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PARTICIPATORY ACTION RESEARCH IN GEOGRAPHIC TEACHING, LEARNING AND RESEARCH

Integrating Participatory Action Research and GIS Education: Negotiating Methodologies, Politics and Technologies

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ABSTRACT *This paper explores some of the unique opportunities and challenges of integrating participatory action research into undergraduate GIS courses, drawing evidence from two undergraduate courses that contributed to a long-term participatory action research project. The author shows that incorporating participatory action research in undergraduate GIS courses can enhance students' learning of fundamental concepts in GIS, as well as their understanding of the social and political construction and impacts of digital spatial data and GIS technologies. As well, this approach can foster critical reflection on research design and methodologies.*

KEY WORDS: GIS, participatory action research, active learning, research methods

Introduction

> These maps are more than a final project. They are a tool for community members, made partially by them, for them. I have had the opportunity to be a co-researcher through reading texts, participating in discussions, conducting field research, going to community meetings, entering data and creating maps in conjunction with my peers and the community members. (Jennifer, 2004)

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In the Humboldt Park Community GIS Project (HPCGIS), university students, community organization staff members and local residents created an updated version of a neighbourhood strategic plan and developed spatial data for ongoing GIS applications by the two partner agencies. In the statement above, one of the students articulates benefits of incorporating participatory action research into GIS education, including embedding students in the social and political processes of producing GIS-based data and maps. There is rich ongoing discussion in geography about the pedagogical and sociopolitical benefits of incorporating fieldwork, service learning and experiential or active learning strategies in undergraduate education (Buckingham-Hatfield, 1995; Mohan, 1995; Warf, 1999; Dorsey, 2001; Pawson & Teather, 2003; Elwood, 2004; Shah & Treby, 2006). The literature on teaching and learning in GIS is no exception, with model curricula emphasizing the potential of active learning strategies for linking students' conceptual and applied learning (Kemp, 1997; Unwin, 1997). In practice, active learning in GIS tends to be laboratory based, though some courses do incorporate service-learning projects (Esnard *et al.*, 2001/2004; Merrick, 2003). The significance of the latter approach has largely been examined in terms of promoting GIS access for grass-roots groups, with less emphasis on the implications for teaching and learning in GIS.

Here, I focus on the pedagogical significance of incorporating participatory action research (PAR) into undergraduate GIS courses. In PAR, individuals and communities are typically situated as researchers, rather than 'research subjects'. In this role, they are involved in identifying research needs, formulating research questions and methods, carrying out research and applying results (Pain, 2003, 2004). This last point is key. A core commitment of PAR is that research not be conducted for its own sake, but to support action that addresses the questions or needs that motivated the research. Some PAR involves university researchers, but the notion of involving students through their activities in a regular university course has received relatively little attention until recently. Thus, incorporating PAR in undergraduate instruction, especially as a way of promoting active learning in GIS, represents a widening of pedagogies in undergraduate geography. In this paper, I will show that students' involvement in PAR can help fill key gaps in their GIS learning that otherwise limit their success in independent GIS application. Further, these activities can enhance students' exposure to the social and political construction of spatial data and GIS technologies, and promote critical reflection on the politics and power relations of research. I develop these arguments with evidence from a project that involved undergraduate GIS students as part of a research collaboration with local-level community development organizations.

Teaching and Learning Debates in GIS

As GIS became part of university geography curricula in the 1980s and 1990s, appropriate content and effective teaching practices were discussed at length. These debates focused on identifying necessary content and effective design for departmental GIS curricula (Nyerges & Chrisman, 1989), as well as balancing students' conceptual learning about GIS with their applied learning about spatial data analysis and the use of specific software packages (Kemp *et al.*, 1992; Walsh, 1992; Sui, 1995). Some discussions of teaching and learning in GIS focused on certification or standards for benchmarking graduates' GIS preparation (Obermeyer, 1993). Another longstanding priority has been to develop ways of teaching GIS as a socially and politically constructed technology, so that students have

a stronger critical perspective on its societal implications (Warren, 1995; Kemp, 1997). More recently, the literature on GIS pedagogy has considered effective design and instructional practices for distance learning (Wright & DiBiase, 2005). With a good two decades of writing on GIS pedagogies and the development of several 'model curricula' in GIS (NCGIA, 2000; DiBiase, 2006), we have a wealth of approaches for how to balance conceptual and applied learning in GIS. But at least two key weaknesses remain. Many curricula continue to give limited treatment to the social and political construction and impacts of GIS, often as part of a few lectures or readings at the conclusion of course. As well, GIS researchers and practitioners note continued problems in students' preparation for independent GIS application in research or employment after completing university coursework (Montagu, 2001).

Service learning, experiential learning and other active pedagogies would seem to offer a fruitful set of practices for addressing these unmet needs. Evidence suggests that active pedagogies can help students link abstract and applied knowledge (Kolb, 1984; Cone & Harris, 1996), build a commitment to active citizenship, enhance job readiness and foster a critical understanding of inequality (Mohan, 1995; Varlotta, 1996; Kent *et al.*, 1997; May, 1999; Pawson & Teather, 2003). Others suggest that because experiential or service learning partnerships directly involve students in research processes, they foster students' critical reflection on the politics of research methodologies, particularly the negotiation of knowledge and power (Densmore, 2000; Merrett, 2000; Welch & Panelli, 2003). These approaches also have well-documented challenges, including differences in university and community agendas and timelines; historical legacies of exclusion and exploitation; or service outcomes that may not be useful to community partners (Howitt, 2001; Ferman & Hill, 2004). While experiential and service learning in geography have continued to expand, there are still relatively few examples from GIS courses. In practice, active learning in many GIS curricula is primarily laboratory based, in guided lab exercises and student-designed application projects.

There are a few examples of GIS courses where students carry out applications projects with and for partners outside the university. Esnard *et al.* (2001/2004), Merrick (2003), Talen (2000), and Al-Kodmany (2000) use university–community partnership models for student GIS projects, in graduate-level planning studios, internship or practicum requirements, or research methods courses. They note that students gain applied experience in planning, negotiating and carrying out a GIS project; and participating communities gain data, maps and skills that can be applied to local needs. But the main focus of these discussions is on the benefits and challenges of university–community research partnerships and their promise as a strategy for helping grass-roots groups gain access to GIS. These contributions are clearly important, but there has been far less discussion of the significance of these partnerships for teaching and learning in GIS.

Esnard *et al.* (2001/2004) are notably more expansive in their discussion of collaborative learning in university–community partnerships. They argue that students and community partners benefit from the rich co-production of knowledge that occurs when they work together to integrate local knowledge with existing public spatial data in a GIS. They contend that GIS application in the context of service learning demonstrates conceptual and methodological questions being explored in the classroom, and brings students into direct contact with ethical issues of GIS application. I would argue that what Esnard *et al.* (2001/2004) term service learning is actually far closer to PAR. Their process recognizes the considerable expertise that community partners bring to the process, and involves

collaborative development of GIS by students and community partners. Both of these practices open the door to recognizing a far greater range of benefits that may accrue from PAR in GIS courses, beyond just improving student preparation for professional GIS use or increasing community participants' access to digital spatial data and technologies (Leitner *et al.*, 2000; Montagu, 2001).

Here, I build on these propositions to articulate in more detail some of the benefits for student learning in GIS that can stem from incorporating PAR into GIS coursework. I will show that, in these partnerships, students' conceptual and methodological learning is not situated in the classroom and then demonstrated in the collaboration but, rather, is situated in both places simultaneously. For instance, students' GIS activities in field collaboration can and do highlight what has *not* been learned in the classroom, such that to successfully complete the project they must gain greater understanding of fundamental concepts in GIS. A PAR framework situates students as active partners in the processes of GIS application, including formation of research goals, data acquisition and development, analysis and mapping, and application of these outputs. In these activities, they are not learning from secondary sources about the social and political complexities of representing geographic phenomena in GIS-based spatial data. Rather, they are actively negotiating these processes in collaboration with their research partners from inside and outside the academy. They have an opportunity to directly observe how community partners use spatial data and maps to produce knowledge, expertise and power. Together, these experiences can foster critical reflection on the politics and power relations of research. These active engagements with GIS production and application are also, as Schuurman (2002) has argued, an important way of tapping the potential of GIS for inductive interpretive knowledge creation, a potential that has been overlooked in many characterizations of this technology.

Student Participatory Action Research in the Humboldt Park Community GIS Project

The course activities discussed here are part of an ongoing project initiated in 2003 in collaboration with two non-profit organizations in adjacent neighbourhoods on Chicago's near northwest side, Humboldt Park and West Humboldt Park. Both neighbourhoods are multiracial, with a large proportion of Humboldt Park residents identifying as Hispanic or Latino and a large number of West Humboldt Park residents identifying as African-American. Neighbourhood concerns include lower household incomes, elevated crime and unemployment rates, dilapidated housing stock in some areas, and gentrification and displacement in other parts. The area also has tremendous assets, including residents with a great deal of local political and community organizing experience, and a large number of non-profit organizations invested in improving quality of life in the neighbourhood. The West Humboldt Park Family and Community Development Council (known as 'the Development Council') and the Near Northwest Neighborhood Network (NNNN) are two such organizations. Their activities include community building and crisis resolution with residents, public health and education reform, guiding capital investment in the neighbourhood's retail and housing infrastructures, and advocating for neighbourhood issues with local, state and national government.

With these two organizations, I am involved in an ongoing collaborative research and education project that seeks to understand the utility and impacts of GIS use for local-level

civic organizations, and to develop effective strategies for building sustainable GIS capacity in such institutions. Early findings from the research elements of the project are offered in Elwood (2006a, 2006b) whereas here I focus on its pedagogical contributions. Two of our ongoing activities involve working with the community organizations to build a spatial database informing their work in the community, and supporting staff members and residents in learning to use GIS software. Some of these activities have been undertaken through participatory action research involving community participants and students in my undergraduate courses, a strategy we hoped would strengthen the learning of both.

As part of this element of the project, I designed two consecutive geography courses, drawing on Cone and Harris's (1996) conceptual model for service learning, and Kolb's (1984) experiential learning cycle. Cone and Harris's model involves collaborative definition of project tasks and goals by all participants, engagement of students in experiential tasks and critical reflection on the process and knowledge produced. It includes mediated learning forums in which the instructor (and in our case, community participants) guides students in developing greater understanding of the social, political and scholarly meaning of the knowledge created. Kolb's experiential learning cycle forwards a similar model of pre-activity preparation, experiential activity and post-activity reflection. While neither model is specifically oriented toward course-linked PAR, their processes of collective task definition, shared activities and reflection are remarkably similar to the ways that collaborative research is typically practised in a PAR framework. To apply these two learning models in the context of PAR, I developed course activities that facilitated student–community collaboration in these processes of task definition, implementation and reflection.

As we planned the courses, community staff members identified project goals of updating a decade-old community housing and land-use study, and developing additional data for inclusion in the organizations' GIS database. As part of the first course, a 10-week geography class focusing on community-based planning and urban revitalization, the students and community staff gathered data for the updated community study. They conducted walking surveys in small teams, gathering information about building conditions, land use, business activity, residential occupancy and new construction. They also outlined priorities for future data collection, mapping and analysis based on their own discussions and participant observation at community meetings. Students in the second class, a 10-week GIS course, created GIS-based spatial data files from the field survey data, and developed a range of other spatial data resources for the community study. These included vacant lots and their uses, local government-owned properties, contaminated sites, sources of toxic air releases, and social services available in the neighbourhood. Finally, the GIS students worked closely with the community partners to design and produce maps from these data. Over 100 of these maps became the central feature of the updated housing and land-use study. In this paper, I focus primarily on the learning objectives and outcomes in GIS, drawing on evidence from the second course.

The participating students varied tremendously in their experiences, expertise, areas of study, identities and adaptability to the varied challenges of collaboration and applied field research. Most were between the ages of 18 and 22, but this was nearly the only point of commonality among them. Some were residents of affluent suburbs, while others had grown up in Humboldt Park or similar places. Some were intimidated by the notion of gathering field data in an inner-city neighbourhood. Some had worked with or for

community agencies in the past, while others had no familiarity with these types of institutions. The majority of the students identified as white, though the class included Asian, African-American, Latino/a, and Native American students in far greater number than any courses I had offered in the past. A significant number were Spanish speakers, as are many residents of Humboldt Park. I did not query the students on this point, but I wonder whether the opportunity to conduct research with and for minority communities may have attracted this more diverse group of students to the course.

Both courses included multiple forums for all project participants to document and reflect on their experiences and observations. In class discussions, the student teams, research assistants and I compared our field observations and our field journals, which recorded and reflected on activities in Humboldt Park and in the GIS lab. In collaborative work sessions, the student teams and community staff discussed project activities, reviewed data-collection progress, outlined data acquisition and mapping needs, and critiqued data and maps in development. I incorporated these forums in part to promote what Cahill *et al.* (2007) term 'participatory ethics'—an ongoing collaborative dialogue about questions, problems or potential implications of research. One discussion, for instance, focused on data confidentiality in the field survey and the university's legal requirements for protection of human subjects in research.[1] In other sessions, we worked to resolve conflicts or concerns, as when one team failed to deliver data needed by another team or when one of the community organizers raised concerns about students' safety surveying one part of the neighbourhood. Creating such opportunities for collaborative work, reflection and problem-solving is an essential step in incorporating PAR into university courses, because it embeds students in the mutual research processes that characterize PAR.

A significant challenge to integrating PAR into university courses is defining learning objectives in a process that is often unpredictable, not fully controlled by university staff and difficult to determine in advance. I tried to address this challenge in part by working with the Humboldt Park participants to envision potential student contributions to the project when I was planning the university course content, activities and forms of assessment. Thus, we had outlined a plan for involving the students in spatial data preparation and GIS application in advance, and these goals became part of my course design. Clearly, this flexibility to structure course content in response to the needs of a research project is not available in all institutional contexts, and any university course is typically responding to multiple needs. For instance, my GIS course was also developed to address departmental needs for an applied projects course to serve as a 'capstone experience' in the GIS curriculum. Unsurprisingly, the course learning goals reflect the influences of both the collaborative research relationship and my department's curriculum needs. These objectives included developing skills to successfully complete all steps in a GIS implementation—from data acquisition to map production; the ability to develop spatial data relevant for GIS applications in urban redevelopment; the capacity to independently solve GIS problems (without scripted guidance); and the ability to navigate the politics and ethics of collaborative research relationships.

To assess the extent to which students had achieved these goals, I relied on several forms of evidence, including their field journals, the spatial data and maps they produced, and oral and written feedback from their project team members and community partners. I also kept a weekly narrative recording my own observations of each student's activities and interactions in collaborative work sessions, fieldwork, or other project activities. Some

of these approaches provided quite tangible demonstrations of skills developed, such as examining a student's spatial data file to determine whether it was complete, accurate and appropriately georeferenced for inclusion in the community spatial data library. But other sources required more subjective or interpretive analysis, such as weighing community feedback on whether a student team had indeed developed spatial data relevant for their urban redevelopment activities. Assessing whether a particular student was demonstrating a critical understanding of the politics and ethics of research relationships in his/her field journal or in collaborative work sessions was similarly subjective. In the case of these more subjective measures, I relied on the familiar qualitative research technique of triangulation, considering multiple sources of evidence such as community partners' feedback and my own observations. This flexibility to assess student learning through non-traditional work products and qualitative methods is a tremendously important element in enabling course-linked PAR, but something that is increasingly rare in the face of mandated assessment techniques and quality assurance documentation.

Expanding and Strengthening GIS Learning through Participatory Action Research

When incorporated into a GIS course, participatory action research has some important differences from active learning approaches where students work on pre-defined service tasks for an external client. By design, the research goals, data, analysis and outputs of PAR are negotiated and carried out by all participants. Through these interactions, students become active agents in GIS-based spatial data creation and use, working closely with the individuals and groups affected by this use of spatial data and technologies. The negotiated nature of PAR also means that the students are developing and using spatial data and GIS with far less pre-determined guidance than in lab-based exercises. These unique characteristics and relationships of PAR can strengthen students' fundamental learning in GIS, their critical reflection on the social construction of spatial data and GIS, and their understanding of how expertise and power are negotiated in spatial data and maps.

Learning GIS as part of a PAR project prepares students for independent GIS application, in part by highlighting gaps in their fundamental learning in GIS. Students must address these gaps in order to successfully complete the tasks that they, community participants and other research partners have defined, and the interactions that occur in a PAR framework can support their efforts to do so. As noted above, students in my GIS course were expected to develop the ability to successfully complete all steps in a GIS implementation, from data acquisition to analysis and mapping, and to do so in the absence of scripted instructions. The very nature of using GIS in the context of PAR sets the stage to demonstrate the extent to which these objectives have been met. By design, the students are responsible, at least in part, for developing a tangible GIS-based output that is needed by their community partners, and success in doing so indicates that they are indeed able to carry out relatively independent GIS application. Conversely, in the early stages of the GIS course, it was plainly apparent that the students had not achieved this objective. Nearly all the teams had tremendous initial difficulty with data entry, acquisition and preparation. One task involved creating a simple tabular data structure for the community survey data, adding and altering fields and resolving inconsistencies between spatial identifiers such as address number and street direction. The students had performed these tasks in laboratory exercises in a required introductory GIS class, but most had little success in their first attempts to do so without step-by-step instructions. Similar problems arose when they

began new data development for the community organizations' spatial database, and early in the course most of the student teams were plagued with problems in joining tables and georeferencing newly acquired data.

It is important to view these struggles in spatial data development not just as technical problems of being unable to operate the software or manipulate a data table. In many cases, the root of the problem was that students did not understand the fundamental organization of the database, its different data types (and implications for mapping and analysis), or the implications of different spatial identifiers for georeferencing in a GIS. They had learned *about* these concepts in previous courses. But their activities in the PAR project required them to *use* this knowledge in practice without specific instructions for how to do so. Their initial struggles show the extent to which the PAR activities required a stronger and more independent understanding of spatial data, their structure, and various techniques for their production and representation in a GIS.

That the students had successfully achieved the objective of learning to develop spatial data and implement a GIS application is demonstrated by the simple fact that they were able, by the end of the course, to prepare multiple additions to the community's spatial data library and complete the GIS-based community study. Over the 10-week period, the student teams resolved their data entry, joining and georeferencing problems and produced complete accurate data files that functioned properly for their mapping and analysis. The fact that these data and maps are still being used by the community organizations nearly 4 years later provides further evidence that the students successfully achieved this goal.

The activities they were responsible for in the PAR project highlighted what they had *not* fully learned in classroom and laboratory settings, and required them to gain sufficient mastery to be able to use their knowledge in practice. The PAR framework is a critical part of enabling this process to occur, because its collaborative relationships shift the stakes of student learning. In the context of PAR, developing a strong working understanding of basic principles of spatial and attribute data in GIS is about more than scoring highly on exams or lab exercises; it is about being able to carry out tasks needed by one's research partners to address important issues in their community. In this case, the students' sense of accountability to these relationships and to needs and problems in Humboldt Park was revealed in their field journals. One student, after describing his conversation with a community organizer about how his organization would use data from the field study in its affordable housing development work, wrote this:

> I have to admit I am glad that the project I worked on is used for such important matters. Though now I am a little nervous that I did not produce a map that is exactly what NNNN wants. (David, 2004)

This sense of accountability and understanding of the broader significance of their work directly affects the students' GIS activities, and I would argue that it is motivated by a PAR framework's emphasis on shared responsibility for achieving research goals.

Participatory action research can also strengthen students' learning about the social, political and practical challenges of data development and representation. Here again, applying GIS within the collaborative processes of PAR is a centrally important determinant of this outcome. As students and community partners work together to develop needed spatial data, they directly confront these issues as they discuss the impacts of particular data representation or analysis choices. In the HPCGIS project, the

community organizers proposed using land-use classification categories from an earlier field study for the updated community study. But in field testing the schema, the students noted that key differences in land use, such as the distinction between a school playground and a community garden, were subsumed within overly general categories. Other scenarios had no place within the older scheme, such as an abandoned building, which was neither 'vacant land' nor characterized by the residential, commercial, or institutional use codes. The students proposed a revised scheme addressing these problems. The community organizers agreed that the new classification would generate more accurate data, but highlighted their own practical constraints. They intended to join the new field data with data from an earlier survey of another part of the neighbourhood. A revised categorization scheme would make this integration difficult, and time and budget constraints prevented re-surveying with the new classification system. The students and community staff eventually decided to use the earlier categorization scheme, in spite of its problems, but to record the additional detail in a new text field.

For the students this situation was more than a mundane discussion of data codes, budgets and staffing. Rather, they learned from first-hand experience that spatial data are negotiated representations of observed conditions or characteristics, not a fixed measure of reality. One of the students documents his awareness of data as constructed in this very simple field note about one of the data development meetings with the community participants: "Everyone has a different idea of what should be included, [and] what categories each project should fall under…" (Todd, 2007). In building the data classification for the community study, the students recognized that data categories can obscure important differences or omit other characteristics entirely, and their discussions with the community partners illustrated some of the data integration problems that can result from semantic heterogeneity in data.

These experiences have a tendency to foster a critical perspective on data and their use. Entering field survey data into the GIS was difficult because of inconsistencies with base map data obtained from the City of Chicago. Students' journals were filled with questions about these inconsistencies:

> I thought the field data would be really easy to put in. But some of the building numbers must be written down wrong, or they're wrong in the City's records. I have house numbers in my field data that isn't in the parcels shapefile at all. What should I do? (Diana, 2004)

This quote evidences the student's shift toward being a critical data user/producer. She considers several possibilities for the source of the inconsistency, something that a less engaged user of data would be unable to do. Did the data collector write down the address incorrectly? Or is there a difference between the address as shown on the building and what is recorded in the City records? Here again, the PAR framework is key. Students are not working with data that have been prepared for them (as they would in many laboratory exercises), so these kinds of inconsistencies and problems are inevitable. The PAR framework provides a collaborative setting in which they can develop solutions with others. In the case above, the students and community staff developed a data duplication method that enabled them to show the legacy data from the City of Chicago as well as the directly observed conditions. Thus, the PAR framework accomplishes a dual mission by putting students in a situation in which they

will need to become active agents in producing and trouble-shooting spatial data, *and* providing an environment that supports their ability to do so.

Learning about GIS in the context of PAR also directly exposes students to the multi-faceted ways that spatial data and maps can be used to negotiate expertise, knowledge and power, because they have an opportunity to observe some of the very situations through which these negotiations occur. In the HPCGIS project, students directly observed, for example, how the community organizations use their maps to create flexible spatial narratives, a remarkably effective strategy for negotiating with different institutions or government agencies. One of the students was surprised to find that a single map he had worked on was used to tell several stories about the neighbourhood. The map was developed from a data layer that included the organization's activities and programmes in the neighbourhood and sites of new or planned affordable housing projects. In his field journal he reflected on a conversation with one of the community staff members:

> He told me that the map [I worked on] is used for a lot of things. It is used for presentations to foundations as a way to show them the work [the organization] has done and the work they plan to do. The map is used for presentations to City departments such as Planning, Zoning, City Council, etc. as a way to prove that they have been successful in revitalizing the area ... it is used for small and large business attraction, as a way to show potential business owners the resources and development that already exists in the area. (Todd, 2004)

In this passage, the student alludes to the community organizations' strategy of interpreting and reinterpreting a single map to present the neighbourhood and organization in slightly different ways with different audiences, for different purposes.

In these and other interactions, the students participating in the HPCGIS project were exposed to the social and political impacts of their maps and spatial data, with particular emphasis on the negotiation of expertise and power. For example, several students remarked on the extensive deliberation and debate among the community staff about design and layout of maps for the community study. Some of the community organizers insisted that it was best to follow the City of Chicago's design requirements for maps submitted in housing or business development proposals by for-profit developers. They argued that this approach would lend legitimacy to the maps and therefore to the community organizations, reinforcing their efforts to present themselves as informed, expert and professional. But others argued that matching the City of Chicago's cartographic conventions was not as important as ensuring that the maps asserted community control over decisions about housing and economic development. While not all students picked up on the subtleties of these debates, a number of them did, as in this excerpt from one of the field journals:

> It seems to me that the people at [the organization] truly feel as if this is their community's last stand. They are sick of being displaced and moved around the city at the will of wealthy private developers and those who purchase the trendy new homes, and shop at the trendy new stores in the neighborhood. I feel that this concern and this battle far overshadow any other matter in the work they do ... Alonso thought that it was a little silly to be focused on [matching our maps to the City's color scheme] and was impressed with the overall work that was done in the project. Alonso seems to have a bigger picture in mind, a plan or strategy of what to do with

> the maps and data. I think it is important to make sure the maps are standardized with the standards that the city … uses for their maps. But perhaps Alonso is on to something. Things like that can be easily changed, but it is the vision for the community that is important, and how well you can do the work necessary to make that vision some sort of reality. I am not sure how well I articulated what Alonso meant when we talked about this, but I hope I represented him well. (David, 2004)

In this entry, not only is the student weighing the different political practices he has observed being negotiated in the organization's GIS use and its other activities, but he also shows he has achieved one of the key learning objectives of the course by beginning to develop a critical understanding of the politics of research. Throughout the passage, he weighs his own views on the political implications of these mapping practices, and at the end expresses concern about his representation of one of the community participants' views. I had emphasized to students that their journals would become part of the qualitative data informing broader research questions in the HPCGIS Project, so this statement speaks to the student's awareness of the interpretive and representative power that researchers wield.

The examples discussed in this section illustrate how involvement in PAR brings GIS students into direct contact with conceptual and practical problems inherent in GIS application, and requires them to consider the potential consequences of these challenges for spatial data and research findings. As they develop and work with spatial data, they must develop a strong working understanding of how data are prepared, organized, edited and represented if they are to deliver their contribution to a collective research effort. Working within a PAR framework directly engages students in the social and political construction of data as they explore possible sources of data errors and inconsistencies, the appropriateness of data attribute schema for application needs, and the practical consequences of choices made in data development. Finally, undertaking GIS application in this framework embeds students in the social and political context in which spatial data and maps are being produced and used to negotiate knowledge, expertise and power. The collaborative working relationships that tend to characterize PAR are central to the learning outcomes that are possible in course-linked PAR. In the HPCGIS Project, the community participants cite this sharing of expertise as an important positive outcome. One of the organization leaders writes:

> … participatory GIS partnerships need all kinds of expertise… Everyone brings something, and everyone gains extraordinary knowledge. When we place the students and a community person together to work with GIS, they learn from each other. (Juan, in Elwood *et al.*, 2008)

Conclusion: Persistent Challenges and Unexpected Benefits

While the benefits of integrating participatory action research into GIS courses are considerable, this approach is not without its challenges. By design, PAR brings together co-researchers with diverse research, application and learning needs. Students often become co-researchers with their own sense of responsibility to a project, but they may also have their own (potentially different) personal goals for new skills development or learning. Community participants are co-researchers, but may also be staff members

beholden to the sometimes contradictory expectations of organization directors, colleagues and local residents. Faculty members are involved as teachers responsible for their students' learning in a particular class (and often, their preparation for a colleague's more advanced class), as collaborative partners in the PAR project, and also as university-embedded scholars subject to publication imperatives.

The time-limited nature of course-linked PAR can place practical limits on the extent to which it is possible for students to take the lead in negotiating the research with community participants. Having students and community partners fully negotiate the research project is ideal, but may not leave enough time to fully complete the project. In the HPCGIS Project, with only 20 weeks to complete any course-linked activities, the community participants and I opted to lay out some of the project goals and desired outputs in advance, and then we worked with the students to develop more specific plans for accomplishing these goals.

In course-linked PAR that is part of a larger project, students may not get to see the *action* part of the research. In the HPCGIS Project, the community study and new data layers the students had developed were not used extensively until after the end of the two courses, leaving some students questioning the long-term impacts:

> I just don't know how much they use GIS or how important they find it to be in accomplishing their goals... I think that the amount of enthusiasm they showed toward the progress of the project is a good indicator that they won't let these data sets fall through the cracks, especially when the whole collaboration is as big as this one was. It's still hard for me to picture a few maps and a massive stack of documentation making noticeable change in a community, but that's what it's for and that's what it has accomplished in other areas. (Tanya 2004)

This statement also points to two other challenges of course-linked PAR: the uncertainty of benefits for the participating community and the sustainability of these outcomes. As Reardon (1998) has noted about service learning, it is essential not to assume that communities necessarily benefit, or that they benefit in ways that were anticipated at the outset. Beneficial outcomes do seem more likely in PAR because community participants are actively defining research which they intend to use, but useful outcomes are not guaranteed. Second, especially in the context of PAR that incorporates GIS, sustained utility of spatial databases and maps produced may be problematic once students are not present to help support their use and maintenance. But a PAR model may help bridge this gap because the community participants are developing skills in spatial data development and GIS use, hopefully enabling them to continue using the GIS and data resources. That has certainly been the case in the HPCGIS project, as both NNNN and the Development Council have become central resources of maps, spatial data and GIS training for other community organizations in Humboldt Park.

Alongside these challenges, course-linked PAR can also create a plethora of unexpected positive outcomes. Following the two courses described here, one of the organizations began to regularly seek other geography students as volunteer interns or temporary staff members, to support their continued data development and mapping, and the GIS skill building of its staff. The project has unexpectedly expanded GIS capabilities in other non-profit organizations across Chicago's northwest side, as some of the original community participants have taken new jobs. For some of the students, their interactions with the

community staff and residents led them to learn of employment possibilities in other non-profit organizations in Humboldt Park or in other places. One student recently wrote:

> I am currently coordinating a neighborhood planning initiative program where I am making efforts to engage residents to work with the city and make neighborhood plans … What we were doing [in the Humboldt Park Community GIS Project] ended up being almost exactly what I am doing now. (Personal communication from former student, 25 June 2007)

These ongoing interconnections speak to the foundational commitment in PAR that knowledge creation in research is always collaborative, never 'independent'. All of these unexpected outcomes, while not initially anticipated and certainly difficult for a faculty member to engineer by intent, are part of the serendipity of course-linked participatory action research. All said, perhaps the best guidance for such work is to expect the unexpected, make plans but be prepared to throw them out, and appreciate the diversity of the learning and expertise that develops in these collaborations.

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Note

[1] For those in a US context, Institutional Review Board (IRB) approval typically must be obtained for any research that involves human participants, even if conducted by students as part of a class. Many universities will allow instructors to submit a protocol on behalf of a class, prior to the start of the term. IRBs may raise questions about whether students are researchers (who must go through IRB training) or research 'subjects' (who must give informed consent in order to participate). In my case, the students' participation was approved as part of my research protocol, though each was required to complete the University's IRB training in order to enrol on the course.

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