weiner 1998). What scholars and practitioners see in common is that GIS can facilitate a broader set of participants in the planning process because of its visual orientation when addressing spatial issues (Al-Kodmany 2001). This process of spatially investigating an issue through PPGIS can produce positive returns in group dynamics, consensus building, and joint planning (Schlossberg and Shuford 2005), although participatory GIS itself exists in a murky area between fields and goals, "often with contradictory implications, priorities, and outputs" (Elwood 2006a, 197).

To ensure the realization of the positive returns of PPGIS, Leitner et al. (2002) formulated six models for successfully making GIS available to community organizations. The six models are: community-based (in-house) GIS, university-community partnerships, publicly accessible GIS facilities at universities and libraries, map rooms, Internet map servers, and the neighborhood GIS center. Each model inherently contains certain advantages and disadvantages, but the university-community partnership is of particular interest because of the possibility of adding the component of service learning to the project. This thread of PPGIS is often overlooked and provides an interesting model of building community capacity and empowerment. Sawicki and Peterman (2002) suggest that "an ideal PPGIS could be where neighborhood residents collect their own spatial data and process it themselves using GIS software." Service-learning PPGIS could be a step toward that "ideal," where the initial university-community partnership may lead to community empowerment and self-sufficiency, or may lead to an ongoing relationship between the university and community, but a relationship based on shared benefit.

While conducting service-learning GIS can be important for the community, evaluating the effort can be helpful for future instruction for students. Jordan (2002), however, found that PPGIS evaluation is often not conducted with enough rigor, making it difficult for others to properly learn from past efforts. Barndt (2002), on observing the role of GIS as a tool for participation, developed a set of criteria for the evaluation of PPGIS to encourage a more rigorous evaluation process. The focus of the criteria is on the value of the project results, particularly for the community; however, when considering the model of university-community partnerships and the role of service learning in PPGIS, this form of evaluation only touches half (the community) of the participants involved. The students are involved to provide a service, but also to gain educational value from the process. Using the service-learning principle of reflection could help to understand the benefits to the students (Leitner et al. 2002, Joerin and Nembrini 2005). "Service learning involves faculty and students in providing a service to the community, such as developing a GIS application based on a community request, and then reflecting on the lessons learned from the experience. Its primary goal is to enhance learning through the service experience with less emphasis on changing social systems or generating new knowledge although it can provide the opportunity for both to happen" (Leitner et al. 2002, XX). This process also increases the students appreciation for the community usage of GIS through observation and understanding of how communities develop their own spatial narratives within a participatory GIS endeavor (Elwood 2006b).

Community-Based Research

The concept of community-based research (CBR) is predicated on including the community members as research partners and active participants in a community-based project (Checkoway 1997). This emphasis on the participation and influence of nonacademic researchers in the process of creating knowledge is what Israel (1998) identifies as the fundamental characteristic of CBR. Viewing the community as a social entity instead of simply a place or setting in which community members are not actively involved is the critical distinction between CBR and other research processes (Hatch et al. 1993).

The more traditional "professional-expert" model, where project decision-making power is concentrated in the hands of the researcher, often produces results that are impractical and unresponsive to local needs (Whyte 1989). CBR, by involving the community in the research processes, attempts to overcome the "professional-expert" shortfalls. For example, equitable participation and shared control over all phases of the research process is a goal to strive to achieve for beneficial results (Green et al. 1995). A participatory bottom-up approach involves the community throughout the process, from identifying the issues examined to participating in data collection to analysis and discussion of the action steps (Heskin 1991). This empowerment approach can lead to greater community ownership of the project and significantly increase the participation of local residents (Reardon 1998). Additionally, CBR can connect communities with university knowledge, a potentially local resource that is often difficult or confusing to access by the local community (Checkoway 1997). CBR utilized as a service-learning activity helps improve communication with constituencies, increases the accessibility of knowledge, and builds support for university-community partnerships that help higher education fulfill its responsibilities to society (Checkoway 1997). These are very important aspects of the scholarship of integration, application, and teaching (Boyer 1994).

Service Learning

The term *service learning* has come to be applied to a wide range of activities, from tutoring programs across grade levels to community tree plantings, and with students from kindergarten through higher education (Waterman 1997). Although no agreed-on definition of service learning exists, the basic requirement is a service experience that is both personally meaningful and beneficial to the community (Pritchard 2002). The Corporation on National and Community Service, an independent federal agency that supports volunteering and community service nationally, suggests four key components to service learning, which form the theoretical basis for this research. Service learning is a method:

1. under which students learn and develop through active participation in thoughtfully organized service experiences that meet actual community needs and that are coordinated in collaboration with the school and community;
2. that is integrated into the students' academic curriculum or provides structured time for the students to think, talk, or write about what the students did and saw during the actual service activity;
3. that provides students with opportunities to use newly acquired skills and knowledge in real-life situations in their own communities; and
4. that enhances what is taught in school by extending student learning beyond the classroom and into the community and helps to foster the development of a sense of caring for others (National and Community Service Act of 1990, 5).

The basic idea behind service learning is to use a community or public service experience to enhance the meaning and impact of traditional course content (Sax and Astin 1997). Dewey (1916) viewed the community as an integral part of educational experiences, because what is learned in the school must be taken and utilized beyond its bounds, both for the advancement of the student and the betterment of future societies. Dewey (1956) later helped advance the view that active student involvement in learning was an essential element in effective education. Service-based learning has been shown to be an effective educational approach to improve student learning (Markus, Howard, and Peterson 1993; Boss 1994; Cohen and Kinsey 1994) and carefully designed service-learning experiences can lead to profound learning and developmental outcomes for students (McEwen 1996).

In terms of service-learning outcomes, Sax and Astin (1997) found that the real-world value of service participation reveals itself in the positive effects observed in three areas of student satisfaction: leadership opportunities, relevance of course work to everyday life, and preparation for future career. They also identified additional benefits in terms of a number of college outcomes, including students' commitment to their communities, skills in conflict resolution, and understanding the community problems—all skills we would hope that future PPGIS practitioners would hold.

BACKGROUND: THE COURSE

These skills are being taught in the course, "Applied GIS and Social Planning," a mixed, five-credit, undergraduate/graduate class taught during a one-term quarter (ten weeks) with enrollment usually between 12 to 15 students. Offered each fall, the course is a regular intermediate-level GIS course for students across campus, with priority given to students in the home department of Planning, Public Policy, and Management. Students are expected to have taken an Introduction to GIS course or have an equivalent level of knowledge prior to enrolling in this course, and such skill level is assessed during the first week of class. The class meets six hours per week, with two of those hours dedicated to lectures and discussions and the other four dedicated to GIS lab work. The class is essentially divided into four primary components, each of which is discussed more fully in the following sections: technical GIS skills, theory and practice of PPGIS, applied service-learning experience, and individual projects.

Technical GIS Skills

This class is an intermediate-level GIS course and teaches a variety of technical skills, including network analyses, a variety of more advanced spatial analyses, analysis of census data, and an introduction to three-dimensional modeling. Moreover, there is a significant focus on mobile GIS technology, both on operating GIS on a personal digital assistant (PDA) and in creating customized data-entry interfaces for field-based data collection.

Theory and Practice of PPGIS

Unlike many GIS courses, the lecture component of this course does not cover the theoretical underpinnings of GIS science skills. Rather, discussion time focuses on the environment in which GIS can be applied, with a special emphasis on social and participatory applications. Students have an extensive reading list and in-class discussions based on those readings include social planning, community-based research, PPGIS, and social equity and empowerment. Short two-page thought papers are assigned to give students an opportunity to think about these more context-oriented issues and how they relate to the use of a technical tool such as GIS.

Applied Service-Learning Experience

All students are required to participate in a community mapping service-learning project that is ongoing throughout the entire term. As mentioned in more detail in a following section, this component includes attending neighborhood meetings (in Eugene, Oregon) and partnering with a neighborhood resident to collect community data to train that community member in data collection, and to build goodwill between the university and the community.

Individual Projects

Finally, each student is required to conduct an individual and original GIS analysis. Students may choose to use the community

project data as an input to their individual projects, or students can choose to work with other community organizations or community issues for their projects. The project emphasizes that GIS is a tool in understanding some larger question or issue, and, accordingly, students are required to write reports and make public presentations of these larger efforts.

PARTICIPATORY GIS IN PRACTICE: THE WUN MAP PROJECT

Students in the class are able to translate the theory and discussions about PPGIS to practice in the classwide-applied service-learning project. Planning and carrying out this community-based project occurs throughout the term, some of which is in direct collaboration with the community and some on behalf of the community. The basic goals of this part of the course are:

1. The project should be of immediate value to the neighborhood.
2. The project should be small enough in scope to ensure success at the end.
3. The students must be able to gain tangible skills.

The WUN MAP (pronounced *one map*) project, which stands for the West University Neighbors Mapping Project, occurred during the fall 2004 term.[1] The WUN MAP project was born from two key events that took place almost simultaneously during the spring of 2004, about five months prior to the class. The first event was when the chair of the West University Neighbors (WUN), a city-sanctioned neighborhood association, contacted the University of Oregon seeking assistance in visualizing the neighborhood in some way. The request sought to create a means of increasing involvement in the neighborhood, improving the neighborhood for residents, and at the same time making use of the vast resources at the university. Eventually, the WUN chair was placed in contact with the Department of Planning, Public Policy, and Management (PPPM) because of its interest in social planning, empowerment, and GIS. It is important to note that the initiation of the project came from the neighborhood itself and not from the teacher/researcher of the course. Often in community-based work such as this, "experts" at universities seek to impose solutions on neighborhoods rather than work collaboratively with neighborhoods (Checkoway 1997). That the project was neighborhood-driven in the first place established a good foundation for a joint PPGIS effort, and one that can flip the research university paradigm where community partners would be regarded as "research partners and active participants in knowledge development rather than as human subjects and passive recipients of information" (Checkoway 1997, 310).

At about the same time as the contact by the neighborhood, PPPM was awarded a small classroom technology grant that allowed this intermediate GIS course to develop a new teaching curriculum around community-based GIS and the use of mobile, PDA-based GIS. This grant, together with the interest from the neighborhood, led to the formation of a course-based service-learning project.

THE PLANNING OF WUN MAP

The class is taught in the fall, and because the course is only ten weeks in length, considerable planning for the project occurred in the summer prior to class. As the instructor and teaching assistant for the course, we met with the chair of the WUN group several times to explore the type of joint project that would make sense for all involved and we established the following three points during our discussions:

1. Control over the basic structure and content of the project would be in the hands of neighborhood residents. The effort would be based on the neighborhood inviting the class to participate.
2. As a class-based exercise, the educational value to the students was essential.
3. The project should be viewed as an opportunity to establish positive university-community interactions where each could derive benefit from the project.

Once the neighborhood formally invited us in, the development and planning of the project happened over the course of regular monthly WUN meetings. Of primary importance was that residents chose what data was to be collected. After taking into account the size and layout of the neighborhood, the amount of time that would be available for collecting, and the number of possible student-resident teams, the neighborhood decided on mapping the location of three key assets.

Public Street Trees. The neighborhood was interested in knowing where the trees in the public right-of-way were, as well as some basic facts about them. Their interest in street trees stems from their desire to protect trees in their neighborhood. The primary attribute of interest, therefore, was tree diameter because trees greater than eight inches in diameter have a different and stronger legal status.

Streetlights. The neighborhood has a spatially unequal distribution of streetlights, which can impact safety. Of equal interest to the neighborhood was where "traditional" or old-fashioned pedestrian-oriented and styled streetlights were. Once residents know where these community assets are clustered, they can begin thinking about strategies to use them for additional community-building activities.

Visible Dumpsters. In addition to detached residential housing, the neighborhood has many multiunit apartment buildings and some businesses that utilize Dumpsters for garbage collection. In some instances, these Dumpsters are highly visible from any walking path, detracting from the viewshed throughout the neighborhood. Moreover, the Dumpsters are often misused, further impacting the "feel" of the community.

We decided that one weekend day, preferably a Saturday, would be dedicated to bringing students and residents together to collect neighborhood data. The final steps were to publicize the data-collection day event and to develop the data-collection instrument using ArcPad, a mobile GIS software program.[2] The process of creating and using the data instrument was developed into an in-class lab exercise for students to learn and develop

the new skills and understanding of the mobile GIS technology, and it also allowed students to participate in a test run to familiarize themselves with the data-collection instruments before participating in the data-collection day. Concepts of instrument development and pretesting were incorporated into the learning concepts of the class.

Actual data collection took place on one Saturday that began with complimentary coffee and pastries and included a complimentary pizza lunch, both from neighborhood shops. Although the students were required to attend, neighborhood participation relied on volunteers, and free food is always a good way to get help. More important, the social time afforded during these meals allowed students and residents to meet one another and develop an initial trust and bond that would serve them well for the project and for a larger, although unspoken, goal of fostering good community-university relations.

The neighborhood was divided into 12 sections, and student-resident teams were responsible for collecting the three sets of data in one section each. Of the 12 teams, six used PDAs to collect data and six teams used pen-and-paper data-entry forms. The total time commitment of the data-gathering day was six hours and the students spent another two hours entering data that had been gathered with the paper instrument.

The final phase of the project included several students creating maps that represented the data in various ways. One student created a map template that was used to coordinate the layout of all the maps. In the end, approximately 80 maps were given to the WUN group using a consistent and cartographically pleasing format. These maps, along with the raw data (in spreadsheet and GIS formats) were uploaded to a project Web site, free to use and manipulate as anyone sees fit. These maps and data have subsequently been used by the neighborhood to lobby various city departments on a variety of decisions that affect the neighborhood. In one example, the presence of the maps and neighborhood knowledge put pressure on the city's urban forester to begin an effort of data collection on the city's trees that was more detailed and accurate than what the community project gathered. While there were other community benefits that accrued from this project, the remainder of this paper will focus on the value of this PPGIS effort on student learning and experience in the classroom.

PPGIS AND STUDENT LEARNING

Many service-learning projects are evaluated based on the outcomes for the community, but we were interested in the outcomes for students. Specifically, we wanted to know whether this type of applied PPGIS project added to students' GIS skill set, afforded students a beneficial learning opportunity, what the opportunity costs for including a service-learning component to class was in terms of time away from technical-skill building, and how the project could be improved, if indeed it is worthwhile. Using recommendations of Bradley (1997), we used six different instruments to collect project evaluations from students:

Preproject questionnaire. The preproject questionnaire was distributed to students the morning of the data-collection day. The questionnaire intended to gauge student expectations and feelings about participating in the project.

Postproject questionnaire. The postproject questionnaire was distributed students on the completion of the field-collection activity. The students took the questionnaires home and returned them during class the following week. The questionnaire was designed to induce reflection, a critical part of service learning, from the students on their participation in the project.

Focus group. A focus group was organized approximately one and a half months after the class ended and was led by two neutral facilitators. The discussion covered a wide range of topics, from the educational benefits of the project to suggestions for improvement, and the full participation by all students created a lively and energetic dialogue.

Outcome survey. A survey that addressed key elements of service-learning theory was then sent to students based on themes that emerged from the focus group. Questions included both open-ended and closed Likert-scaled questions.

One-on-one interview. These interviews were conducted about three months following the end of the course and were designed to provide an additional means of reflection for the student participants and to allow for more in-depth discussion about the personal outcomes for each participant. Conducting the interviews three months after the end of the class permitted the students to have stepped away, completed another term of course work, and have time to think about the experience.

Participant observation. We were involved in all phases of the project, from planning to implementation to evaluation, and acted as participant observers during the process. This constant connection with the project allowed us to observe student interactions and reactions and to hold candid conversations about their involvement in the project along the way.

These varied approaches produced information pertaining to student expectations, learning, and recommendations, and because of the multiple methods, we are confident in the reliability of the student assessments.

STUDENT REFLECTIONS

After collecting and analyzing the data derived from the methods previously discussed, four primary findings of student outcomes emerged:

1. *The classroom-based PPGIS project provided a positive learning environment that the students felt was worthwhile to their educational experience.* The opportunities to interact, communicate, and share ideas and knowledge was an important component of the project for the students. Very few opportunities exist in most classes, especially GIS classes, for the students to work on a real-world project, particularly involving personal, hands-on interaction with a community group. One student commented, "I enjoyed the team building aspect of it. Learning GIS and sharing skills with

others (we were not all experts, but helped one another to be efficient) was awesome." This experience of learning and using a new technology, not only for student benefit but also for the community, was empowering for the students and helped to create a sense of purpose for their work.

Participants expressed satisfaction with the opportunity to build communication skills outside of the university, which included explaining GIS to the residents. This real-world application of learning the software and applying those skills worked well for learning through action, not just reading. One student commented, "The community involvement aspect, listening to the needs of the community, was a good complement to the planning program." Those who attended neighborhood meetings expressed the added benefit of witnessing the "cynic factor" of those opposed to the project and the work needed to compromise and accommodate.

2. *The classroom-based PPGIS project was of appropriate structure to learn ArcPad and practice the concepts of PPGIS and CBR.* The inherent purpose of the software is to collect field data, so the hands-on aspect of learning it was very beneficial to understanding the worth and utility of the tool. Participating in the project also allowed the classroom concepts to be better understood through implementation. Student participants were able to witness and make connections between the readings and the project. It provided the opportunity to experience the importance of planning, collaborating, and compromising when developing and implementing a public-participation endeavor. One student commented, "I was able to see the divide between letting the public choose subjects versus the researcher seeing things that should have been done, but that could have just been the limits of residents not understanding what could have taken place and the need to educate them." And another student observed, "I felt like the explanations of the project were OK, although I didn't buy into helping the community with what was collected until afterwards when introduced to a portion of the group who were skeptical about GIS and saw that it was a controversial issue."

   Students spoke on the benefits of learning ArcPad and the new skill set it provided them. They also reiterated that the way it was taught, through the hands-on experience of field collection, was a valuable learning experience. They viewed the project as a team effort that allowed for positive interaction and an exchange of ideas, while working towards the goal of helping the neighborhood address its needs ("Really felt that working with others in the class on a real project was beneficial."). The students saw the value in introducing the tool of GIS to the community and helping to create a relationship between the university and community that could lead to future projects. ("The experience of working with folks outside of academia was great for learning to communicate ideas better, through explaining the uses of GIS and what it can/cannot do.") Student responses also indicated the project was a good effort at connecting theory and practice. The project provided insight into how to engage the community with GIS and involve residents in the project planning that otherwise would have been missed. One student commented, "The project helped me gain real-life experience that I could reflect upon and then compare to the learning in the classroom, which was different. Afterward, I could see the connection between them."

3. *The classroom-based PPGIS project could have had more of an impact on student learning by increasing interaction with the community, more participation in the planning process, and a greater transfer of knowledge to the community.* Students spoke of wishing for more community interaction (before, during, and after data-collection day) that would have enhanced the learning experience. As mentioned previously, because of the short time frame of the course (ten weeks), some of the project planning happened prior to the start of the academic term. Being involved in the planning of the project would have allowed for more interaction and exposed the students to the intricacies of developing a PPGIS/CBR project. Students felt that more involvement in these preproject-planning stages could have developed skills for formulating such a project in the future. Students also expressed the need for more time to fully appreciate the project, perhaps by extending the class over two or three terms.

   Students also felt that increasing interaction between students and community members could have helped to enhance communication, collaboration, and analytical skills. Interactions between students and community residents were limited to one active engagement (joint data gathering) and two more passive interactions (project presentations at monthly meetings) over the course of the term. Students were not given an opportunity to more formally transfer GIS skills to residents, although they provided training on the PDA on the data-collection day. Students suggested that adding several opportunities to interact with the community, whether on the project planning or on direct GIS skill transfer, would have been of value.

4. *The classroom-based PPGIS project was restricted by time in meeting the goals of community empowerment and building a relationship with the community, but the value of working towards those longer-term goals was understood and evident in the student reflections.* The student participants were truly interested in achieving the goals of PPGIS and CBR, as evidenced by suggestions for developing a project over multiple ten-week classes to experience the community outcomes. This lack of completeness or ability to see the project through on a longer-term basis was discouraging for the students, but the ability to stand back and reflect on longer-term community change goals, and the piece they played in the process, allowed the students to appreciate their efforts and envision the worth of a classroom-based PPGIS project.

Prior to the data-gathering day, students were asked, "What are your expectations for the day from an educational standpoint?" Three key themes emerged: 1) to gain skill-building experience, 2) to share skills and interact with the community members, and 3) to experience the value of a public-participation/collaborative process for students and residents. The key findings previously mentioned suggest that all three of these expectations were met at varying degrees. The students gained tangible skills, while the inherent nature of the project was to interact with the community in a participatory environment. Increased interaction and a greater transfer of knowledge could have helped to better solidify these expectations.

When students were asked, "What are your ideas where this project could lead?" the longer-term goals of building relationships and empowering the residents were the key themes that emerged. These expectations were not completely met by the project, but the key findings suggest that the students were able to experience and value the contributions that were made in working toward those longer-term goals. These outcomes provided the students a view into the positive attributes of the concepts of PPGIS and CBR.

When students were asked, "What are your feelings in participating with the community?" they responded with it is important to build relationships that include the community, it gives context and value to student work through real-world experience, and it is enjoyable to transfer knowledge/skills to benefit those outside of the university. The key findings suggest that these expectations were met for the students found the project a positive learning experience and they were able to experience all of the listed processes. Again, improvements could have been made, but the introduction to the expectations was valuable to the participants.

RECOMMENDATIONS FOR FUTURE WORK

Based on the experiences of the students, as well the instructors, we offer the following recommendations on future classroom-based PPGIS activities:

Project Continuation

The creation and implementation of classroom-based PPGIS projects are effective ways to teach the application of new GIS skills in addition to the technical know-how of GIS software. Moreover, for those interested in understanding how GIS can play a role in fostering community change, bottom-up planning, or participatory decision making, a service-learning model of classroom learning can be an invaluable tool to link theory, practice, and experience. Students in general have limited opportunities to participate in service-learning endeavors where they can practice concepts and utilize skills learned in the classroom—especially in GIS classes where the focus is predominantly on technical skills and the GIS science that informs its use. This real-world application of knowledge, hands-on experience, and communication that takes place provides numerous educational benefits for the students, including insight into community skepticism about data, maps, and the motivation of university students to "help" their community neighbors. One student reflected, "[the] community meetings seemed disruptive, but introduced [us] to the element of 'conspiracy'and distrust that is inherent in projects working with the public." Additionally, understanding what it takes to work toward the larger goals of community empowerment, building relationships, and increasing participation in the decision-making process is difficult to achieve without directly participating in such a project.

Increased Interaction

Classroom-based PPGIS projects need to include multiple, required activities and meetings for the students to interact with community members. The project described earlier required only one interaction between students and the community, with two additional opportunities for interaction highly recommended. Students who participated in these recommended opportunities strongly believed that they significantly enhanced their PPGIS experience and helped them better understand the complexities in conducting a community-based, collaborative GIS project. Students who did not attend these optional meetings felt that they missed out on something important—"I didn't go to any community meetings, but wish I could have and maybe it should have been required." The expectations of student participants and the benefits to student learning are directly tied to the communication and collaboration with the community. Participation in goal-setting sessions, conducting GIS workshops for the community, working together in analyzing data, and attending neighborhood association meetings are a few examples of activities that could be required to increase interaction. One student reflected, "A meeting before the data-collection day would have been helpful in having a dialogue about why things were being done and to understand a more comprehensive reason to do things."

That said, a balance between student desire to be part of the entire project-planning process and the requirements for sufficiently organizing a project prior to the beginning of an academic term needs to be met. Especially in institutions on a ten-week quarter system where multiple course terms dedicated to the service-learning project are unrealistic, some work prior to the beginning of the term must be performed. At a minimum, the community group with which to work should be identified and some initial conversations about the types of project that might work should be had prior to the start of class. Also, the community must agree to the project (even if only loosely defined) prior to the class beginning so that proper planning for the academic term can proceed.

Even with those constraints, it is feasible to delay much of the substantive planning decisions until the course begins, as long as the project is defined in such a way that it can be viably completed during the term. Final community deliberations and decisions on precisely what data to collect and analyze can be delayed until the first week or two of class, leaving enough time

for the community and the class to finalize data-collection ideas and protocols before embarking on the collaborative data-collection effort. Clearly, planning a project, deciding on what GIS data to collect, collecting the data, analyzing data, and preparing data and maps with a volunteer community effort is a lot to do within a ten-week quarter (it is even a lot for a 20-week semester), but the value for students to be involved in all phases of the project provides important insight into and experience in the context of GIS projects. And understanding that context is what will help students learn how to use their new technical GIS skills appropriately when working within a PPGIS environment.

Scalability and Transferability

This type of approach to learning PPGIS by doing PPGIS can be carried out in at least two ways. First, the basic approach outlined previously could be scaled up to classes with larger enrollments without much effort if the class is to focus on only a single project. Nothing in this approach becomes more difficult with more participants; rather, the greater the participation (of students and community members), the larger geographical area could be covered through the community-based mapping or the more depth of data that could be captured within a smaller geographical extent. Second, if a course such as this were to take on multiple projects, a separate staff person would need to handle project-management activities. It is not realistic for a single instructor to manage a normal set of responsibilities with the addition of managing several community projects and to do that project management in a way that adheres to the principles of community GIS work discussed previously.

Despite the positive experiences and rich learning opportunity afforded to students within this service-learning model, an extraordinary amount of time was required by the instructor to manage the projects. In addition to preparing labs and lectures that would normally be part of the course, the inclusion of a service-learning project required many out-of-class meetings with the community in both small working groups and larger neighborhood meetings, arranging logistics for the data-gathering day meeting place, reservation paperwork, food, training materials, etc. Fostering a collaborative approach to the project also means spending extra time working with community skeptics to build the trusting relationship that is critical to short-term and long-term successes for the community and a positive experience for students.

Given these time constraints, if multiple projects are needed because of high course enrollments or because of a range of community interests, then we would suggest pulling the project component out of the GIS class and instead offer the project component as a parallel course to the PPGIS course. This parallel course may be focused on service learning itself, within which PPGIS offers one set of tools that may be appropriate for the project at hand. And depending on the skill or time of the GIS instructor, the service-learning and project-management component may be better handled by faculty who specialize in these types of applied experiences. The PPGIS course, then, acts almost like a resource for the service-learning sequence, which itself is a resource for both student learning and community empowerment.

This approach of making PPGIS available as a community and student resource is being explored at the University of Oregon where the institution's Community Service Center (CSC) professional staff already actively manages four to six service-learning projects per year. There is often a desire to have community GIS as a component in these projects, but not enough PPGIS expertise within the CSC staff has been available to adequately offer it as a resource to the community and to students. The current exploration is to develop a three-pronged approach to making PPGIS opportunities: 1) continue to offer the PPGIS class discussed previously, but pull the project out of the course requirements; 2) develop community projects through the CSC that incorporate PPGIS and coordinate these efforts with the PPGIS course as much as possible, either to run in parallel or to use students who have completed the PPGIS course as core organizers of later PPGIS projects; and 3) develop an ongoing PPGIS lab on campus that continually trains and engages students in community work independent of any particular course.

CONCLUSION

Planners have long recognized the importance of public participation in the planning process and this has led to an interest in the concept of PPGIS. This introduction of GIS tools to community organizations for furthering participation has also empowered communities through access to the technology. The act of giving community access to the technology can follow several models, but the university-community model is particularly interesting because of the service aspect possibilities for students. By allowing students to transfer their "expert" knowledge of GIS to the community, the students are gaining educational value as residents gain tools that are intended to empower.

The university-community model of PPGIS also corresponds nicely with the concept of community-based research (CBR). CBR emphasizes recognizing the community as a research partner and using a bottom-up approach to project development by involving the community in all phases. In a service-learning environment, the partnership would benefit everyone with the community gaining empowerment, ownership, and needed assistance, while the university furthers the education of the student.

The service-learning model is a widely used approach to enhancing student education through applying classroom ideas to real-world projects. Assessing the value of a service-learning project through an evaluation strategy is difficult, but recommended. A variety of assessments can be made, but evaluating student outcomes is crucial to the continuous improvement of the process.

In the case presented here, the four primary findings from student reflections show that the student participants appreciated the opportunity to apply their developing skills to a community project and that the outcomes from that participation were beneficial to their learning experience. In general, their expectations for the project were met, and students did not feel that the PPGIS project unduly took time away from learning technical GIS

skills. The students felt the project could have been improved by including students more in the project-planning phase and by requiring multiple events where students and community members could interact around the project. Overall, students found value in combining technical learning with applied experiences in PPGIS: "I got a good sense of using GIS as a tool to engage the community and really couldn't truly learn the concept of PPGIS without experiencing a real-world project."

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Footnotes

(Endnotes)

1 Additional information can be found by visiting http://www.uoregon.edu/~wunmap/.

2 ArcPad is created and distributed by Environmental Systems Research Institute.