Learner-Centered Education Program

Arizona Board of Regents

Attachment A

INSTITUTIONAL SUPPORT FORM

Proposal Title: Enhanced Student Learning with Internet GIS Enrichment and Participatory GIS Collaboration

Institution: University of Arizona Dept./Unit: Geog/Regional Development and the Center for Applied Spatial Analysis

Multi-Campus/University Projects
(check other campuses or universities participating)

___ ASU Main _X__ UA

___ ASU East ___ UA South

___ ASU West ___ NAU

List other participating agencies:

Briefly describe the program and the development plan.

This project uses interactive web-based technologies to enhance student learning with new curricular content in six geographic information systems (GIS) courses offered by multiple units at UA. We seek to develop interactive course project web sites to enhance the collaboration of student teams with community partners as they complete applied GIS projects for these partners.

Funding Category

Indicate a primary (P) and, if applicable, secondary (S) funding category:

Professional Development _____ Program or Course Development/Modification _P____

LCE Research _____ Improved Assessment of Learning Outcomes _____

Authorizations

Project Director

Signature: _____

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Department Chair / Unit Director / College Dean / Provost (may not be PD)

Name: John Paul Jones III Title: Professor and Head

_____

Signature

Official Authorized to Enter into Contractual Obligations

Signature _____

Name: _____ Title: _____

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Enhanced Student Learning with Internet GIS Enrichment and Participatory GIS Collaboration

I. Abstract

This proposal seeks funding for an Internet GIS Coordinator, training for the project directors, and software to enhance undergraduate and graduate student learning in six Geographic Information Systems (GIS) classes offered by multiple units at University of Arizona. GIS is a data analysis and mapping software widely used in the public, private, and non profit sectors for urban planning, natural resource management, hazard and risk modeling, neighborhood revitalization, marketing, and many other crucial societal activities. This initiative will strengthen students' skills in using cutting edge Internet-based GIS software and delivery systems, and enrich their collaboration with local stakeholders as they learn GIS by completing 'real world' projects with community partners. These activities will integrate a learner centered approach throughout the University of Arizona's GIS courses by enabling active collaborative learning, creative use of information technologies, and demonstrable student learning assessed through the successful preparation of GIS projects for community clients. Specific project activities include developing Internet GIS skill-building exercises for students and interactive course project websites, to be used by student teams to collaborate with community partners and disseminate project results. These outputs will be used on ongoing basis in six GIS classes offered annually by the project directors and in Community GIS Academies, short term educational workshops they offer to at-risk high school students and community-based organizations in distressed urban and rural places. This project will better prepare Arizona students for employment in the rapidly expanding range of professions that involve GIS use and stakeholder participation; enhance the University's capacity for GIS-based community outreach and data gathering; and showcase student/community collaborations linked to the University's GIS programs.

II. Identification of Need

GIS is a rapidly growing and constantly changing industry, and GIS educators are engaged in equally intensive modification of their curricular content and approach to teaching and learning in GIS. New developments in GIS include the emergence of Internet-based GIS (Peng and Tsao 2003), a rising emphasis on participatory approaches to planning and decision-making processes that use GIS (Craig et al. 2002), and the growth of 'experiential' or 'active' learning approaches to GIS education (Kemp 1997). The most effective GIS educators will modify their curricular content and student learning activities to address the needs created by these changes. We propose to do so by integrating new activities and approaches in multiple courses in the University of Arizona's GIS program, drawing on several elements of a learner-centered approach. Specifically, we propose the following additions to the GIS curriculum, in 6 undergraduate/graduate courses taught by the project directors:

- New course content on Internet GIS, in the form of lab activities and projects in target courses, and
- Interactive GIS-enabled course project websites to enhance the collaboration of student teams with the community stakeholders who commission these applied GIS projects.

University-community collaborative projects are already central to the GIS education and research activities of the project directors. The short term support requested here will enable us to develop a sustainable curricular infrastructure to foster student learning in Internet GIS and collaborative GIS education and application. Our curricular modifications will enable students to learn necessary skills for dissemination of GIS-based data and maps using ArcIMS (the industry-leading Internet GIS software package). We will generate prototype course project websites for online delivery of maps and data that students produce in their collaboration with the local stakeholders or 'community clients' who have commissioned these projects. These activities address important student learning goals in an outstanding GIS program: Internet GIS curricular content, project management with 'real world' participant teams, and web-based collaboration. Rather than targeting the requested resources toward a single course in Internet GIS, we seek to integrate these activities and their LCE approaches into multiple courses. This approach maximizes the impact of the requested resources with respect to breadth of curriculum modification, number and level of students who will benefit, and range of research and teaching units affected (including the Department of Geography and Regional Development and the Center for Applied Spatial Analysis in the College of Social and Behavior Sciences, and the Renewable Natural Resources graduate program in the College of Agriculture and Life Sciences). Courses include:

Geog 416/516A: Computer Cartography (2/yr, 80 students, Bailey)
Geog 416/516C: Urban GIS (1/yr, 20 students, Elwood)
Geog 416/516D: Participatory Approaches to GIS (1/yr, 20 students, Elwood)

Geog 416/516E GeoVisualization (1/yr, 20 students, Bailey)
RNR/Geog 417/517: Fundamentals of GIS (1/yr, 170 students, Christopherson)
RNR/Geog 420/520: Advanced Techniques in GIS (1/yr, 20 students, Christopherson)

The proposed curricular modifications respond to several principles of learner centered education. The applied projects we use in these GIS courses foster active learning by teams of students, in consultation with faculty and with their community clients. The web-based collaboration tools and Internet GIS teaching materials we will develop use information technologies to both strengthen the community collaboration that is essential to student learning in these courses and help students develop skills in new technologies they will use as GIS professionals. A key component of learner centered education is its emphasis on demonstrable student learning and use of assessment measure that illustrate such learning. The community projects in our GIS courses are simultaneously a learning experience and a tangible demonstration of student learning. Successful completion of the project, as evidenced in delivery of project data, maps, analyses, and final reports to community clients is a clear measure of student learning. Additionally, feedback from community clients on the appropriateness and usefulness of project outputs provides critical assessment of students' development of the software, spatial analysis, and collaboration skills needed for successful GIS application.

University of Arizona has recently reconfigured its GIS program to include two larger introductory courses (416/516A, 417/517) and several intensive project-based courses (416/516C, 416/516D, 416/516D, 419, 420). These existing and newly introduced GIS classes are increasingly popular among students and with working professionals. This rising number of students and a new certification program position the University of Arizona as a major GIS educator in the State. In this context, integrating the proposed activities and learner centered education approaches across our GIS program is essential and will have far-reaching impacts. We will systematically integrate the proposed Internet GIS learning exercises and interactive course project websites into our GIS program in the following manner.

Geog/RNR 417/517 & 420/520: The Internet GIS learning exercises to be developed for 417/517 will be designed to equip students with fundamental hardware, software, and analysis skills they need to implement simple web-based GIS applications. More advanced exercises developed for use in 420/520 will guide them through the design and implementation of their own Internet GIS applications, requiring greater independence and higher level skills. These skills are essential for students' use of ArcIMS in community projects they will complete in 416/516 C, D, and E, which require 417/517 as a prerequisite. The inter-college cross-listing of 417/517 and 420/520 will enable us to develop Internet GIS skills in a large number of students in multiple campus units.

416/516A and 416/516E: These courses will be enhanced with interactive GIS-enabled websites and collaboration tools for student teams to use in their course projects with community stakeholders. For instance, 416/516A students are working with the US Geological Survey on mapping important cultural sites. Student in 416/516E conduct more advanced visualization projects, such as urban growth scenario modeling, in collaboration with local development and planning officials. The maps and models produced in these projects will be embedded into the Internet GIS capabilities of the course project websites; and the interactive communication and assessment tools in these sites will be used to facilitate the collaboration among student teams and their community clients. These two courses develop skills in digital cartography and visual representation of spatial phenomena, for purposes of communicating, analyzing, and disseminating information about complex issues such as urban development or growth management policies. 416/516A introduces relevant software and analysis skills, and 416/516E develops more advanced GIS skills and 3D visualization capabilities, using software such as *CommunityViz* or *Visual Studio.*

416/516C and 416/516D: These courses will be similarly enhanced with interactive course project websites, but in the context of introductory and advanced urban applications of GIS for urban revitalization, housing and economic development, and neighborhood planning. Projects in both courses require student teams to work with urban community organizations to identify their goals for a GIS mapping project and to design and implement projects addressing these goals. While students and community partners meet together in person, web-based collaboration tools will enable much more frequent and detailed collaboration throughout the stages of these projects. The Internet GIS capabilities and interactive websites are essential, so that community participants can access the resulting data and maps via the Internet in places such as public libraries. For low income individuals and

neighborhoods, such approaches are critical in combating the 'digital divide' they experience in terms of reaping the benefits of powerful new information technologies. These courses projects are also essential preparation for students who will use GIS professionally in urban planning or development, because participatory decision making has become a dominant approach in these fields.

Finally, Bailey and Elwood both conduct community-based GIS educational workshops as part of their research and teaching agenda, and some of the GIS Coordinator's hours will be devoted to enriching the existing Community GIS Academy website (http://www.u.arizona.edu/~kbailey/CommunityGIS/) to enable more interactive use of data and maps created by students and community partners. In summer 2004, Bailey designed, developed and delivered a Community GIS Academy for primarily Hispanic GED and at-risk high school students in Nogales, Arizona, in collaboration with Santa Cruz County's GIS Division and Workforce Development Program. The students learned GIS skills and conducted a field survey to map and photograph cultural resources in Nogales. Adding Internet GIS capabilities to the Academy website will enable students and participating community groups to access photographs, maps, and data via the Internet on an ongoing basis. Bailey and Elwood will continue to offer such community education workshops, using the Community GIS Academy website as a template to enable similar Internet GIS capabilities for these projects. Outstanding students in 416A/C/D/E, 417, and 420 will be encouraged to extend their learning in participatory GIS and Internet GIS by working with the Bailey and Elwood on future Community GIS Academy sessions for independent student or internship credit.

III. Technical Needs

These activities require hardware, software, staff time, and technical support and training. Necessary software includes: Dreamweaver for web development, as well as the software used in the GIS courses: ArcGIS, ArcIMS, CommunityViz, and Visual Studio. Microsoft SQL Server will be used to serve geospatial data, and ArcSDE will be used to communicate between the GIS and the spatial data. Hardware needs include a web server, map server, and data server, to enable Internet GIS capabilities, as well as a workstation for the GIS Coordinator's work, and a raid array for data storage and backup. The project requires a graduate assistant with skills in Internet GIS and web programming to serve as the Internet GIS Coordinator. We seek funding for the Internet GIS Coordinator, some technical support, partial provision of Dreamweaver software, and travel and tuition costs for software training for the project directors. All remaining hardware and software needs will be met through the GeoVisualization Lab and the Center for Applied Spatial Analysis as part of the cost sharing contribution.

IV. Work Plan

The specific curricular modifications to be made include: 1) Skill building exercises for 417/517 and 420/520 in which students will develop introductory and then more advanced skills in developing Internet GIS applications using ArcIMS software, and 2) Interactive course project website templates such that students in all 416/516 courses (A, C, D, E) will be able to upload their community GIS project content, and participate in interactive discussion and modification of this content with community participants. These website templates will require developing interactive web functions and Internet GIS components:

- Web-based feedback forms and interactive discussion logs that enable students, community clients, and the instructors to review maps and data being developed and provide comments, critique, and additional data.
- A spatial database in which community project data may be archived, for eventual uploading via the Internet GIS web server and ArcIMS software.
- ArcIMS 'map service' templates for use in the GIS courses and Community GIS Academy. These will enable Internet-based dissemination of GIS data and maps, as well as real-time development of maps by students and community participants, from the information stored in the spatial database.

The GIS Coordinator will develop and refine the prototype versions of these tools, which project directors and students will be able to utilize in future courses by inserting new content. Project directors will need to enroll in a 2-day ArcIMS training course, to facilitate the installation and ongoing use of this software in their courses. They will supervise the GIS Coordinator's activities and conduct assessment of the Internet applications and tools developed. The project will be conducted according to the following schedule for development, implementation, assessment, and revision.

Delivery Date	Activities and Planned Accomplishments	Personnel / Hours
Summer 2005	• Configuration of ArcIMS server & Dreamweaver software	GIS coordinator (80 hrs)

	• Create Internet GIS content (ArcIMS labs) for 417/517 • Community GIS Academies • ArcIMS training (2 days)	GIS coordinator (240 hrs) Bailey / Elwood All project directors
Fall 2005	• Develop ArcIMS/web content and prototype community project websites for 416/516D & 416/516E • Teach 417/517 with internet content • Assess student learning in 41	GIS coordinator (440 hrs) Christopherson Christopherson
Spring 2006	• Develop ArcIMS/web content and prototype community project websites for 416/516A & 416/516C • Teach 416/516D & 416/516E with Internet GIS content and web collaboration components • Assess student learning (with stakeholder review sessions & student feedback forms) and revise curriculum content.	GIS coordinator (440 hrs) Bailey / Elwood Bailey/Elwood
Summer 2006	• Revise web content for all 416x/516x, based on assessment • Create Internet GIS content (ArcIMS labs) for 420/520 • Community GIS Academies	GIS Coordinator (80 hrs) GIS Coordinator (240 hrs) Bailey / Elwood
Fall 2006	• Final project outcomes assessment • Teach GEOG 416A & 416C with Internet GIS content and collaboration, assessment of student learning as before	All project directors Bailey /Elwood

This work plan includes several elements designed to assess student learning, disseminate the teaching and learning resources developed, and sustain the activities initiated. As noted earlier, successful completion of community projects is demonstrable evidence of student learning. In courses with such projects, the PIs will also convene evaluation meetings with community partners and students, to discuss and assess projects' processes, outputs, and impacts. The websites developed in this initiative serve as the primary means of sharing the GIS teaching and learning materials developed. Other GIS educators, as well as students and community organizations, will have access to these sites. Such sharing of online teaching resources is extensively practiced in GIS education, and is ideal because of the fast-changing technologies of GIS. With respect to sustainability, the activities proposed here will create an infrastructure that can be maintained and used into the future by the project directors, their students, the Community GIS Academy, and community partners. The prototype websites and Internet GIS databases function as templates to which the data, maps, and project reports from future courses can easily be added. The Department of Geography and Regional Development is adding a full-time staff cartographer with Internet GIS expertise, and this cartographer will assist in maintaining the ArcIMS and other web resources developed here. Finally, the project's effort to foster Internet GIS skills in students will create a sustained flow of research assistants and student interns to assist in maintaining these capacities.

V. Key personnel

This project will be directed and implemented by Keiron Bailey and Sarah Elwood, assistant professors in the Department of Geography and Regional Development (GRD); and by Gary Christopherson, Director of the Center for Applied Spatial Analysis, and adjunct faculty member in Geography and Regional Development. A graduate assistant with appropriate skills will be hired as the Internet GIS Coordinator. Bailey, Christopherson, and Elwood are the instructors for the GIS courses and community-engaged GIS activities referenced here and will be responsible for directing the GIS Coordinator's activities for each of their respective courses. Bailey's earlier work has involved extensive research on web-based collaboration with community stakeholders and Elwood's previous work in participatory GIS has involved integrated collaborations involving stakeholder organizations and community-based service learning with university students (c.f. Bailey and Grosshardt 2004; Elwood and Ghose 2004). Christopherson has extensive experience with GIS based research in the social sciences. The Center for Applied Spatial Analysis is a GIS research facility that supports and develops research projects and encourages the wider use of GIS and related techniques in the social sciences through collaboration on grants, demonstration, training, teaching and internships.

VI. Expected Results / Outcomes

The activities outlined here will result in Internet GIS teaching tools and interactive website templates that can be used on an ongoing basis to foster student learning in Internet GIS and participatory team-based approaches to

using GIS and disseminating results among stakeholders. These activities will enhance UA students' development of the hardware, software, analysis, and collaboration capabilities they will need as contemporary GIS professionals. These curricular modifications expand the skill level of all graduates of current and future GIS classes, benefiting at least 330 students annually, as well as the community organizations and individuals involved in our outreach activities. The Internet GIS and web-based collaboration tools will enable sustained commitment to the community-engaged learning that forms the basis of the project directors' GIS education efforts. Broad and significant institutional benefits will accrue from the proposed activities. The interactive websites will showcase University of Arizona's outreach and education for minority and underserved populations, enable professionals to review student portfolios, and provide instructional resources for colleagues at other institutions. In sum, the proposed activities enhance the University of Arizona's national reputation as a leading GIS educator and its local and regional presence in university-community partnerships for education and research.

References

Bailey, K. and Grossardt T. 2004. EP-AMIS: Enhanced Participatory GIS/Multicriteria Methodology, *Proceedings of MapAsia2004*. Beijing, China: GIS Development.

Craig, W., Harris, T., and Weiner, D. (Eds). 2002.*Community Participation and Geographic Information Systems.* London: Taylor & Francis.

Elwood, S. and Ghose. R. 2004. PPGIS in Community Development Planning: Framing the Organizational Context. *Cartographica* 38(3/4): 19-33

Kemp, K. 1997. NCGIA Core Curricula in GIS and Remote Sensing. *Transactions in GIS* 2(2):181-190.

Peng, Z. and Tsao, H. 2003. *Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks.* New York: Wiley.

Budget Narrative

As described in Part III (Technical needs), the implementation and long term benefits of this curriculum development project require hardware, software, training and related travel, and personnel support. These costs will be shared significantly through the existing hardware and software resources of the Center for Applied Spatial Analysis Laboratory, and the Department of Geography and Regional Development's GeoVisualization Laboratory, as outlined below. We request ABOR's short-term support for the following costs, to modify our GIS curriculum in ways that will enable long-term benefits for our students in their preparation for Internet GIS application and collaboration as future professionals:

1. Personnel ($39,274)

Technical ($2,274): The installation and maintenance of servers, workstations, and software necessary for implementing ArcIMS the proposed interactive websites will require the assistance of an information technology support person, above and beyond the current hours of the Department of Geography and Regional Development's technical support staff member. The implementation of ArcIMS requires multiple servers, databases, and development softwares, and is far more technically demanding and technology intensive than any applications currently operating in either the Department of Geography and Regional Development or the Center for Applied Spatial Analysis. Thus, we seek funding for 130 hours of technical support, to be allocated throughout the duration of the project, on an average of 1.5 hours per week.

Graduate Assistant ($27,815): This budget item supports graduate assistant salary and ERE for the Internet GIS Coordinator, for the duration of the project. The graduate assistant will work 40 hours per week during summer 2005 and summer 2006, 20 hours per week during the 2005-2006 academic year, and 20 hours per week in September 2006, the final month of the project. The graduate assistant's hours will be devoted to developing the Internet GIS teaching materials and GIS-enabled course project websites, creating the supporting spatial database and uploading data for existing community projects and Community GIS Academies, and revising the prototype materials following initial testing and assessment.

Fringe benefits for personnel ($9,186): This item includes ERE for graduate assistant and technical support person, for the hours specified above.

3. Staff travel ($1,755)

The Project Directors (Elwood, Bailey, Christopherson) will need initial training in use of ArcIMS software, the Internet GIS software that students will be learning and using in the GIS courses and community workshops. The software vendor, Environmental Systems Research Institute (ESRI), offers 2 day intensive courses in ArcIMS, with the closest sites for this course in Denver and Albuquerque. Thus, we request travel Bailey, Elwood, and Christopherson for the purposes of this training. These costs include 3 round trip airfares ($900 total), 3 nights hotel costs ($600 total), meals ($180 total), and ground transportation ($75 total).

6. Materials and supplies ($500)

In order to use Internet GIS in their class projects and activities, students in our GIS courses will need access to a web development software, such as Macromedia Dreamweaver. We will need 13 licenses (11 for the GeoVisualization lab and 1 each for Bailey's and Elwood's workstations), and request funding for 8 licenses at a total of $500. The cost of the additional licenses will be shared from the GeoVisualization Laboratory's start-up budget. All additional equipment, computer hardware, and software needs will be met through the existing resources of the Department of Geography and the Center for Applied Spatial Analysis. The items include: 1 workstation, ESRI software licenses, Visual Studio software, Microsoft SQL Server and Server Developer, remaining copies of Macromedia Dreamweaver, data server, web server, map server, and raid array for data storage and backup.

7. Other operating expenditures ($1,530)

As noted above in Staff Travel, the Project Directors will need training in use of ArcIMS, through an intensive 2-day training course offered by the software vendor. Tuition for this course, discounted for participants from higher education, is $510/person.

Matching Funds ($18,444)
The total costs of this project will be shared with the University of Arizona as indirect costs foregone, in the amount specified above.