Annual Report for Period: 10/2004 - 10/2005   **Submitted on:** 04/01/2005

Principal Investigator: Johnson, John .   **Award ID:** 0401990

Organization: San Diego Mesa College

Title:

A Scalable Skills Certification Program in Geographic Information Systems (GIS)

Project Participants

Senior Personnel

Name: Tsou, Ming-Hsiang

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Tsou is the co-PI of the project. He is responsible for the SDSU sub-award and activities. He is the lead scientist for the development of the Web-based GIS career awareness program and the standard-based GIS curriculum at SDSU.

Name: Eckberg, Carl

Worked for more than 160 Hours: Yes

Contribution to Project:

Dr. Eckberg is the co-PI of the project. He is responsible for the development of GIS skill certificates, articulation, and the Web-based GIS Career awareness program.

Name: Johnson, John

Worked for more than 160 Hours: Yes

Contribution to Project:

Mr. Johnson is the PI of the project. He is responsible for the administration of the project, coordination of major research tasks, meetings and the DACUM and curriculum development process. As an Authorized ESRI/K12 Instructor and Certified Trimble Instructor Mr. Johnson is also involved in the training workshops and outreach activities.

Name: Berggren, Bill

Worked for more than 160 Hours: Yes

Contribution to Project:

Mr. Berggren is the Schoo-to-Career Specialist. He is responsible for the coordination between the project and San Diego High school teachers and students and the development of high school outreach activities.

Post-doc

Graduate Student

Name: Howser, Anthony

Worked for more than 160 Hours: Yes

Contribution to Project:

Mr. Howser is a graduate student at SDSU Geography Department and the webmaster of this project. He is responsible for the development of research websites and the Web-based GIS modules.

Name: Chen, Jing-Yi

Worked for more than 160 Hours: Yes

Contribution to Project:

Name: Li, Yinghui

Worked for more than 160 Hours: Yes

Contribution to Project:

Ms. Li is a graduate student at SDSU Computer Science Department. She is responsible for the development of the Web-based GIS modules and the documentation of our research activities.

Name: Zou, Wendy

Worked for more than 160 Hours: No

Contribution to Project:

Ms. Zou is a graduate student at SDSU Computer Science Department. She is responsible for the development of online Quiz exercises for the high school Web-based GIS learning modules.

Undergraduate Student

Technician, Programmer

Other Participant

Name: Sensenig, Phyllis

Worked for more than 160 Hours: No

Contribution to Project:

Dr. Sensenig is the program evaluator. She is responsible for

1. Providing limited advice and guidance to the Mesa College NSF ATE management team regarding the project design, proposal components, implementation plan and key activities and priorities.

2. Providing limited guidance to the Mesa College NSF ATE management team in designing the evaluation data collection process and developing data collection tools.

3. Conducting a mid-term evaluation of the NSF ATE project in March/April 2005. This mid-term evaluation will include:

a) meeting with the NSF ATE Principal Investigator, Co-PIs, and the Mesa College Administrator to review project goals and objectives, activities undertaken to date, and project achievements to date. As needed, meetings with other key College representatives to discuss the NSF ATE project may be scheduled for the same day.

b) preparing a written report of the evaluation findings for submission to the Mesa College cognizant administrator and the NSF ATE Principal Investigator.

4. Conducting a final evaluation of the NSF ATE Project in October 2005. This final evaluation will include:

a) meeting with the NSF ATE Principal Investigator, Co-PIs, and Mesa College cognizant Administrator to review project goals and objectives, activities undertaken to date, and project achievements. Additional meetings with key College representatives may be scheduled for the same day.

b) preparing a written report of the evaluation findings for submission to the Mesa College cognizant administrator and the NSF ATE Principal Investigator.

Research Experience for Undergraduates

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Organizational Partners
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High Tech High School

High Tech High is a well funded, leading edge Charter School operating within the San Diego Unified School Distirct. It has partnered with us to help promote GIS in the High School curriculum. Dr. Jay Vavra, HTH's biotechnology teacher, is currently working with project staff to incorporate GIS into a project which maps the marine biology of San Diego Bay.

The Gary and Jerri-Ann Jacobs High Tech High Charter School is a bold innovation in public education. Launched in September 2000 by an industry and educator coalition, High Tech High (HTH) occupies a newly designed learning space at the former Naval Training Center (NTC) in San Diego. A small, diverse learning community with a current enrollment of 452 students, HTH is founded on three design principles: personalization, adult-world connection, and a common intellectual mission. Innovative features include performance-based assessment,

commom planning time, state-of-the-art technical facilities for project-based learning, internships for all students, and close links to the high tech workplace.

Helix Charter High School

Helix Charter High School (7323 UNIVERSITY AVE.LA MESA, CA 91941)
operates outside of the San Diego Unified School District. Two of its teachers, Paula Ann Trevino and Garry Wilcox, are currently using GIS in their classrooms. Paula and Gary are interested in working with our project team to enhance their GIS activities and network with other teachers with similar ambitions.

Helix, located in a low to middle socio-economic community twelve miles east of the San Diego beaches, has a changing student body which reflects the rich ethnic diversity of California. Students of color comprise 41% of the total school population of 2,357, with 19% Hispanic, 14% African American, 4% Asian, and 4% other ethnicities. Twenty-five different languages can be heard on campus. Hearing impaired, Special Education, Title 1, and sheltered students participate in extra curricular programs like drama, cheer, choir, athletics, USA Club and Peer Mediation. Through our weekly Advisory Classes, staff members support their students and encourage them to be involved at Helix. One-third of the student body takes part in at least one athletic program.

ESRI

ESRI, a leading producer of GIS software has partnered with us on this project. Ann Johnson, an ESRI higher education manager, is on our National Visiting Committee and San Diego Mesa College and SDSU currently have ESRI College Site Licenses.

ESRI was founded as Environmental Systems Research Institute in 1969 as a privately held consulting firm that specialized in land use analysis projects. The worldwide headquarters of ESRI are anchored in a multicampus environment in Redlands, California, about a 2 hour drive from San Diego. Today, ESRI employs more than 2,900 staff, more than 1,500 of whom are based in Redlands, California, at the world headquarters. The company has revenues of more than $560 million and an annual growth rate of over 20 percent. ESRI software is used by more than 300,000 organizations worldwide including most U.S. federal agencies and national mapping agencies, 45 of the top 50 petroleum companies, all 50 U.S. state health departments, most forestry companies, and many others in dozens of industries.

ESRI software is the standard in state and local government and is used by more than 24,000 state and local governments including Paris, France; Los Angeles, California, USA; Beijing, China; and Kuwait City, Kuwait.

ESRI fosters relationships with more than 65 software, technology, data, hardware, system integrator, and consulting companies to ensure product compatibility and to explore new technologies. ESRI works closely with major technology partners such as SAP, Microsoft, SAS, IBM, FileNET, Sun Microsystems, Hewlett-Packard, and others.

Each year, more than 25,000 GIS professionals and students in the United States are trained by ESRI or ESRI-authorized instructors. In addition, more than 11,000 individuals from 180 countries have enrolled in ESRI Virtual Campus Web-based training courses on the Internet, and approximately 50,000 students a year complete university courses taught with ESRI software.

Employee Training Institute

The Employee Training Institute (ETI) is a division of the San Diego Community College District dedicated to staff training and development. ETI provided project staff with assistance in conducting the DACUM Workshop for GIS Technicians in January, 2005. They also have computer lab facilities which are available for project use.

ETI is dedicated to providing expertise and skill development to organizations and individuals to contribute to the economic development of San Diego; and to offer programs and services that complement those of the SDCCD.

Other Collaborators or Contacts

San Diego Regional GIS Council: This local GIS council serves as our project advisory committee and its members serve as 'subject matter experts' for our GIS curriculum.

Affiliated with the California GIS Council, the San Diego Regional GIS Council was formed to collaborate on the planning, implementation and maintenance of a California GIS infrastructure (the term 'infrastructure' is used here in a holistic sense to encompass systems, organizational programs, policy, standards, procedures, and any other factors that affect the ability of member organizations to jointly develop

or acquire, share and maintain spatial data adequate to their needs). The San Diego Regional GIS Council is made up of local government agencies, water agencies, and state and federal agencies. They collaborate to acquire and share data, information and discuss GIS-related issues common to member agencies.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:

The project has been underway for 6 months and recruiting and training of project members is underway according to our project schedule.

John Johnson (PI) has received training on DACUM 'Developing a Curriculum', SCID 'Systematic Curriculum & Instructional Development' and ROI 'Performance based assessment & training analysis'

At SDSU, the major training task is to teach the graduate students advanced Web authoring technologies and Internet Map Servers (IMS). Dr. Tsou is responsible for this training for graduate students. By choosing the graduate students who already have strong background knowledge in Web authoring and IMS, our geography-major graduate students (Howser and Chen) can immediately contribute to our project and only require minimum training and advise during the development of project Website and Web-based GIS modules. Two computer science graduate students (Li and Zou) are also capable of developing web-based GIS modules, but they will need more training in GIS technologies and Web-based mapping tools since they have only limited prior knowledge of GIS. The major Web-GIS technology training for our graduate students will be accomplished by the end of 2005.

Outreach Activities:

Mr. Johnson (PI) and Mr. Howser (Webmaster) participated in the 2004 NSF-ATE Principal Investigators Conference in Washington, DC.

The project team conducted its 1st High School outreach activity at High Tech High in March, 2005. Members of the project team also participated in the High Tech High Science Fair which was held in March, 2005.

Dr. Tsou organized two GIS education sessions in the annual meeting of Association of American Geographers (AAG). April 7, 2005 in Denver, Colorado and will present a paper, title: Adopting Web-based GIS for the Development of a Scalable GIS education Program.

Dr. Tsou will attend the 2005 ESRI Education User Conference, San Diego and present a paper, title: Web and Mobile GIS for High School GIS Career Awareness.

Mr. Johnson will attend the 2005 ESRI Education User Conference, San Diego and present 2 papers: (1) DACUM Curriculum Analysis for GIS Technicians and (2) The Future of GIS Education at the Community College.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

URL(s):
http://geoinfo.sdsu.edu/hightech
Description:
Project Web Site

Other Specific Products

Product Type:

Teaching aids

Product Description:

Project Website Overview & Guide

Sharing Information:

Workshops, Meetings, Outreach activities

Product Type:

Teaching aids

Product Description:

Learning Module 1: Mapping Earthquake Magnitude & Plate Boundaries with ArcExplorer Java Edition for Education

Sharing Information:

Workshops, meetings, outreach activities

Product Type:

Data or databases

Product Description:

DACUM Chart for GIS Technician

Sharing Information:

Website, meetings, workshops, surveys

Product Type:

Software (or netware)

Product Description:

Two Web-based GIS learning modules (http://geoinfo.sdsu.edu/hightech/earthquakeModule.html)

One Desktop GIS learning modules (CD-ROM and hard copy printout)

Three Internet Maps (http://geoinfo.sdsu.edu/hightech/MapViewer/index.asp)

One Video Clip (MPEG format) for High Tech High GIS workshop.

Sharing Information:

Workshops, Meetings, Outreach activities

Contributions

Contributions within Discipline:

We have completed a new DACUM Chart for GIS Technicians which identifies specific work-based competencies.

Geography Education: The development of Web-based GIS learning modules will have significant impacts for the future Geography Education in K-12 education plan. Traditional Geography courses (such as Human and Culture Geography, Physical Geography, and Map readings) will be transformed into more interactive and query-based learning materials.

GIS education: a new DACUM Chart for GIS Technicians has been identified with specific work-based competencies. The result of DACUM will change the design of entry-level GIS courses in participating Community Colleges and Universities and may be adapted by others.

The new development of GE-level GIS course (Geographic Information Science and Spatial Reasoning) will become the first national model course for integrating multiple geospatial technologies and skills together (by combining GIS, remote sensing, cartography, spatial statistics, and GPS technologies).

Contributions to Other Disciplines:

Educational Technology: The project web site was designed to be a resource for educators seeking to incorporate GIS into their curriculum. It's effectiveness is indicated by the fact that 6,650 unique visitors have logged onto the site since it was created.

This site contains multimedia, web-based learning modules and customizable web map viewers which provide new directions for the next generation of Educational Technology. This project demonstrates some new directions, including advanced client/server computing, distributed components, Java programming, and Web services technologies during the development of Web-based GIS learning modules.

Enhance High school Education in biology and geology courses by creating 2 High School GIS learning modules:
- Biology: San Diego Bay Marine Monitoring Study.
- Geology: Earthquake Chaser module.

Contributions to Human Resource Development:

We are working with a group of San Diego High School Teachers to help them incorporate GIS into their curriculum. We are providing them with assistance in developing custom modules that enable them to teach with GIS.

Contributions to Resources for Research and Education:

We have developed a website which is used to introduce our project, disseminate on-line and desktop GIS learning modules, provide grounding in the fundamentals of GIS theory & concepts, help students assess their interest in and aptitude for GIS-related careers and form an on-line community and portal for GIS-education research and related projects.

Contributions Beyond Science and Engineering:

We are helping to expand the use of GIS in the San Diego region and beyond by (1) increasing the number of trained GIS technicians, (2)providing these students with internships, (3) increasing the number of teachers and students who use GIS as a tool for learning and exploration. These new GIS users will be critical thinkers with strong spatial reasoning abilities. They will be better able to interactively explore, analyze and make decisions about problems. This will contribute to an improved society with a more efficient use of its limited natural resources.

<u>**Special Requirements**</u>

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

<u>**Categories for which nothing is reported:**</u>

Any Journal

Any Book

PROJECT ACTIVITIES

Scalable Skills GIS Certificate Program #0401990
San Diego Mesa College, San Diego State University, San Diego City Schools
October, 2004 – March 2005

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 has begun the development of a scalable GIS skills certification program that will prepare students for entry into a range of jobs in GIS-related fields and for career advancement. The proposed project will create GIS skills certifications that can be combined to provide an articulated educational program.   It will involve the development of a series of skills certificates designed to meet industry and employer needs. These certificates will build on each other and feed into an associate's degree in GIS for more comprehensive technical training, a bachelor's degree, and advanced degrees in the field.

Major project objectives along with specific activities and deliverables were identified in the project work-plan. The status of those scheduled for year 1 are as follows:

Objective 1: Develop skills certificates at identified levels of training, to certify specific work-based competencies.

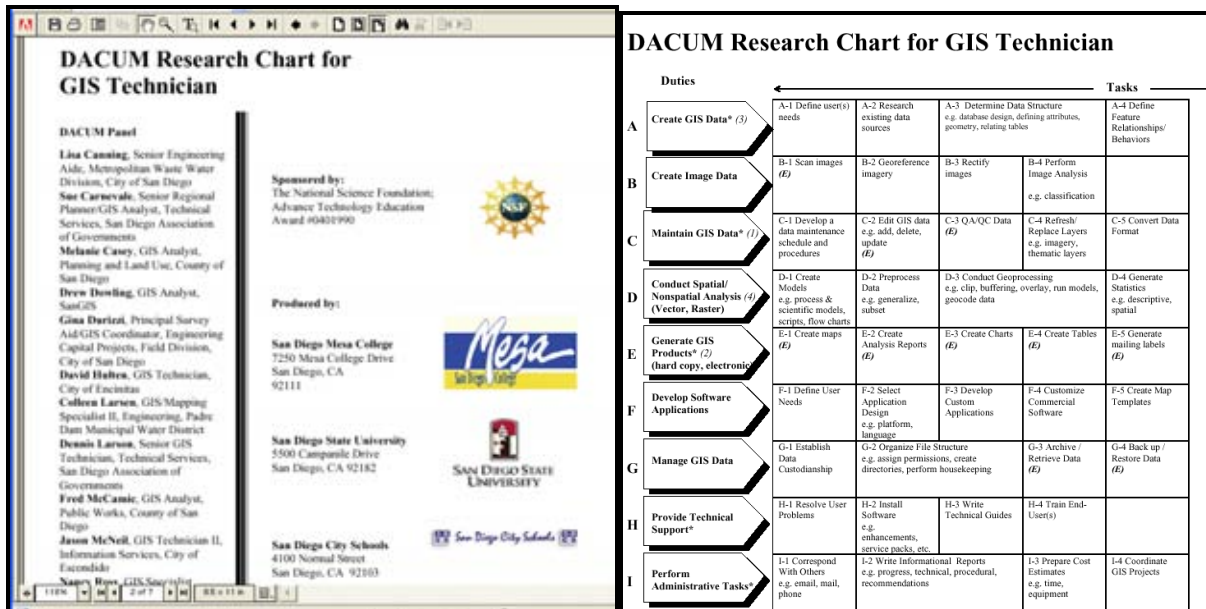| Activities	Deliverables:
A group of GIS employers will be asked to identify categories of employees. A group of GIS role experts will use the DACUM process to identify career ladders and the knowledge, skills, abilities and education needed at each level.	DACUM descriptions of the Jobs and career ladders for GIS positions. These descriptions will identify the skills standards for GIS positions.
Status: Mr. Johnson (PI) and Sarah Halstead from the Employee Training Institute, attended DACUM training and became certified DACUM Instructors on December 3, 2005. Together they conducted the project's "DACUM" Workshop to identify specific work-based competencies on January 13th & 14th, at the Holiday Inn in San Diego. Eleven GIS Technicians from the San Diego Regional GIS Council took part in this activity. The results of this workshop is a DACUM chart for GIS Technicians (see below)	
Participants at ESRI's annual conference in San Diego will be asked to further validate the results of the DACUM process.	Revisions to the DACUM descriptions, based on the input received. (Year 1)
Status: Presentation is Scheduled for July, 2005	
The GIS Educational Consortium will develop project-based certification procedures, and will utilize them to award independent employment skills certifications to students who successfully complete the skills certification courses and pass the project-based certification tests.	Certification policies and procedures Certificates awarded. (Year 1)
Status: This activity is awaiting the results of the DACUM process.	

DACUM Research Chart for GIS Technician

Duties	Tasks				
A — Create GIS Data* (3)	A-1 Define user(s) needs	A-2 Research existing data sources	A-3 Determine Data Structure e.g. database design, defining attributes, geometry, relating tables	A-4 Define Feature Relationships/ Behaviors	
B — Create Image Data	B-1 Scan images (E)	B-2 Georeference imagery	B-3 Rectify images	B-4 Perform Image Analysis e.g. classification	
C — Maintain GIS Data* (1)	C-1 Develop a data maintenance schedule and procedures	C-2 Edit GIS data e.g. add, delete, update (E)	C-3 QA/QC Data (E)	C-4 Refresh/ Replace Layers e.g. imagery, thematic layers	C-5 Convert Data Format
D — Conduct Spatial/ Nonspatial Analysis (4) (Vector, Raster)	D-1 Create Models e.g. process & scientific models, scripts, flow charts	D-2 Preprocess Data e.g. generalize, subset	D-3 Conduct Geoprocessing e.g. clip, buffering, overlay, run models, geocode data	D-4 Generate Statistics e.g. descriptive, spatial	
E — Generate GIS Products* (2) (hard copy, electronic)	E-1 Create maps (E)	E-2 Create Analysis Reports (E)	E-3 Create Charts (E)	E-4 Create Tables (E)	E-5 Generate mailing labels (E)
F — Develop Software Applications	F-1 Define User Needs	F-2 Select Application Design e.g. platform, language	F-3 Develop Custom Applications	F-4 Customize Commercial Software	F-5 Create Map Templates
G — Manage GIS Data	G-1 Establish Data Custodianship	G-2 Organize File Structure e.g. assign permissions, create directories, perform housekeeping	G-3 Archive / Retrieve Data (E)	G-4 Back up / Restore Data (E)	
H — Provide Technical Support*	H-1 Resolve User Problems	H-2 Install Software e.g. enhancements, service packs, etc.	H-3 Write Technical Guides	H-4 Train End-User(s)	
I — Perform Administrative Tasks*	I-1 Correspond With Others e.g. email, mail, phone	I-2 Write Informational Reports e.g. progress, technical, procedural, recommendations	I-3 Prepare Cost Estimates e.g. time, equipment	I-4 Coordinate GIS Projects	

Figure 1. Draft DACUM report (available on-line at
http://geoinfo.sdsu.edu/hightech/Documents/draftDACUMResults.pdf)

Figure 2. The DACUM meeting.

Comments:

Upon completion of the DACUM chart, J. Johnson (PI) attended follow-up training on the Systematic Curriculum & Instructional Development Process. This process identifies DACUM as only the first step in curriculum development. It should be followed by "Task Verification" where Tasks are refined and rated by importance and learning difficulty using input from questionnaires research and other sources. These will include the ESRI User Conference in July, other DACUM charts and work from the GeoSpatial Workforce Development Center of S. Mississippi.

The next step is "Task Identification" where duties & tasks that are considered to be important, critical and complex are identified for inclusion into the curriculum. Following this is "Task Analysis" where these tasks are broken down into incremental steps and such things as performance standards, knowledge, skills and equipment are associated with each one. Once this is completed, individual steps, tasks and duties are then mapped to individual courses using a rubric. Course development begins at this point, followed by implementation at the three educational levels, alignment and the development of articulation agreements.

J. Johnson also completed training on "ROI: Performance based assessment & training analysis" This knowledge will be used to assess the effectiveness of this curriculum in meeting the stated objectives.

The results of the DACUM process will be used throughout this project as a basis for curriculum, high school outreach activities and web-based/desktop learning modules.

Objective 2: Develop a standards-based curriculum, aligned across the three educational levels, designed to meet identified industry needs. The project-based curriculum will be linked to job descriptions, will integrate Geography and Computer Science, and will include a work-based component focused on career ladders in GIS.

Activities	Deliverables:
Map the DACUM results to courses across the three levels of education, and identify the additional curriculum needed to provide skills certifications.	List of courses and curriculum is prepared, with gaps identified. (Year 1)
Status: Awaiting "Task Verification" and "Task Analysis".	
Develop project-based activities for the skills certification courses.	Project curriculum outlines. (Year 1)
Status: Two web based learning modules were developed by the project team based upon this principle. Additional project-based learning modules will be developed for web site as well as for the Community College and University GIS curriculum.	
Arrange internship opportunities for students in the skills certification programs.	Internship completion. (Year 1,2,3)
Status: Student internships with local agencies and businesses will be conducted in the summer of 2005.	

Comments:

The focus of this objective is to develop a basic GIS curriculum, aligned across the three educational levels, designed to meet identified industry needs. Dr. Tsou (co-PI) is currently developing a new course, GEOG 104 (Geographic Information Science and Spatial Reasoning) at San Diego State University. This course is designed for a General Education (GE) level, which can be used for the articulation with Mesa College and San Diego City Schools.

The preliminary design of this course is under development now and a course website has been established (http://map.sdsu.edu/geog104).   This new course will be taught by Dr. Tsou in Fall 2005. The design of GEOG 104 will use the draft DACUM report to revise the curriculum and learning objectives.   One unique feature of the new GIS curriculum is to adopt Web-based GIS exercises rather than traditional desktop GIS training methods. Figure 3 (right) shows an example of Web-based GIS exercises (Java-based Habitat Monitoring Toolbox) in GEOG 104.
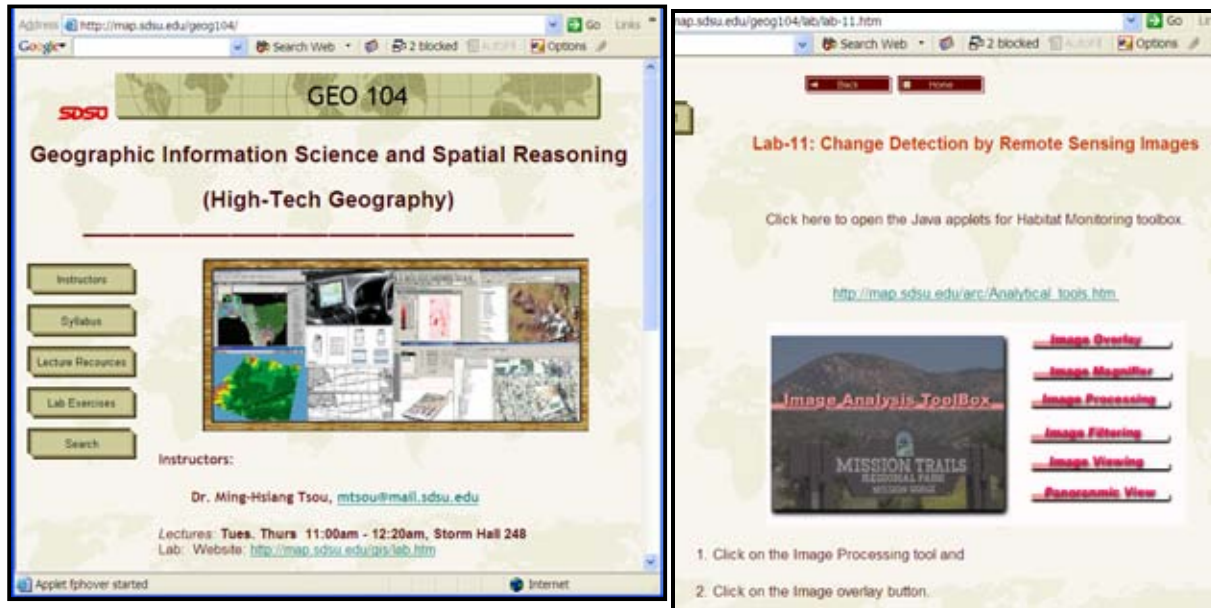
Figure 3.   GEOG 104 course website and Web-based GIS lab exercises.

Objective 4: Prepare high school teachers and post-secondary faculty to provide the GIS skills training.

Activities	Deliverables:
Teacher and faculty training workshops and programs will be developed and offered.	Workshops conducted/attended to capacity (Year 1, 2, 3)
Status: 1st High School Outreach Activity was conducted on February 23, 2005 at High Tech High. Also participated in the High Tech High Science Fair in March, 2005 at High Tech High.	

Comments:

The project team has made contact with approximately 12 teachers from local San Diego County High Schools who are interested in working with us to incorporate GIS into their High School curriculum. Most of these teachers have little to no GIS experience and limited time to devote to this effort. We conducted an initial workshop to introduce our project to these teachers and obtain their input on this project. On the basis of this input we are making plans to offer a second

workshop later this year to provide these teachers with GIS skills training and introduce them to learning activities and modules under development.

Objective 5: Develop 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.

Activities	Deliverables:
The Co-PIs will develop and disseminate web-based GIS career awareness programs, geared mainly for the high school audience. These project-based courses will help students assess their interest in and aptitude for GIS-related careers, and encourage students to enter the field.	Web-based courses. Student completion of web-based courses. (Year 1)
Status: Two Web-based and desktop version GIS learning modules and three Internet Maps has been developed and published on the research Website.	

Comments:

This objective is to develop a Web-based GIS career awareness program to encourage students to pursue careers in the GIS field and enhance enrollment in GIS technician training and educational programs. Dr. Tsou and Dr. Eckberg work with four graduate students (Howser, Chen, Li, and Zou) together to establish 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 gear mainly for the high school audience. By combining multimedia presentation and advanced Web technologies (Flash animation, Online Video clips, and interactive Web mapping tools), the research website provides high school students and teachers a grounding in fundamental GIS theory and concepts. The comprehensive GIS introductions and linked Web resources can help students assess their interest in and aptitude for GIS-related careers.
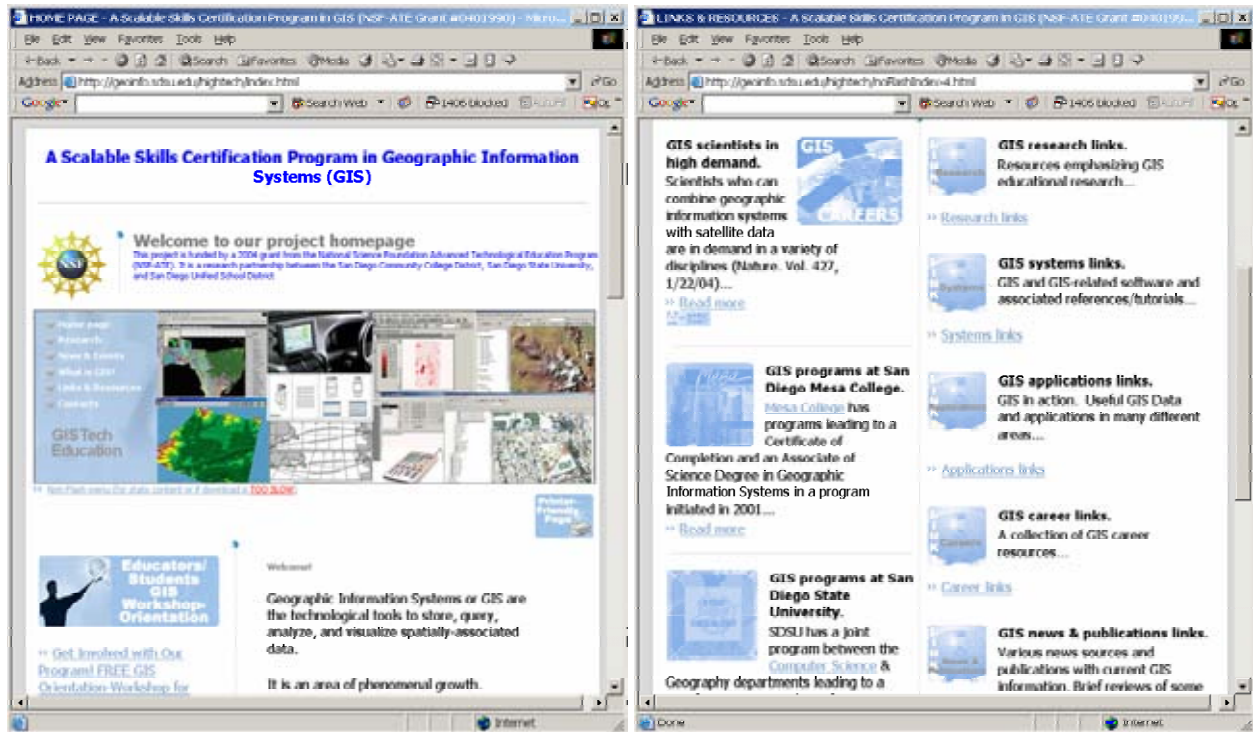
Figure 4. The Research Website for hosting Web-based GIS career awareness program. (http://geoinfo.sdsu.edu/hightech).

Figure 4 illustrates the screen shots and some functions of our research website. The project's website has been created and made available during the first month of the project. The initial web presence contains basic information about the project. It has been continuously updated to include the major findings (DACUM report, High School GIS workshops, and Web-based GIS learning modules, etc.) and research activities. Dr. Tsou is the system administrator of the Web server, a DELL PowerEdge Duel 1.4Ghz Xeron Processors (with 1G RAM) Web Server running Windows Server 2003 operating system. Antony Howser (graduate student) is the Webmaster of our research website. The Web Server is provided by the Department of Geography at San Diego State University and located in the Center for Earth Systems Analysis Research (CESAR).
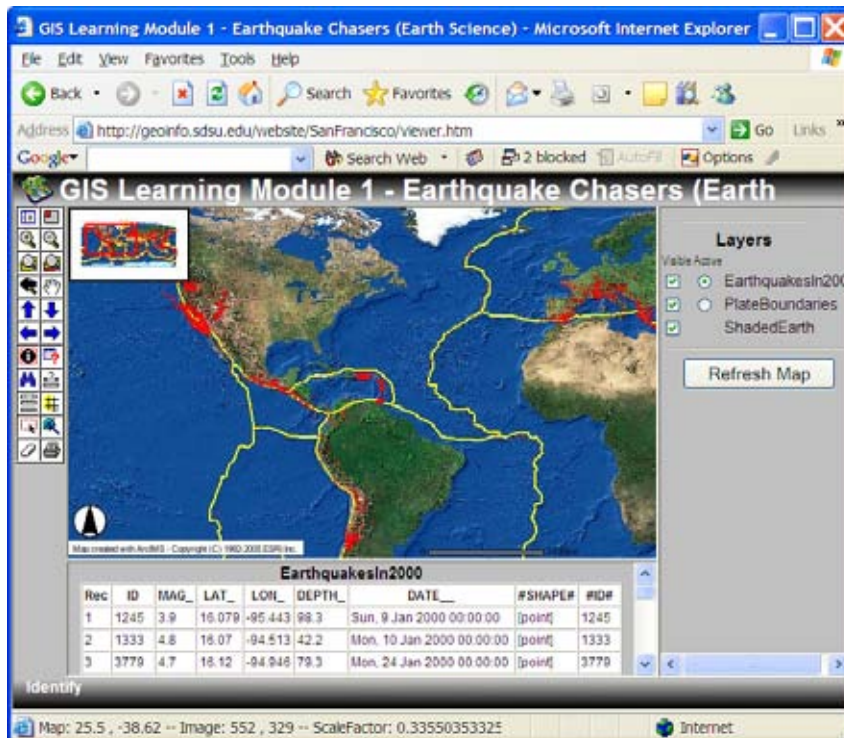
Figure 5. Web-based World Earth Quake Map.
http://geoinfo.sdsu.edu/hightech/MapViewer/viewer.asp

Two Web-based GIS learning modules and three Internet Maps has been developed and published on the research Website. The first module is called **"Earthquake Chasers" (**Figure 5), which is a GIS module for mapping Earthquake Magnitude & Plate Boundaries. We collaborate with Paula Ann Trevino (Geography teacher at Helix Charter High School) to develop this module. The earthquake chasers module will be adopted in her Geography course. The second module is **"San Diego Bay Marine Monitoring Study"** (Figure 6), which is an environmental monitoring project for San Diego Bay area. Dr. Jay Vavra (Biology teacher) in High Tech High School helped us to develop this GIS learning modules for his course and students. These Web-base GIS modules can help high school teacher to integrate GIS technologies into their existing courses, such as Geology, Biology, and Mathematics.

There are two versions for each GIS learning module:

- Desktop version for those high school students lacking broadband Internet Access capability. This version adopts ESRI ArcExplorer Java Edition for Education (AEJEE), which is a stand-alone GIS viewer.
- Web version for those student having high speed Internet Access. The version utilizes ESRI ArcIMS 9.0 with JavaScript customization for Web mapping user interfaces. The ArcIMS mapping tools developed in this project can provide interactive, dynamic, query-based learning tools for high school GIS education.
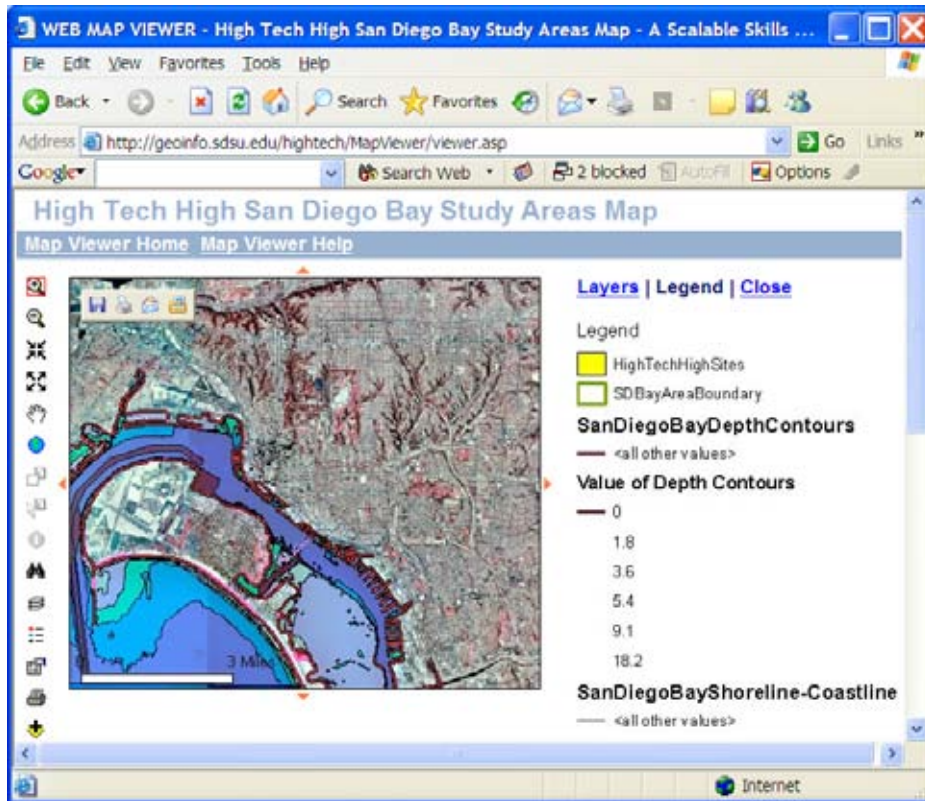
Figure 6. Web-base San Diego Bay Study Areas map.
http://geoinfo.sdsu.edu/hightech/MapViewer/viewer.asp

The web awareness site contains a self assessment quiz for GIS of 15-20 short answer questions. The questions are mostly introductory material or 'common' knowledge. A sample quiz is available and accessible by a link on the homepage.   Such quizzes are a good way to make the web site interactive and to give an idea of what the subject is about.   Rotation of questions on the quiz, not yet available, will make this feature of value to attracting second time site visitors, who would quickly leave a site with no changes in content. Answers to quiz questions will be often annotated with pointers to other parts of this web site, or links to other web locations that provide discussion in greater depth.

The Web-based GIS career awareness program and GIS learning modules for high school students will be pilot-tested by high school teachers and students from High Tech High School and Helix Charter High School. Their comments will be used for future revision of the Web-based GIS career awareness program.

Objective 6: Share the model GIS skills certification and technician training program with other educational institutions and communities across the U.S.

Activities	Deliverables:
Information about the GIS skills certification program will be disseminated to other educational institutions and industry through website and presentations at selected conferences.	Web-based courses available to students outside participating districts. (Year 1)
Status: Two Web-based GIS learning modules are completed and published on our research website.	
	Presentations at conferences. (Year 3)
Status: Five presentations at industry conferences will be conducted by project staff (ahead of schedule)	

Comments:
This objective is to share information about the GIS skills certification program with other educational institutions and industry through our project website and presentations at selected conferences.

So far, the two Web-based GIS learning modules are completed and published on our research website, which is available to high school students to learn foundational GIS concepts and theories remotely.   Our Website also describes the skills certification process at both Mesa College and San Diego State University and provides the draft report of the DACUM progress. All meeting notes and basic GIS education linkages are provided on our research Websites. This project web site also includes two video clips (created by Dr. Tsou) and several powerpoint slides for everyone to download and view (http://map.sdsu.edu/nvc2005-presentation/). One video clip is to show the first GIS high school workshop. Another video clip is to show the 3D presentation of Earthquake locations in California by overlaying Digital Elevation Model (DEM). The second video clip is designed to provide integrated multimedia presentation for the first Web-based GIS learning modules, Earthquake Chasers.

The following paper presentations by project staff will be presented this year at industry conferences:

- 2005 ESRI Education User Conference at San Diego (July 2005).
    - Dr. Tsou will present a paper, title: **Web and Mobile GIS for High School GIS Career Awareness.**
    - Mr. Johnson will present a paper, title: **The Future of GIS Education at the Community College.**
    - Mr. Johnson will present a paper, title: **DACUM Curriculum Analysis for GIS Technicians.**
- Dr. Tsou also organized two GIS education sessions in the annual meeting of Association of American Geographers (AAG) (April 2005) and will present a paper, title: **Adopting Web-based GIS for the Development of a Scalable GIS education Program.**
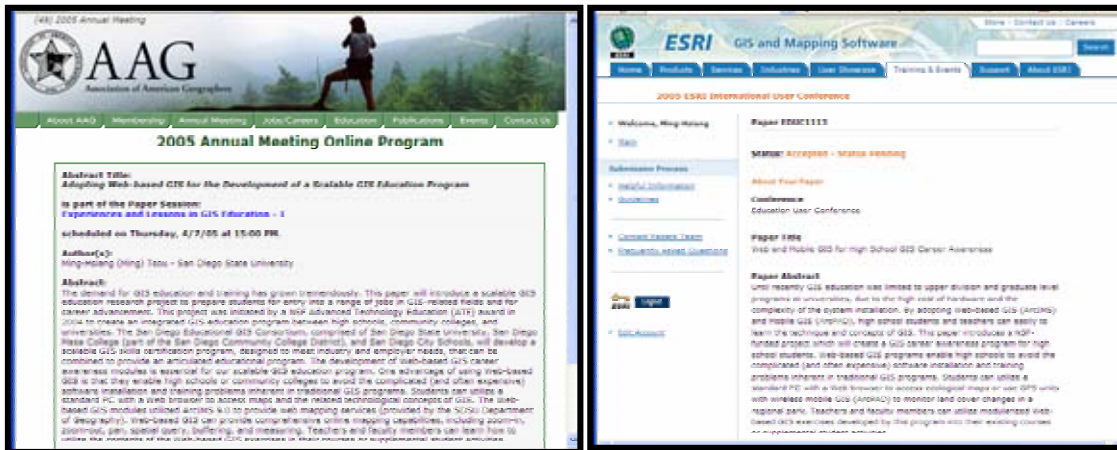
Figure 7. International Conference Presentation Opportunities for our research project. (AAG left, ESRI right).

Other Related Project Activities:

The project team has also completed the following activities:

1. **Conducted Monthly Meetings**
   o Project Steering Committee (Mesa College)
   o SDSU Sub-Committee (SDSU)

Figure 8. Project Steering Committee Meeting, February, 2004

2. **Attended meetings of the project's advisory committee; the San Diego Regional GIS Council.**
   o Provided Council with regular status reports on the progress of this project.

3. **Met with Project Evaluator, Phyllis Sensenig of Program Development Services who:**
   o Provided staff with input used in preparation for National Visiting Committee.
   o Scheduled a meeting to discuss mid-term project assessment.

4. **Held 1st National Visiting Committee Meeting**
   o March 24th & 25th, 2005, San Diego Mesa College

The first National Visiting Committee for this project was held 1 week prior to the submission of this annual report. As such, no documentation or final report is available for consideration at this time. Committee members, including Joseph Kerski on speaker phone, attended this meeting. They were provided with details of the project and its progress. Members were taken on a tour of Mesa College, High Tech High School and San Diego State University. Also in attendance were Mesa College Administrators, 7 people from our Advisory Committee (RGISC), several students and one instructor. The Committee's overall impression of the work on this project was positive. Their report is expected within a few weeks.

Figure 9. Project National Visiting Committee Meeting, March 24th & 25th, 2005

PROJECT FINDINGS

Scalable Skills GIS Certificate Program #0401990
San Diego Mesa College, San Diego State University, San Diego City Schools
October, 2004 – March 2005

Objective 1: Develop skills certificates at identified levels of training, to certify specific work-based competencies.

After attending training on Systematic Curriculum and Instructional Development it was learned that the process of developing curriculum from a DACUM chart is quite extensive and involved. This, in addition to the lengthy curriculum approval and articulation process presents a challenge for this project. Since this project is of limited duration and its other elements are dependent upon this curriculum, we will explore ways to shorten the curriculum development procedure.

We also learned from the draft DACUM chart that the scope of GIS technician is quite different from traditional "technicians" in other fields, such as medical technicians or computer software technicians. The job duties and major tasks of GIS technicians are much broader and more complicated. GIS technicians may need different skills and specialized trainings in different fields, such as forest management, urban planning, or 911 services. Most GIS technicians have different job titles, such as cartographers, urban planners, fire-fighters, etc. The complexity of GIS tasks reflects the truly multidisciplinary feature of Geographic Information Systems.

Finally, our National Visiting Committee suggested that the term, "technician" may not be appropriate to reflect the current job market for entry-level GIS work force. Several alternative terms including "information specialist" was suggested as an alternative to the word "technician".

Objective 2: Develop a standards-based curriculum, aligned across the three educational levels, designed to meet identified industry needs. The project-based curriculum will be linked to job descriptions, will integrate Geography and Computer Science, and will include a work-based component focused on career ladders in GIS.

We found that it is a challenge to create a standards-based GIS curriculum, aligned across the three educational levels (high school, community college, and University). During the creation of GEOG 104 course at San Diego State University, the major problem is to match the contents and teaching methods between Mesa College, high schools, and San Diego State University. Since the three educational institutions have different computer equipments and GIS lab setting (no GIS lab available in high school), the best way to implement a basic GIS curriculum is to create Web-based GIS course with on-line computer lab exercises. All lecture notes and learning activities will be accomplished in an integrated Web-based multimedia environment. Therefore, different levels of educational institutes can adopt the same GIS curriculum for their students and teachers.

Another challenge in developing GEOG 104 is to decide how many levels of details between fundamental GIS theories and practical applications and software techniques. It is very important to balance the two major aspects in creating a General Education (GE) level course at the University. Our solution is to use

GIS project-based class modules to introduce both theories and applications at the same time and keep the 50/50 balance between each other.

Objective 4: Prepare high school teachers and post-secondary faculty to provide the GIS skills training.

Project staff is currently recruiting Community College and High School teachers who may be interested in using GIS in their classroom. We have found that most teachers are very reluctant to explore something that is radically new to them, especially when it involves the use of technology. This is due in part to their heavy workload and the perception of a steep learning curve for both them and their students. In addition, many of these teachers lack access to computers in their classroom.

Those teachers who are interested in using GIS tend to be comfortable using technology and often have a project in mind for its application. They tend to be very motivated but have very little knowledge or experience with GIS. As a result, it was suggested by our Visiting Committee that we focus immediately on helping just a limited number of teachers. In time, these teachers will hopefully get others involved as they see the results of their work. This information will be considered as we develop new custom learning modules and begin planning for our next High School and Community College outreach activity.

Objective 5: Develop 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.

We found that current high school curriculum must match State and Federal Education standards. It will be very difficult to create a brand new GIS course for high school students. Our solution is to develop GIS modules to help the current 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 to the high school teachers and students. The next step is to focus on **teach about GIS** (as the second phase to officially introduce the theories and technology of GIS in details). This step focuses on the systematic introduction of related GIS technology, including GPS, spatial analysis, cartography, and remote sensing.

By combining both "teach with GIS" and "teach about GIS" methods, high school teachers will be more willing to accept the GIS technology as their teaching tools and will help us to develop Web-based GIS career awareness program.

Objective 6: Share the model GIS skills certification and technician training program with other educational institutions and communities across the U.S.

We found that the project website is a great tool to share our research findings and model certificate in the future. This is evident from the fact that the site has experienced over 6000 visits since its inception in November, 2005. We also have plans to present our project at National Conferences. As this project continues to develop we will concentrate more on promoting this work at the national level.