Title: **Web-based and Mobile GIS for High School GIS career awareness.**

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Abstract

Until recently, GIS education was limited to upper division and graduate level programs at universities due to the high cost of hardware, and the complexity of system installation and maintenance. By adopting Web-based GIS (ArcIMS) and Mobile GIS (ArcPad), high school students and educators can easily learn GIS concepts and techniques.

This paper introduces the NSF-funded project, "A Scalable Skills Certification Program in Geographic Information Systems" (HTTP://geoinfo.sdsu.edu/hightech/). One of the main goals of the project is to create an effective GIS career awareness program for high school students. By incorporating Web-based GIS in their curricula, high schools and educators can teach with GIS while minimizing the issues associated with a traditional GIS including training, software installation, and system maintenance. These issues can add complexity, greater time and resource requirements, and cost. Students can utilize a standard desktop computer with a Web browser and Internet connection to access GIS resources such as ecological maps; or use GIS techniques such as using GPS receivers with wireless mobile GIS (ArcPad) to monitor land cover changes in a regional park. Teachers and faculty members can utilize modularized Web-based GIS exercises developed by this program and incorporate them into their existing curricula and supplemental student activities.

Keyword: GIS Education, Web-based GIS, Career Awareness, Mobile GIS.

Introduction

The San Diego Educational GIS Consortium, comprised of San Diego State University, San Diego Mesa College (part of the San Diego Community College District), and San Diego City Schools, is currently funded by the National Science Foundation (NSF) to develop a scalable GIS skills certification program to prepare students for entry into a range of jobs in GIS-related fields and for career advancement. The Consortium will create GIS skills certifications designed to meet industry and employer needs that can be combined to provide an articulated educational program. These certificates will build on each other and provide the student with the opportunities to participate in an associate's degree program for more comprehensive technical training, a bachelor's degree program, and advanced degree programs in the field.

The central goal of this project is to increase the production of qualified GIS technicians to meet workforce demands. Project objectives include: (1) development of skills certificates that certify specific work-based competencies; (2) development of a standards-based curriculum, aligned across the three educational levels, designed to meet identified industry needs, and linked to job descriptions; (3) creation of articulation agreements that ensure that students are able to progress

efficiently through the skills certificate and more traditional educational programs; (4) preparation of high school teachers and post-secondary faculty to provide the GIS skills training; (5) development of a Web-based GIS career awareness program to encourage students to pursue careers in the field and enhance enrollment in technician training and educational programs; and (6) sharing of the model GIS skills certification and technician training program with other educational institutions and communities.

One major component of this NSF project is to develop a Web-based GIS career awareness program to encourage students to pursue careers in the GIS field and to enhance enrollment in GIS technician training and educational programs. The research team (two faculty members and four graduate students) established a research Website (http://geoinfo.sdsu.edu) for hosting the Web-based GIS career awareness program and online GIS learning modules. The GIS career program and the research website is geared mainly for the high school student and educator audience. By combining online multimedia presentation techniques and advanced Web technologies (Flash animation, online video clips, and interactive Web mapping tools), the research website provides high school students and educators a grounding in fundamental GIS theory and concepts. The comprehensive introduction to GIS and linked Web resources can help students assess their own interest in and aptitude for GIS-related careers.
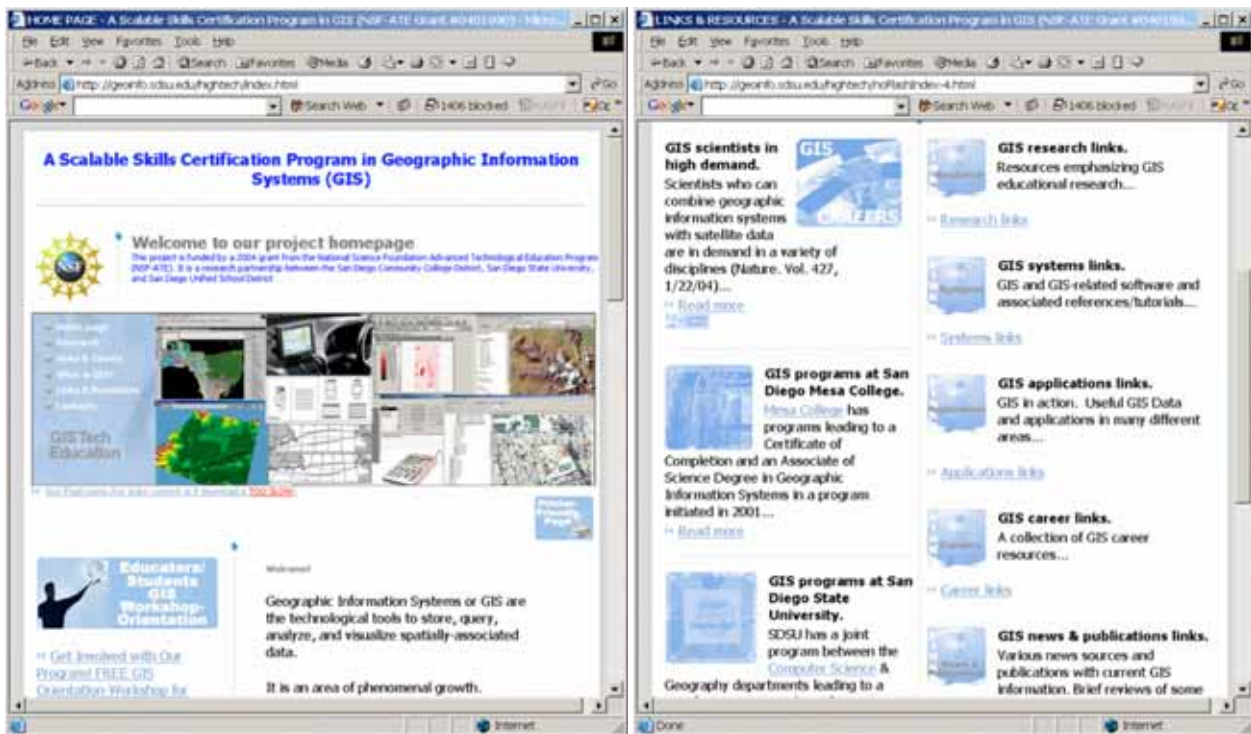

Figure 1. The Research Website for hosting Web-based GIS career awareness program. (http://geoinfo.sdsu.edu/hightech).

Figure 1 illustrates screen shots and some components of the research Website. The project Website was created and made available during the first month of the project. The initial Web page contains basic information about the project. It has been continuously updated to include major project findings and research activities including a DACUM report, information from our High School GIS workshops, and Web-based GIS learning modules. The Web server is a DELL

PowerEdge with duel 1.4Ghz Xenon Processors and 1GB of RAM. The Web Server is running the Windows Server 2003 operating system and is provided by the Department of Geography at San Diego State University. It is located in the Center for Earth Systems Analysis Research (CESAR) at the department.

Web-based GIS Learning Modules

The advent of Internet and Web-based GIS technologies provides a convenient and efficient way to deliver geospatial data and remotely sensed imagery. There is significant potential for Web-based GIS and online education tools in distance learning and GIS education for secondary schools (Peng and Tsou, 2003). The combined strength of GIS tools and functionality, map display, and multimedia presentation via the Internet, can significantly reduce the cost of traditional GIS education associated with hardware and software installation and technical training (Baker, 2005).

Two Web-based GIS learning modules and three Internet Maps have been developed and published on the research Website. The first module is called **"Earthquake Chasers" (**Figure 2). It is a GIS module for mapping Earthquake Magnitude & Plate Boundaries. The project team has been collaborating with Paula Ann Trevino, a geography teacher at Helix Charter High School, to develop and refine this learning module. The "Earthquake Chasers" module will be adopted in her geography course. The second module is called **"San Diego Bay Marine Monitoring Study"** (Figure 3). It is an environmental monitoring project of the San Diego Bay region. Dr. Jay Vavra, a biology teacher at High Tech High School, and his students assisted us in developing this GIS learning module for his lessons and students. These Web-based GIS modules can assist high school teachers in integrating GIS technologies into their existing courses, including geology, biology, and mathematics.
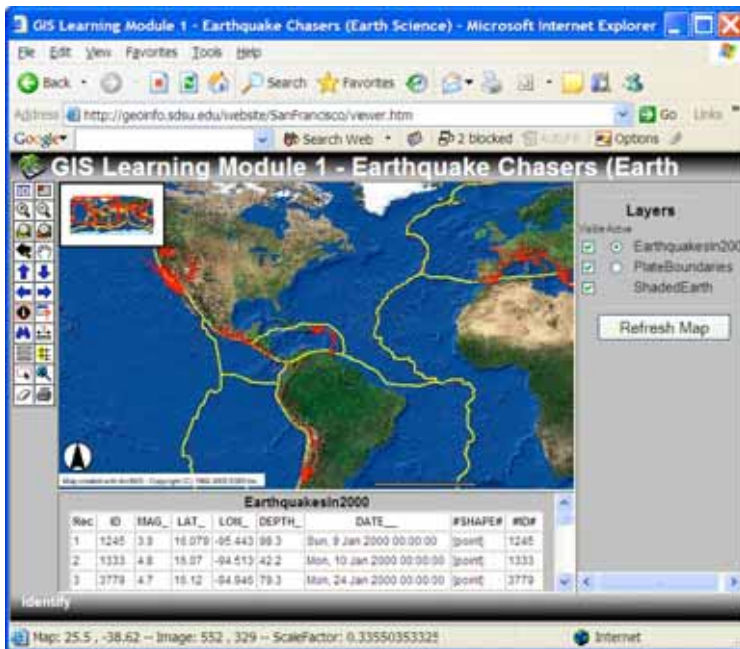

Figure 2. Web-based World Earthquake Map.
http://geoinfo.sdsu.edu/hightech/MapViewer/viewer.asp

There are two versions of each GIS learning module:
- A Desktop version for high school students and educators lacking broadband (higher-speed) Internet access. This version utilizes the stand-alone desktop GIS software application, ESRI ArcExplorer Java Edition for Education (AEJEE).
- A Web version for those students and educators possessing broadband Internet access. This version utilizes ESRI ArcIMS 9.0 with JavaScript customization of the Web map user interfaces. The ArcIMS mapping tools developed in this project can provide interactive, dynamic, query-based GIS tools to facilitate and enrich GIS education in the high schools.
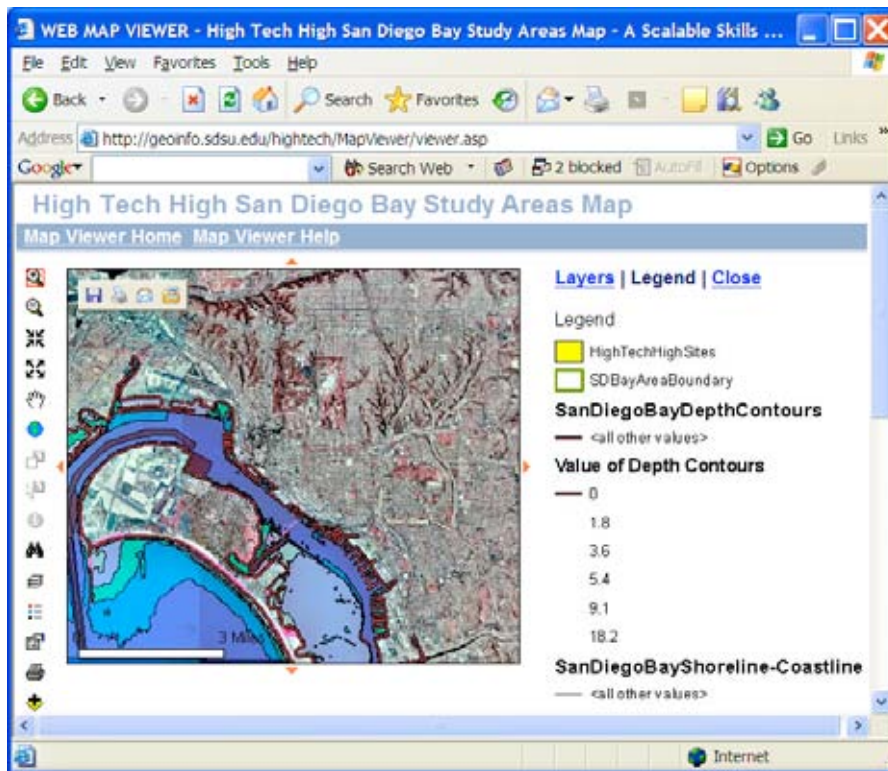

Figure 3. Web-based San Diego Bay Study Areas Map.
http://geoinfo.sdsu.edu/hightech/MapViewer/viewer.asp

The Web-based GIS career awareness program and GIS learning modules for high school students will be test-piloted by high school students and educators from High Tech High School and Helix Charter High School in the San Diego region. Their comments and suggestions will be used for future revisions and deployments of the Web-based GIS career awareness program.

Sharing of the Web-based GIS training programs and information

Currently, two Web-based GIS learning modules are completed and available on our research Website for Web-based learning of fundamental GIS concepts and theories. The Website also describes the skills certification process at both Mesa College and San Diego State University, and provides the draft report of the DACUM process being completed by the project. All meeting notes and basic GIS education links are provided on the research Website as well. The project Website also includes two video clips and several PowerPoint slides for the public to download and view (http://map.sdsu.edu/nvc2005-presentation/). One video clip captures portions of the project's first

GIS high school workshop. The other video clip presents a 3-D representation of Earthquake locations in California by overlaying a Digital Elevation Model (DEM). The second video clip was designed to provide a multimedia introduction of the first Web-based GIS learning module, "Earthquake Chasers."

The Challenge to Develop GIS Education in High School.

Traditionally, it is difficult to implement GIS technology in secondary education (Kerski, 2000). We found that current high school curricula must match state and federal education standards. It is very difficult to create a new GIS course for high school students. The project's solution was to develop GIS modules to supplement the existing courses taught in high school. Our strategy is to **teach** the current courses **with GIS** (as the first step to introduce the usefulness of GIS to teachers and students). We use GIS as a technology bridge to connect the high school teachers and students. The next step is to focus on **teaching about GIS** (a second phase to formally introduce the theories and technology of GIS in detail). This step focuses on the systematic introduction of related GIS technology, including GPS, spatial analysis, cartography, and remote sensing. Hopefully, by combining both "teaching with GIS" and "teaching about GIS," high school teachers will be more willing to accept GIS technology as a teaching tool, and will assist us in developing and meeting the goals of our Web-based GIS career awareness program.

Next Step: Wireless Mobile GIS

This NSF-ATE project is a three year project. Our next focus is to integrate wireless mobile GIS technology with Web-based GIS for high school teachers and students who might be interested in incorporating field work in their student projects. Mobile GIS is an integrated technological framework for the access of geospatial data and location-based services through mobile devices, such as Pocket PCs, Personal Digital Assistants (PDA), or smart cellular phones. With the advancement and convergence of GPS, Internet, and wireless communication technologies, mobile GIS have a great potential to play an important role in field data acquisition and validation. Today, there are more and more mobile GIS applications established by private companies, government agencies, and academic research institutes (Tsou, 2004). We believe that mobile GIS will become a very effective tool to integrate multiple geospatial technologies for high school teachers and students in several subject areas.

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