FY03 Innovations in Teaching with Technology Awards: Develop Lab Exercises Using Wireless GIS

FY04 Innovations in Teaching with Technology Awards

<table>
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<tr>
<th>Proposal Title:</th>
<th>Develop Lab Exercises Using Wireless GIS</th>
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<tr>
<td>Investigators:</td>
<td>David A. Bennett, Marc P. Armstrong</td>
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<td>Org Unit:</td>
<td>College of Liberal Arts &amp; Sciences</td>
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<tr>
<td>Department(s):</td>
<td>Department of Geography</td>
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<tr>
<td>Funding Awarded:</td>
<td>$8,870</td>
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Original proposal is not available.

Project Summary
Our objective in this grant is to investigate the utility of wireless geographic information technology in higher education. This work is predicated on the notion that complex geographical processes are often difficult to convey in the confines of a classroom and that if we could move students into the field and provide them access to knowledge repositories (e.g., the Internet, their professors and peers) via wireless access to the World Wide Web their learning experiences could be enhanced. The implementation of this idea required us to rethink the way in which key geographical concepts are communicated to students. In effect, we needed to formulate a new educational paradigm and at its core is what we call contextually-aware in situ learning. A combination of existing technologies allows us to track students in the field and deliver context-specific materials as they encounter, for example, evidence of particular geographical phenomena and processes. The final product is intended to turn the real-world into a hyperlinked, and contextually-aware learning environment analogous to what one might experience within the more restricted confines of a major museum. The combined package of real-world interactions with immediate access to remote repositories of knowledge is expected to produce positive feedbacks that result in greater understanding of complex geographical processes and better prepare students for professions in a rapidly changing and increasingly technological workplace.

To develop in situ learning capabilities, we requested funds to: 1) hire a TA for one semester to help assemble and develop linked technologies and build related laboratory exercises; and 2) acquire and install outdoor wireless access points on campus. ATAC provided funds for the TA and ITS provided two wireless access points. In May 2003, a temporary access point was installed in a third floor Jessup Hall.
office to facilitate the development of wireless geographic information technology. With this temporary access point in place, we employed two graduate students to work 20 hours a week in June and July. The process of identifying appropriate locations for the permanent access points, developing applicable installation plans, obtaining needed permissions, and installing the selected access points was completed in late August, 2003. This effort resulted in one new external wireless access point on Phillips Hall, and another on the Becker Communication Studies Building.

A research team comprised of Dr. Marc Armstrong, Dr. David Bennett, Mr. Jerry Mount (administrator for the Geographic Information Systems Instructional Laboratory (GISIL)) and the two TAs (Mr. Wenwu Tang, and Mr. Karthik Alamelumangapuram) began regular meetings to work on system design and address issues that emerged during the implementation process. The resulting system is comprised of four technological elements:

1. Global positioning systems (GPS) provide information about location on the surface of the earth.
2. Geographic information system (GIS) software provides data about what is at particular locations (ArcPad, ArcIMS, ArcMap).
3. Wireless communication devices provide in situ access to the knowledge needed to interpret data and understand processes.
4. Handheld computers package these capabilities into a single mobile unit.

Much of the work during this past summer addressed basic technological challenges associated with system integration. Communication pathways among many independent pieces of software had to be identified and constructed to provide the flexibility needed to support a variety of different laboratory exercises. Figure 1 illustrates major software components and associated data flows. Because of computational limitations the handheld devices maintain only a stripped-down GIS software package with limited analytical capabilities. This software communicates over the wireless network with a data and compute server that performs computationally intensive tasks and delivers data and information resources to students in situ. Communication among software elements is implemented through special purpose XML scripts that were written by members of the research team.

These scripts implement the following capabilities:

**Locational triggers** - An instructor may wish to draw a student’s attention to a particular feature or to signal to a student that s/he is at the proper location to perform a particular task. To perform these tasks we must monitor the student’s location and compare this location to a set of location triggers. When the students come within a predetermined distance of such a location, events are triggered (a resource pull or push).
Resource pulls- students can request (pull) information from a variety of Web accessible resources repositories. Resource pulls can provide course specific directions or access to supplemental materials found by the student anywhere on the WWW.

Resource pushes- At certain locations on the landscape the instructor will want to deliver (push) educational resources to the student (e.g., a video of the professor explaining the process by which a feature was formed, instructions on how to proceed with a data collection process).

Using this technological toolbox we are creating a series of three laboratory exercises for GIScience courses. This work is being carried out with the help of Jerry Mount and the TA for 44:005 (Foundations of GIScience).

Plans for the Future

Laboratory exercises will continue to be developed by TAs for specific classes and consideration is being given to the preparation of an NSF grant proposal.

Dissemination of Findings

The experiences gained from this project have resulted in:


Future plans to inform others about our project:

1. Armstrong will deliver two invited presentations about the project this fall: at Ohio State University on 23 October and the University of Illinois at Urbana-Champaign on 7 November. http://geog-www.sbs.ohio-state.edu/colloquia/2003-04/

2. Two additional journal papers, one focused on technological issues and the other on the development of our laboratory exercises.

Evaluation of Success

We successfully overcame a number of technological hurdles during the past summer and succeeded in developing the core set of technological capabilities that we need to implement mobile GIS in an educational setting. We have not yet evaluated the effectiveness of this technology in the educational process. One of the main goals of the NSF grant that we intend to write will be to complete this crucial piece of research.
Acknowledgements

We thank: The Academic Technologies Advisory Council and the College of Liberal Arts and Sciences (Student Computing Fees) for their support of this project. ITS Telecom and Network Services for advice and the installation of wireless access points (Jason Mueller in particular). Jerry Mount, Wenwu Tang, and Karthik Alamelumangapuram for implementing our collective ideas about the role of mobile GIS in education.

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<th>How will it improve student learning?</th>
<th>We received $8,870 from The Academic Technologies Advisory Council. The entire amount was used to support graduate students who helped implement the project.</th>
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<tbody>
<tr>
<td>What resources will you need?</td>
<td>--------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Rough estimate of costs</td>
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ITSupport Information