Annual Report: 0401990

Annual Report for Period: 10/2006 - 10/2007 **Submitted on:** 05/01/2007
Principal Investigator: Goff, Eileen **Award ID:** 0401990
Organization: San Diego Mesa College
Title: A Scalable Skills Certification Program in Geographic Information Systems (GIS)

Project Participants

Senior Personnel

Name: Goff, Eileen
Worked for more than 160 Hours: Yes
Contribution to Project:
Ms. Goff is the PI of the Project and is Adjunct Faculty in GIS at Mesa College. She is responsible for day-to-day leadership on the Project, including coordination of project tasks, meetings, and Mesa College-specific activities.

Name: Lee, Otto
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Lee is a co-PI on the Project and is Dean of the School of Business, Computer Studies, and Technologies at Mesa College in which the Project is housed. He is responsible for much of the Mesa College administrative and budgetary oversight on the Project.

Name: Johnson, John
Worked for more than 160 Hours: Yes
Contribution to Project:
Mr. Johnson is a consulting GIS Specialist on the Project. He is a subject matter expert in the DACUM and curriculum development process and also plays a substantial role in the skills certificate development and the Mesa College student GIS Internship program.

Name: Williams, Karen
Worked for more than 160 Hours: No
Contribution to Project:
Professor Williams is Department Chair in the School of Business, Computer Studies, and Technologies at Mesa College and oversees the College's GIS program. In addition, she has experience in curriculum development and processes at the College.

Name: Owen, Karen
Worked for more than 160 Hours: No
Contribution to Project:
Ms. Owen is an Associate Professor with the Multi-media program in the School of Business, Computer Studies, and Technologies at Mesa College. Like Professor Williams, she also has experience in curriculum development and processes at the College.

Name: Tsou, Ming-Hsiang
Worked for more than 160 Hours: Yes
Contribution to Project:
Dr. Tsou is a co-PI on the Project and an Associate Professor at the Department of Geography, San Diego State University. 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 a co-PI on the Project and an Associate Professor at the Department of Computer Science, San Diego State University. He is responsible for the development of GIS skill certificates, articulation, and the Web-based GIS Career awareness program.

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 learning modules.

Name: Pavagada, Deepthi
Worked for more than 160 Hours: Yes
Contribution to Project:
Ms. Pavagada is a graduate student at SDSU Computer Science Department and the technical programmer of this Project. She is responsible for the re-design of website pages and online video webpage update.

Name: Lee, Ting-Hwan
Worked for more than 160 Hours: Yes
Contribution to Project:
Ms. Lee is a graduate student at SDSU Geography Department. She is responsible for the re-design of project website and the evaluation of the website (weblog analysis).

Undergraduate Student
NA

Technician, Programmer
NA

Other Participant

Name: Sensenig, Phyllis

Worked for more than 160 Hours: No

Contribution to Project:

Research Experience for Undergraduates

NA

Organizational Partners

High Tech High School

High Tech High is a well funded, leading edge Charter School operating within the San Diego Unified School District. It has partnered with us to help promote GIS in the High School curriculum. Dr. Jay Vavra, HTH's biotechnology teacher, works with project staff to incorporate GIS teaching into High School courses.

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, common 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 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.

Hoover High School

Hoover is one of sixteen High Schools in the San Diego Unified District, and is one of the oldest schools in the district. Hoover is located to the east of downtown San Diego and is attended by approximately 2,000 students. A faculty of about 80 instructs a very diverse student population in academic and extra curricular disciplines.

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 organizations worldwide including most U.S. federal agencies and national mapping agencies, the top 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 across the globe. ESRI fosters relationships with dozens of 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.

ESRI staff and ESRI-authorized instructors train GIS professionals and students in countries throughout the world. In addition, ESRI hosts an on-line Virtual Campus with Web-based training courses.

Other Collaborators or Contacts

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

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

PROJECT ACTIVITIES (SDSU Parts)

The major research goals for Year THREE of this Project are to:

- Develop skills certificates (Objective 1)
- Develop a standards-based GIS curriculum (Objective 2)
- Create articulation agreements across the three educational levels (Objective 3)
- Prepare high school teachers to provide GIS skills training (Objective 4)
- Develop Web-based GIS career awareness program (Objective 5)
- Share model skills certificates and training programs with other institutions (Objective 6)

The following report will highlight the major activities in each objective during the last 12 months.

Objective 1. Develop skills certificates

(Mesa College parts – to be filled)

Objective 2. Develop a standards-based GIS curriculum

The focus of this objective is to develop a basic GIS curriculum, aligned across the three educational levels, designed to meet identified industry needs.

Mesa College part (be filled).

At San Diego State University, the new GEOG 104 course developed by Dr. Tsou has been taught in Fall 2006 semester with 25 students enrolled. The GEOG104 is the first GIS course approved by the University at the general education level, which can be articulated with Mesa College's new GISG 104 (GIS and Spatial Reasoning) course.

One change comparing to the original proposal of GEOG104 is the new prerequisite of GEOG104: Satisfaction of the Entry-Level Mathematics requirement (ELM). The reason for adding this new prerequisite is because that this GE level course is under the GE category of Mathematics/Quantitative Reasoning in the Foundations of Natural Science and Quantitative Reasoning. All GE courses under this category need to have the ELM prerequisite. This course is also designed for the fundamental core course for B.S. program Emphasized in Geographic Information Science at the Department of Geography. The class units can be used for the Geographic Information Science Certificate Program at SDSU, which is a collaborative program between Geography Department and Computer Science Department.

The official description of GEOG 104 is listed in the general catalog of San Diego State University (2006-2007) as the following:

GEOG 104. Geographic Information Science and Spatial Reasoning (3) [GE]
Prerequisite: Satisfaction of the Entry-Level Mathematics requirement.
Fundamental concepts in geographic information systems, cartography, remote sensing, spatial statistics, and global positioning systems. Use of critical technologies in addressing human and environmental problems.

A course website has been established in the URL: http://map.sdsu.edu/geog104 . All lecture contents and Web-based GIS exercises are all accessible via the course website. The contents of GEOG 104 have revised based on the finding of the DACUM result created in this project.

Objective 3. Create articulation agreements across the three educational levels

The goal of this objective is to create articulation agreements across the three educational levels to ensure that students are able to progress efficiently through the educational programs. San Diego State University, San Diego Mesa College, and local high schools (Helix High) are the major participants in this research objective.

At the High school level, Dr. Tsou continued to working with the Helix Charter High School teacher, Paula Trevino (Social Studies Department Chair) to develop a new GIS course (GIS 1c/2c) for high school students. This new GIS course has been offered in Fall 2006 and Spring 2007

semester. The first year GIS student mapping works can be found at the URL: http://stream.helixcharter.net/trevino/patrevi/GIS/Home.html) (Figure 1).

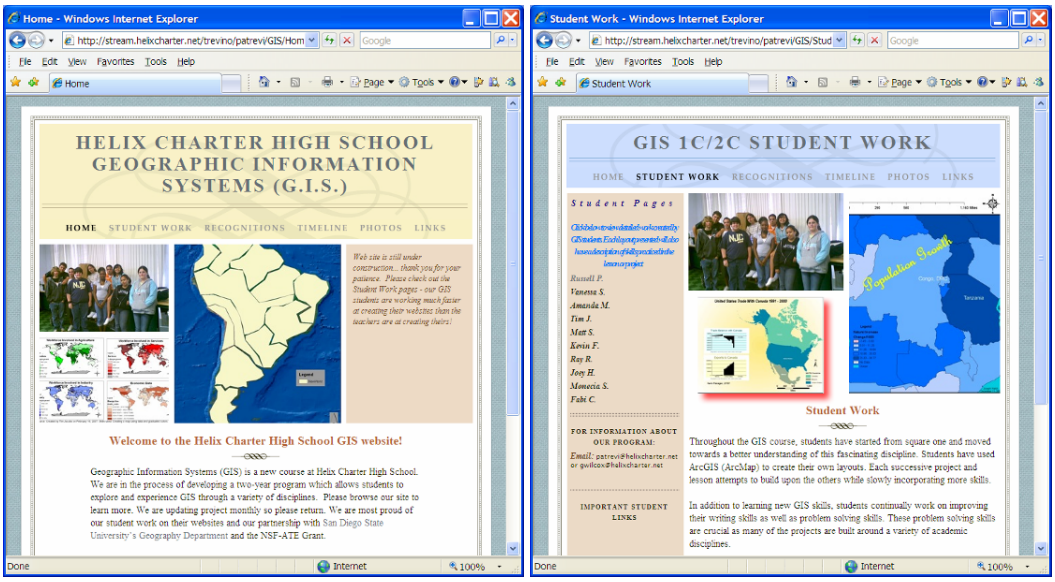


Figure 1. The GIS class website at Helix Charter High School. (URL: http://stream.helixcharter.net/trevino/patrevi/GIS/Home.html)

At the community college level, three community colleges (Southwestern College, Mesa College, and Grossmont College) are working on the articulation of their own GIS courses to the SDSU GEOG104. Southwestern College and Grossmont College have approved the new GIS course in their curriculum committee and submitted the articulation request to SDSU for GEOG104 course. The official articulation of GIS course (GEOG104) between community colleges and universities will be completed by the beginning of 2008.

At the university level, Dr. Tsou at San Diego State University has submitted the curriculum change forms for the change of prerequisites in the following courses (adding 104 in the prerequisites list of high-division GIS courses, GEOG381 and GEOG380).

- GEOG 380: Map Investigation. (Prerequisites: GEOG101, 102 or **104**).
- GEOG 381: Computerized Map Design (Prerequisites: GEOG101, 102 or **104**).

These curriculum changes are currently reviewed by the curriculum committee at the Geography Department, SDSU in Spring 2007.

Objective 4. Prepare high school teachers to provide GIS skills training

In the third year, the SDSU team mainly collaborated with two high schools (Helix High and Hoover High) to introduce GIS technology and provide their teachers and students with training resources (books, websites, on-line mapping tools). The major collaborators at high schools are the following:

- Helix Charter High School: Teachers:

    - Paula Ann Trevino (social studies), M.Ed, Social Studies Department Chair, (patrevi@helixcharter.net)
    - Garry Wilcox (social studies) gwilcox@helixcharter.net
- Hoover High: Teacher:
    - Ellen Towers, Academy Coordinator/Teacher (etowers@sandi.net)

From April 1, 2006 to May 6, 2007, the SDSU Team conducted one high school teacher GIS workshop and three high school student GIS outreach activity events as the following:

High school teachers GIS workshops:

- 2006, November 3 (Friday). 12 high school teachers in the region of San Diego attended the workshop to learn the functions of our new GIS career awareness learning modules. The workshop was hold as one day event (at the Spatial Analysis Lab (SAL), San Diego State University.

High School Student GIS tours:

- 2006, December 1 (Friday). Dr. Tsou and Tony Howser introduced GIS and GPS technology to 60 Hoover High School students (8:30am – 11:00am).
- 2007, April 13 (Friday). Dr. Tsou, Dr. Eckberg, Tony Howser, Ting-Hwan Lee, and Deepthi Pavagada introduced Web GIS and GPS technology to 60 Helix High school students at the SDSU GIS lab (SAL and CESAR lab) (8:00am – 11:00am)
- 2007, May 4 (Friday). Dr. Tsou, Dr. Eckberg, Tony Howser, Ting-Hwan Lee, and Deepthi Pavagada introduced Web GIS and GPS technology to 60 Helix High school students at the SDSU GIS lab (CESAR lab) (8:00am – 11:00am).

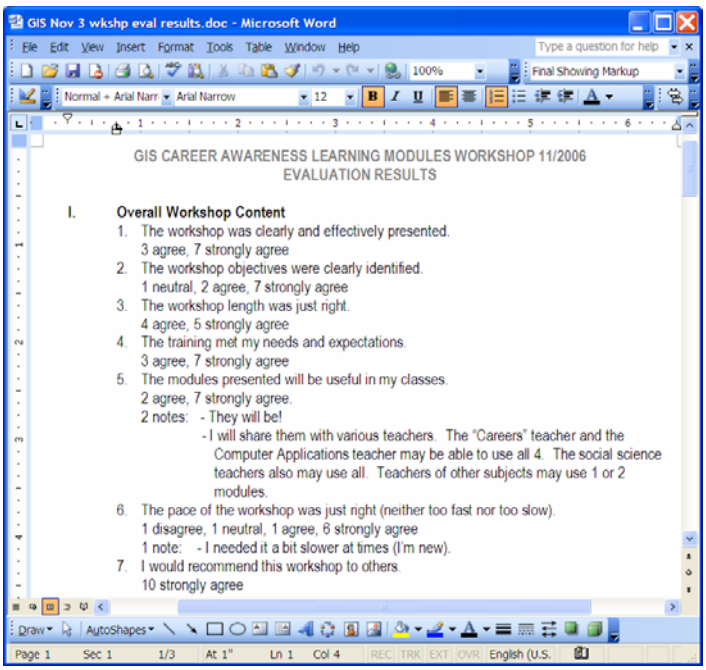
Figure 2. The GIS Training Workshop for high school teachers.

Figure 2. illustrated the GIS workshop for high school teachers on November 3, 2006. The following is the detail workshop schedule.

GIS Workshop Schedule:

0815	Arrival
0830	Opening & Introduction
0900-1000	Module 1 Lecture and Brief Hands-On
1000-1015	Morning Break
1015-1115	Module 2 Lecture and Brief Hands-On
1115-1215	Module 3 Lecture and Brief Hands-On
1215-1330	Lunch (provided)
1330-1345	Teaching GIS at Helix Charter High School (Paula Ann Trevino)
1345-1400	Module 4 Brief Description
1400-1430	Hands-On Free "Play" Time with Modules
1430-1530	Discussion/Feedback and Closing

After the completion of the GIS workshop, we also conduct an evaluation questionnaire for each teacher to evaluate the effectiveness of the GIS workshop. Overall, the feedbacks from the participants are all very possible and encouraging. Figure 3 illustrated some survey results from high school teachers regarding the workshop. One month after the workshop, we also conduct a post-workshop evaluation questionnaire. The general feedbacks from teachers are also very positive and encouraging.


GIS Nov 3 wkshp eval results.doc - Microsoft Word

GIS CAREER AWARENESS LEARNING MODULES WORKSHOP 11/2006
EVALUATION RESULTS

I. **Overall Workshop Content**

1. The workshop was clearly and effectively presented.
   3 agree, 7 strongly agree
2. The workshop objectives were clearly identified.
   1 neutral, 2 agree, 7 strongly agree
3. The workshop length was just right.
   4 agree, 5 strongly agree
4. The training met my needs and expectations.
   3 agree, 7 strongly agree
5. The modules presented will be useful in my classes.
   2 agree, 7 strongly agree.
   2 notes: - They will be!
   - I will share them with various teachers. The "Careers" teacher and the Computer Applications teacher may be able to use all 4. The social science teachers also may use all. Teachers of other subjects may use 1 or 2 modules.
6. The pace of the workshop was just right (neither too fast nor too slow).
   1 disagree, 1 neutral, 1 agree, 6 strongly agree
   1 note: - I needed it a bit slower at times (I'm new).
7. I would recommend this workshop to others.
   10 strongly agree

Figure 3. The evaluation results of the GIS workshop for high school teachers.

Some of the feedbacks from teachers are the following:

- *"Yes, I will be having a student next semester pilot lessons that I am looking to incorporate in the GIS class. I will be having her start with the career awareness modules. My current plan is to incorporate those as a beginning of the year set of activities to give an overview."*
- *"While I found the workshop both valuable and inspiring, I have not yet been able to use any of the modules in my class because my current computer lab is outdated and unable to run Google Earth. I'm hoping to get new equipment, but nothing has been approved yet. If I am able to get new computers I definitely plan on using the modules and ERSI software in the near future."*
- *"I'm in the process of going through all 4 modules in depth myself. I've completed #1 and will be moving on to the others. They appear appropriate, but I do need to write an answer sheet, having the answers interspersed with the instructions would take way too much paper to distribute."*

With the new GIS class installed at the Helix High School, SDSU team collaborate with Helix High School teachers, Paula and Garry, to organize two GIS tour and computer laboratory visits for their students in April and May 2007 (Figure 4).

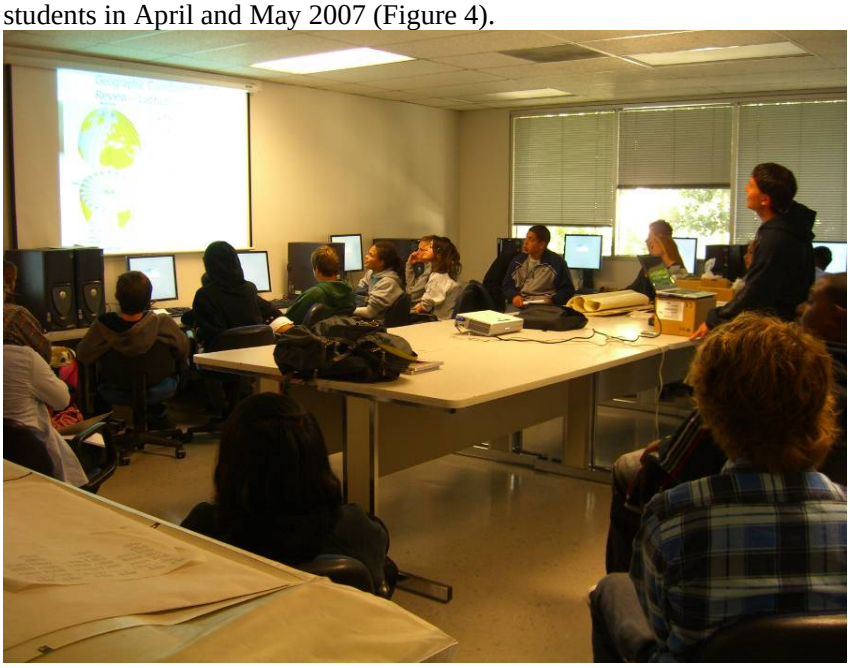


Figure 4. The GIS tour for Helix High School Students.

Because of the collaboration between SDSU team and Helix High School teachers, Mrs. Paula Ann Trevino and Mr. Garry Wilcox were selected as the Education innovators of the Month at Grossmont Unit High School District in November 2006 (Figure 5).

Beside that, they also received "**2007 Innovation in Education Award**" by the Classroom of the Future Foundation (CFF Award). This is a very prestige award which is nominated by their school principle.

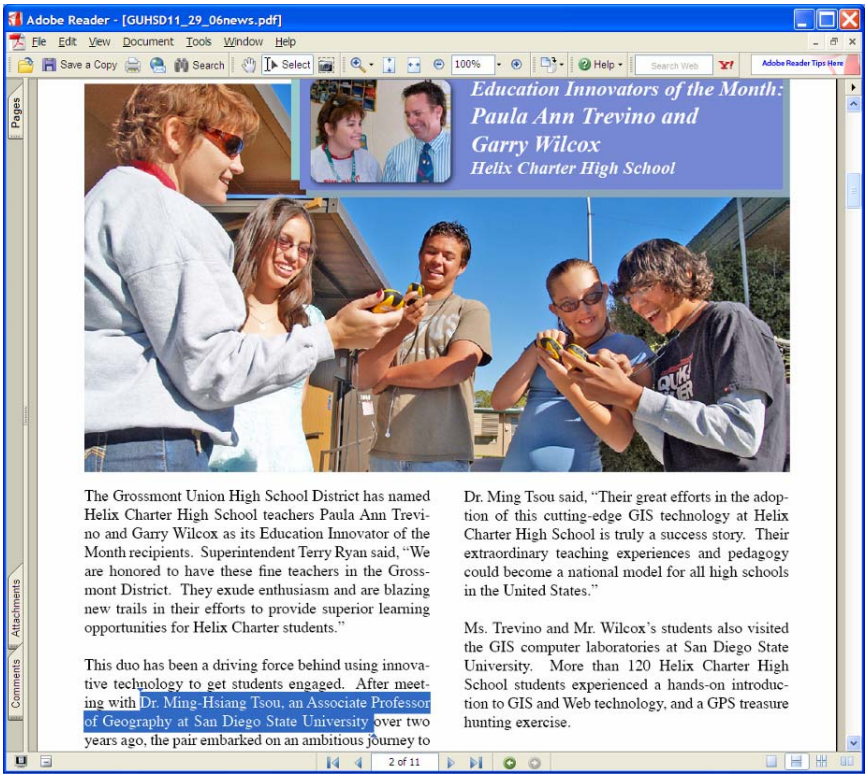


Figure 5. The education innovators (Paula and Garry) of the month at Grossmont Unit High School District in November 2006.

Objective 5. Develop Web-based GIS career awareness program

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. In the third year, Dr. Tsou and Dr. Eckberg are working with three graduate students (Tony Howser, Ting-Hwan Lee, and Deepthi Pavagada) to create a series of Web-based GIS career learning modules and to revise the project website with career-focused contents.

The revised Website (URL: http://geoinfo.sdsu.edu) emphasized GIS career awareness and GIS education resources for high school students. Figure 6 illustrated the major changes between the old version of the website and the new version. The revised website adopted colorful graphic icons and menus with large-size text fonts and friendly user interfaces. Four icons were designed corresponding to GIS Career learning modules, GIS Career links, Education Resources and GIS Videos. The designing was done in Adobe's Photoshop CS2. The main motive to put icons in grid format was to give aesthetic touch to the website. The icons enable visitors to directly access important sections of the website content. Labels for the icons were also created in Adobe's Photoshop CS2. There are several new contents and functions added in the new website, including the GIS career awareness learning modules, GIS videos, Photo Albums, etc. The design team also tested the new website in both Windows and Mac OX environments to ensure that all web pages are compatible with different operating systems and web browsers. Cross browser compatibility is enhanced with certain changes in the website. Use of Cascading Style Sheets (CSS) is done and use

of table in content display is reduced. The content is kept separate from display with the help of CSS technology. JVM dependent menu is replaced by CSS driven menu which is fast and doesn't consume browser's resources.

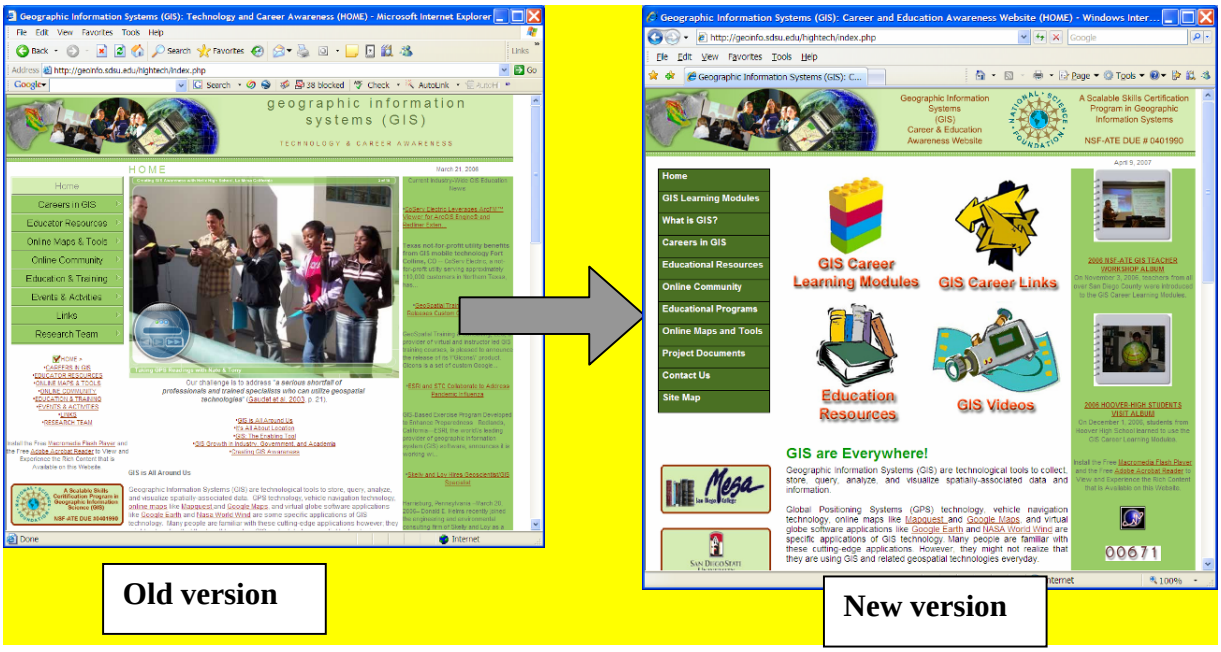


Figure 6. The Revision process of the Research Website for hosting Web-based GIS career awareness program. (http://geoinfo.sdsu.edu/hightech).

One major revision work for the new website is to focus more on GIS career information and resources. The website created two different web pages providing website resources for GIS career overview and job market links for high school teachers and students (Figure 7).

Figure 7. The new website focused on the GIS Career resource and information.

Another unique feature of the website is to create a self-assessment quiz function in the website. The on-line quiz function will be useful in increasing reader awareness of various issues, and also potentially useful in encouraging word of mouth visitors, and even repeat visits, for those who find such things appealing. The repeat visit goal requires varying the quiz over time by some method. A large database of questions, with random selections, is effective, but very labor intensive. At this year, the SDSU team has 5 sets of 17 questions per set, or enough for a different set of questions for each school day. The intent is to have questions that cover areas of "general" knowledge about human geography, physical geography, and GIS. To clarify, the goal is to include questions that a high school student will have a chance of answering without having taken classes in GIS or geography. This is, after all, a website whose goal is to promote awareness, and foster curiosity.

Producing questions where users interact with maps and are 'graded' on that interaction would be good GIS questions, but are much harder to create, so the current format is multiple choice questions, some of which are based on typical GIS icons, and others of which involve questions about displayed maps, but none involve interaction with dynamic maps. Some questions are intended to be easier for students in the San Diego area, some reflect a USA bias, but many are reasonable for a user in any part of the globe.

Our self-assessment of the self-assessment quizzes is that they are well done visually, easy to use, and have easy navigation. The answers are nicely displayed, contain links to further information, and occasionally advertise other parts of the site. Some of the questions are quite good, and others could be replaced with better questions as we think of them. More map based questions is another goal. Figure 8 illustrated some sample screens.

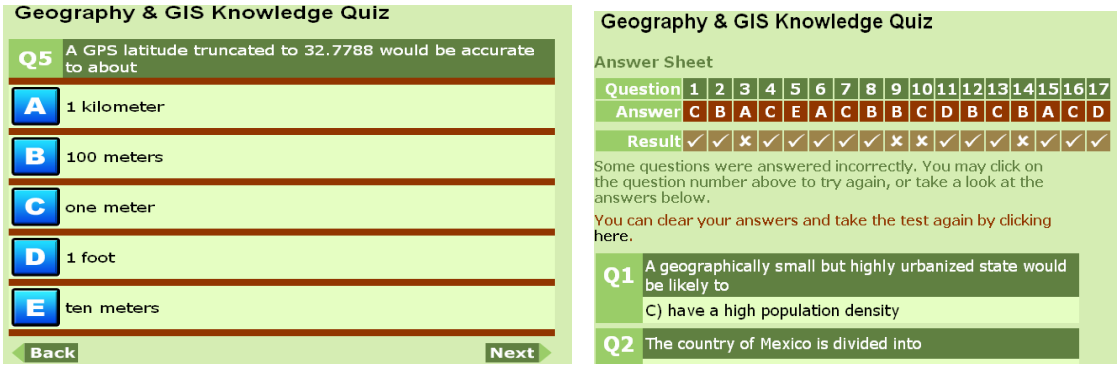


Figure 8. The development of on-line self-assessment quizzes.

The most important component in the revised website is the GIS awareness career modules. The SDSU team created a series of Web-based GIS career awareness learning modules for high school students. The following is the detail description of the learning module components.

- **The learning module ONE:** The Digital Earth --- Virtual Globes and Computerized Maps (create interests and funs for high school students by using Google Earth and Google Maps. Introduce latitudes/longitudes and coordinate systems).

- **The learning module TWO:** How Can GIS Help Us? --- GIS Applications in Various Fields (criminal justice, business and marketing, environmental protection, etc.)

- **The learning module THREE:** The Cutting Edge and Future of GIS Including Mobile GIS, Multimedia GIS Visualization, and Participatory (Collaborative) GIS applications (Mapping Where You Want to Visit in the World in Web-based Community Maps).

- **The learning module FOUR:** Putting It All Together: Our Future with GIS. Submit an GIS Career essay (three pages around 500 words) about their learning results from three modules and their future GIS career plan.

Figure 9 illustrated the web page created for the GIS career awareness learning modules. High school teachers and students can access this website to download the exercise instructions and answer sheets directly. The documents are provided in two different formats, MS word files and PDF formats.

Figure 9. The Four GIS Career Awareness Learning Modules.

In each learning modules, the instruction include a clear learning goals and system requirement procedures. Each module also has a separated answer sheet. So high school teachers can easily implement these modules for their own classes (Figure 10).

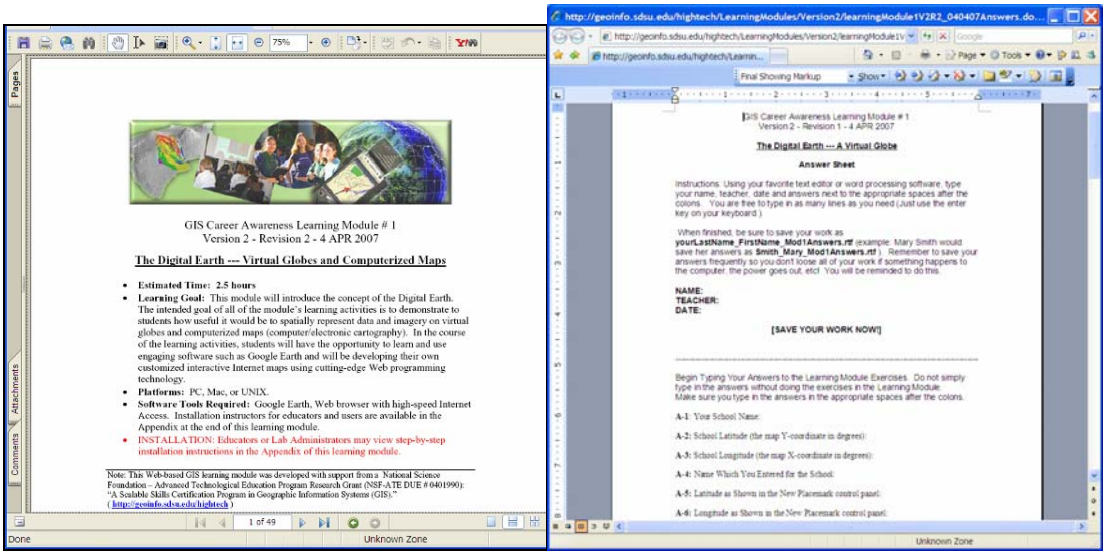


Figure 10. The PDF version of the learning module instructions and the answer sheet.

The development process of Web-based GIS career learning modules started in June, 2006. The first version (version 1.0) was completed in October 2006. On November 3, the SDSU team conducted a workshop for high school teachers to introduce the GIS learning module version 1.0. After the feedback from the workshop, our research team revised the learning modules and created the version 2.0 in March 2007.

The major differences and upgrades between version 1.0 and version 2.0 are listed in the following:

- The Geofusion component in Version 1.0 (Module#1: Virtual Globe exercises) was removed because the compatibility problem with Mac OS. The component was replaced by the new Google Map API Exercise in Version 2.0.
- Version 2.0 used Google Earth 4.0., which is an upgraded version of Google with new Sketch-up functions and new user interfaces.
- Version 2.0 separated answer sheets from the exercise instruction. (Easier for teacher to use and print-out). Version 1.0 instructions have both answer sheets and instructions in a single long document.
- Version 2.0 corrected errors and mistakes founded in version 1.0.
- Version 2.0 added components for getting students' feedback about the learning modules.

There are several key features in our Web-based GIS career learning modules. The modules combined with many cutting-edge technologies and tools, such as Google Earth, Google Maps, ArcIMS, etc. The design of modules focused on problem-solving based exercises with detail instructions and real world problems. Also, Web-based GIS tools are easier to be adopted in high school computer laboratories.

In the version 2.0, we formalize the **Student Learning Outcome (SLO)** Objectives of the modules as the following:

Upon successful completion of the learning modules, the student will be able to:

- *Understand the value of GIS skills and the potential of GIS career (module 4).*
- *Explain the fundamental GIS concepts, coordinate systems, and the idea of Digital Globe (module 1).*
- *Describe at least two GIS applications in various industries and careers (module 2).*
- *Identify at least two new directions of future GIS research (such as mobile GIS, multimedia, visualization, and participatory GIS (module 3).*

Since the completion of the GIS learning modules, two high schools (Helix High and Hoover High) started to test the modules. There are eight students in Helix High School completed the four modules and got their GIS certificates already. Figure 11 illustrated the picture of GIS Career Awareness Learning Modules Certification of Completion.

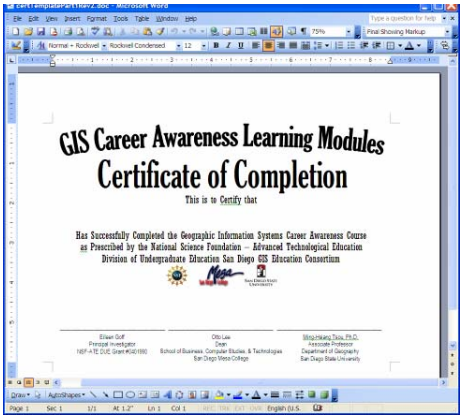


Figure 11. The Certificate of Completion for GIS Career Awareness Learning Modules.

Beside the eight students from Helix High, there are already 203 students (most of them from Helix and Hoover high schools) granted to access our collaborative GIS modules (Learning module #3) (Figure 12) according to the web server records.

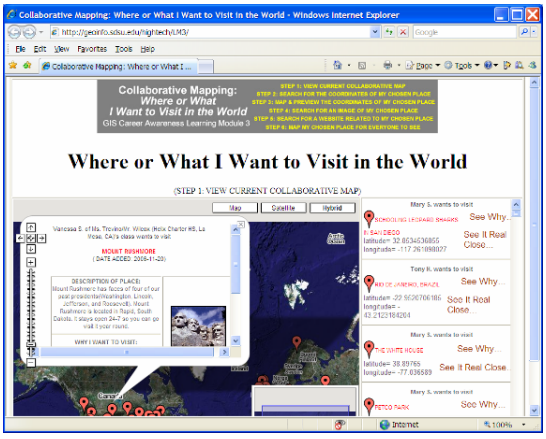


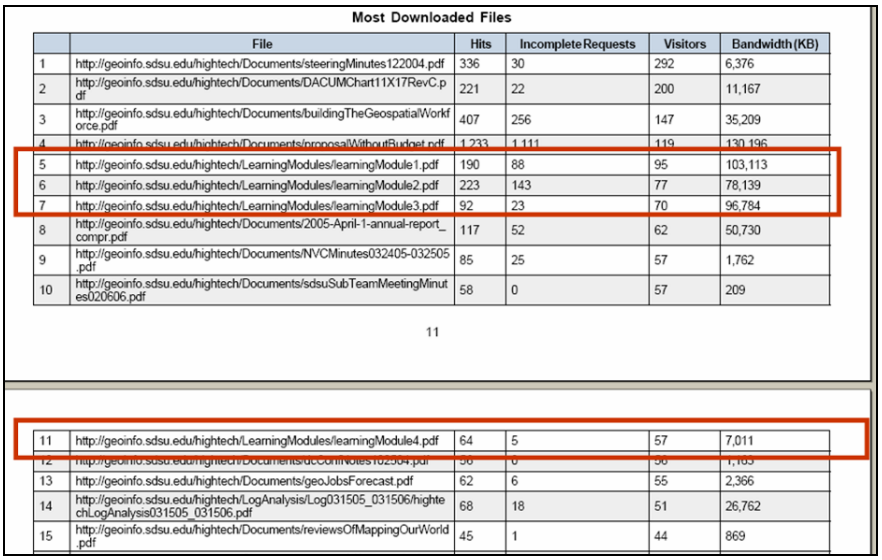
Figure 12. The collaborative GIS Mapping function (Learning Module #3).

One major task for the next year (fourth year) is to create a stronger connection to current High School Education Goals and Content Standards, such as National Geography Standards, Content Standards for California State Board of Education, or Goals of Advanced Placement Program (AP) Human Geography Course. We also need to continue the GIS workshops designed for high school teachers with different skill levels and encourage more high schools to adopt the GIS modules.

Objective 6: Share model skills certificates and training programs with other institutions

The major goal of objective 6 is to share information about the GIS skills certification program with other educational institutions and industry through websites and presentations at selected conferences.

In the third year, Web-based GIS career learning modules (version 1.0 and version 2.0) are completed and published on our research website. According to the web-log analysis, the first learning module in PDF format has been downloaded 190 times with 88 visitors since it was posted on our website in October 2006 (within four month). The second module has been downloaded 223 times with 77 visitors (Figure 13).



Most Downloaded Files

	File	Hits	Incomplete Requests	Visitors	Bandwidth (KB)
1	http://geoinfo.sdsu.edu/hightech/Documents/steeringMinutes122004.pdf	336	30	292	6,376
2	http://geoinfo.sdsu.edu/hightech/Documents/DACUMChart11X17RevC.pdf	221	22	200	11,167
3	http://geoinfo.sdsu.edu/hightech/Documents/buildingTheGeospatialWorkforce.pdf	407	256	147	35,209
4	http://geoinfo.sdsu.edu/hightech/Documents/proposalWithoutBudget.pdf	1,233	1,111	119	130,196
5	http://geoinfo.sdsu.edu/hightech/LearningModules/learningModule1.pdf	190	88	95	103,113
6	http://geoinfo.sdsu.edu/hightech/LearningModules/learningModule2.pdf	223	143	77	78,139
7	http://geoinfo.sdsu.edu/hightech/LearningModules/learningModule3.pdf	92	23	70	96,784
8	http://geoinfo.sdsu.edu/hightech/Documents/2005-April-1-annual-report_compr.pdf	117	52	62	50,730
9	http://geoinfo.sdsu.edu/hightech/Documents/NVCMinutes032405-032505.pdf	85	25	57	1,762
10	http://geoinfo.sdsu.edu/hightech/Documents/sdsuSubTeamMeetingMinutes020606.pdf	58	0	57	209

11

11	http://geoinfo.sdsu.edu/hightech/LearningModules/learningModule4.pdf	64	5	57	7,011
12	http://geoinfo.sdsu.edu/hightech/Documents/dcConfNotes102304.pdf	56	0	56	1,165
13	http://geoinfo.sdsu.edu/hightech/Documents/geoJobsForecast.pdf	62	6	55	2,366
14	http://geoinfo.sdsu.edu/hightech/LogAnalysis/Log031505_031506/hightechLogAnalysis031505_031506.pdf	68	18	51	26,762
15	http://geoinfo.sdsu.edu/hightech/Documents/reviewsOfMappingOurWorld.pdf	45	1	44	869

Figure 13. The weblog analysis for document downloads.

The new research project web site also included several video clips related to the GIS career awareness and technology. Most videos are created by Dr. Tsou and Tony Howser. The SDSU team publish the videos in the popular YouTube website (Figure 14) for various viewers to view or download these GIS videos.

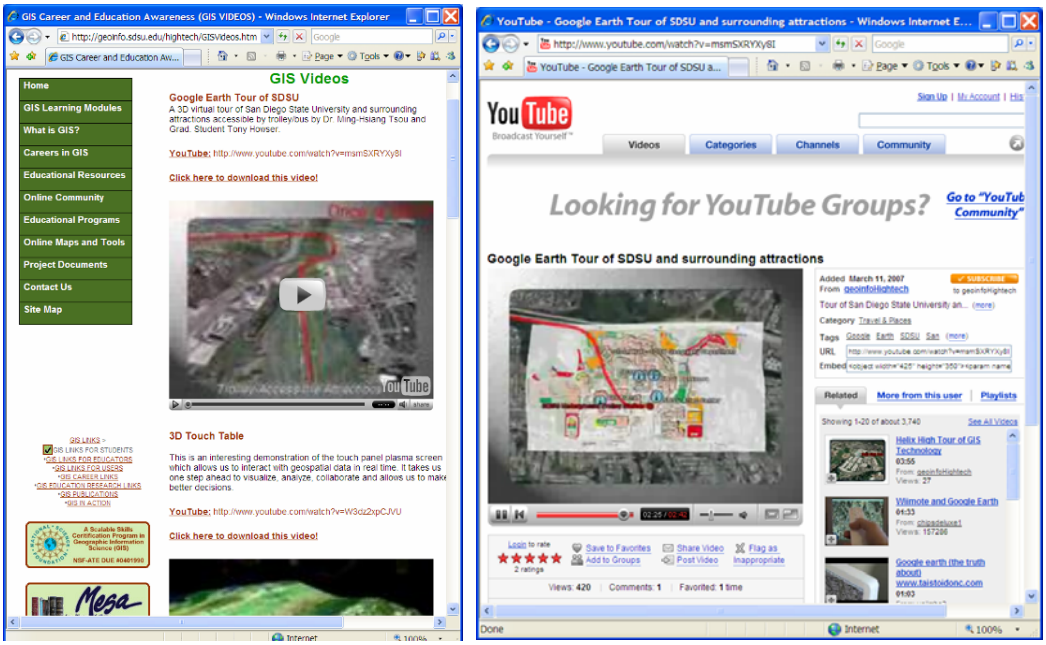


Figure 14. The adoption of YouTube service for Multimedia GIS presentation (movies) in the GIS career awareness website.

During the last year, the SDSU Team created one peer-review article, one book chapter, and two conference presentations with proceedings derived from this Project. These articles, book chapters, and conference presentations create a strong outreach and share this GIS program with other institutes and communities in the U.S. and other counties, including Japan and Taiwan.

Invited Speaker (Dr. Tsou) in the University of Redlands/ESRI Colloquium Series

- October 11, 2006 - Ming-Hsiang Tsou, San Diego State University, "Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Networks" (http://institute.redlands.edu/msgis/colloquium_2006.htm)

Invited Colloquium at National Taiwan Normal University.

- Tsou, M. H. *Web-based Geospatial Technology for High School Education*. National Taiwan Normal University, Department of Geography, Taipei, Taiwan, June 14th, 2006.

Conference Presentation and Proceeding:

- **2006 ESRI Education User Conference: Ming-Hsiang Tsou and Jing-Yi Chen,** A Web-based Scalable GIS Education Program linking high schools and universities (http://gis2.esri.com/library/userconf/educ06/abstracts/a1934.html)

Peer Review Journal Article:

- **Tsou, M.H., Jing-Yi Chen** (2007 submitted), Adopting Web-based Geographic Information Services (Web GIS) in High School Geographic Education. *Journal of Geography*.

Book chapter:

- **Tsou, M.H. (2006).** Bridging the Gap: Connecting Internet-based Spatial Decision Support Systems to the Field-based Personnel with Real time Wireless Mobile GIS applications. Book chapter in *Collaborative Geographic Information Systems* (Edited by Shivanand Balram and Suzana Dragicevic). Idea Group, Inc., pp. 316-339.

One Poster: NSF-ATE conference at Washington D.C.

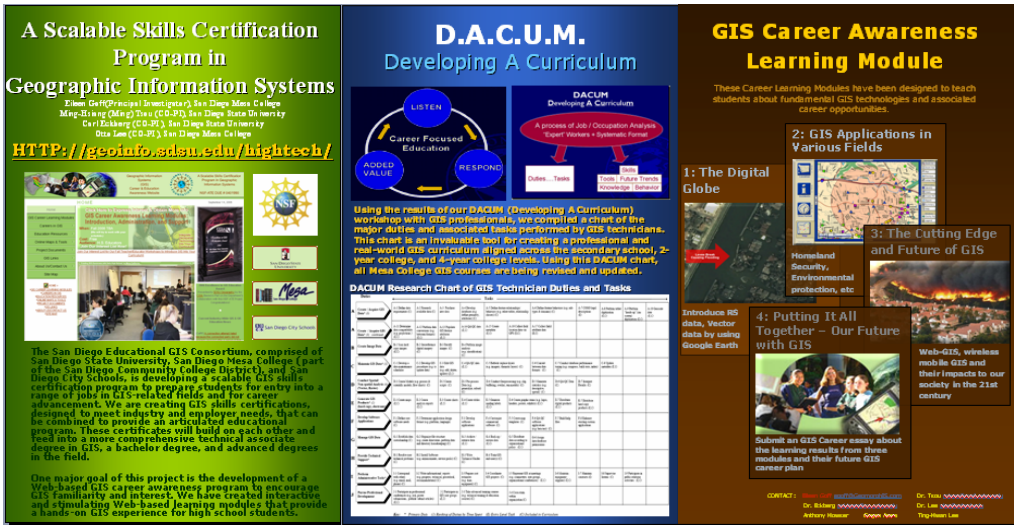


Figure 15. One poster created for the NSF-ATE conference.

NSF-ATE conference Live demonstration and Exhibit Booth: (Tony Howser).

- Delivered live demonstrations of the career at two showcases at the NSF-ATE PI Conference in Washington, D.C. during 10/18/2006-10/21/2006.

Dr. Tsou was invited to participate in the future planning of a National Geospatial Technology Resource Center and participated on the National Forum in January 5-7, 2007, organized by the same research project.

The SDSU team continues to collaborate with other NSF-ATE project around the San Diego Regions, including the NSF-ATE grant (2006) at Southwestern College (SWC) with their faculty: Ken Yanow and Erin Browder. Our graduate students also help one Economy professor at Mesa College to adopt Web GIS for her courses.

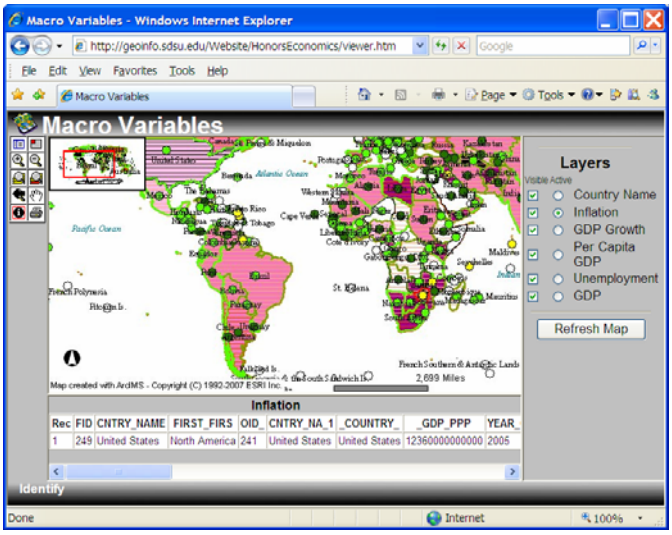


Figure 15. Web GIS Mapping Services developed for one Mesa College Economy course.

Project Website Evaluation

Finally, the SDSU team conducted a detailed website usage analysis to analyze how many users access or download information from our project website (http://geoinfo.sdsu.edu/hightech). We conducted the web logs analysis from March 16, 2006 to March 15, 2007. During this year, our research website had almost triple the number of website visitors to **43,565** visitors total (**13,779** unique IP) comparing to last year 17,067 visitors (3559 unique IP address) (Figure 16).

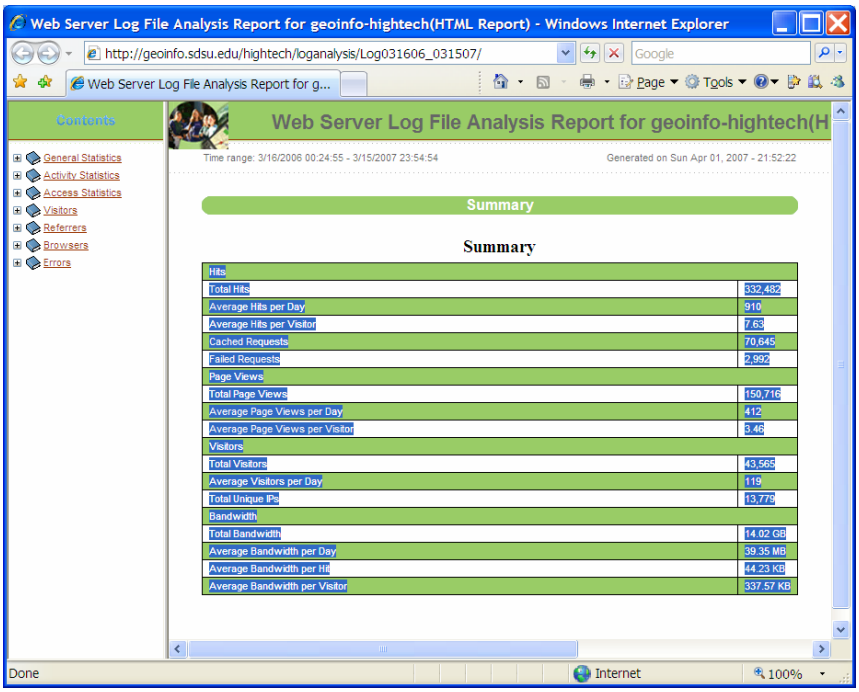


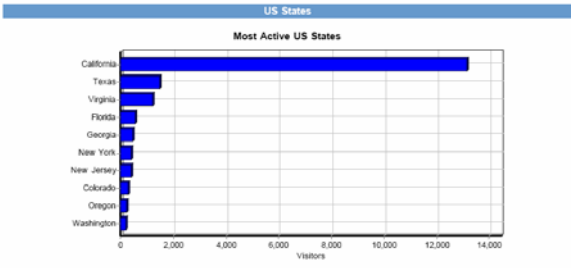
Figure 16. The Weblog analysis (from 3/16/2006 to 3/15/2007).

Figure 17 and 18. illustrated the numbers of total visitors by each month and the major statistic numbers for the project website.

Most Active Countries

	Country	Hits	Visitors	% of Total Visitors	Bandwidth (KB)
1	United States	278,818	29,163	66.94%	13,808,996
2	Korea, Republic of	3,719	2,063	4.74%	56,204
3	China	4,016	1,468	3.37%	59,377
4	Japan	2,187	1,093	2.51%	76,852
5	India	5,379	893	2.05%	91,549
6	Brazil	1,135	719	1.65%	20,552
7	Russian Federation	1,682	609	1.40%	35,252
8	Saudi Arabia	695	471	1.08%	7,277
9	Germany	1,534	463	1.06%	29,466
10	Turkey	977	423	0.97%	17,849
11	Denmark	668	419	0.96%	11,189
12	Ukraine	1,955	366	0.84%	16,452

Figure 17. The Web log Analysis (NSF-ATE Project website).



Most Active US States

	State	Hits	Visitors	Bandwidth (KB)
1	California	163,167	13,136	11,957,224
2	Texas	8,273	1,487	124,543
3	Virginia	19,872	1,230	230,498
4	Florida	3,298	545	37,596
5	Georgia	4,662	470	142,086
6	New York	3,409	400	53,156
7	New Jersey	2,207	395	36,162
8	Colorado	3,178	290	76,651
9	Oregon	1,631	244	17,212
10	Washington	3,272	217	32,370
11	Pennsylvania	2,176	175	27,009
12	Illinois	2,227	156	21,919
13	North Carolina	1,751	152	27,426
14	Michigan	1,869	142	17,409
15	Maryland	1,103	125	15,315
16	Massachusetts	1,645	122	22,401
17	Ohio	1,665	112	28,763
18	District of Columbia	1,391	105	18,771
19	Tennessee	981	99	10,838
20	Arizona	2,372	84	18,227

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Figure 18. Most Active US States.

PROJECT FINDINGS

Objective 1. Develop skills certificates

(Mesa College)

Objective 2. Develop a standards-based GIS curriculum

(mesa college parts)

The successful implementation of GEOG 104 in the General Education level at SDSU is a significant progress of GIS education and one major goal of this project. There are several challenges and difficulties during the approval process of GEOG104. The whole process of submission, revision, and approval takes three years to be completed. One key issue for the qualification of general education courses is to emphasize on problem-solving exercises and critical thinking with real-world questions. Therefore, the design of GEOG104 is actually re-organizing traditional GIS courses and materials toward to more scientific-oriented course contents (teach with GIS) rather than software-skill-oriented course contents (teach about GIS). Currently, some community colleges might still have problems getting their GIS courses approved in the GE level. One suggestion will be to follow the design concept of GEOG104 to focus on GIS applications and society impacts rather than GIS software-oriented training in order to qualify for general education courses.

Object 3. Create articulation agreements across the three educational levels.

In the last year, San Diego Mesa College, Southwestern College and Grossmont College are all initiating the articulation requests to GEOG104. However, the articulation requests need to be revised and add the new prerequisite of GEOG 104: Satisfaction of the Entry-Level Mathematics requirement (ELM). The new change might cause some delay of the articulation process. However, the new change is mandatory for all GE level courses under the category of Mathematics/Quantitative Reasoning in the Foundations of Natural Science and Quantitative Reasoning. Therefore, it is very important to understand the rules of general education courses and University policies before submitting any articulation requests to universities or colleges.

Objective 4. Prepare high school teachers to provide GIS skills training

The research team conducted the first high school teachers GIS workshop in November, 2006. there are many lessons and findings need more resources.
(Eileen, maybe you could summarize the finding of the workshop here).

One month after the workshop, we also conducted the post-workshop questionnaires as the follow up item with these high school teachers. The research team asked about the potential adoption of the GIS learning modules into their own classes. One of the major concern from teachers is the need to create stronger connection between the GIS modules and education standards in their school and the secondary education systems, such as the Content Standards for California State Board of Education. With these education standards embedded inside the GIS learning modules, it will be easier for teachers to adopt these GIS modules in high school courses.

Objective 5. Develop Web-based GIS career awareness program

One major finding in this object is that web technologies change very fast. It is very difficult to catch up these changes while developing web-based GIS learning modules. For example, after the completion of the GIS learning module version 1.0, Google announced the new version of Google Earth (version 4.0), which has significant different user interfaces and functions comparing to the previous version. Our GIS learning modules need to be revised significantly to accommodate these changes. Therefore, to develop a successful web-based GIS career awareness program, we need a long-term financial support and a yearly-based software upgrade/maintenance plan for the development of GIS learning modules.

Objective 6: Share model skills certificates and training programs with other institutions.

The Project website is still an effective tool to share our project information and model curriculum with other researchers. According to the Web log analysis, from March 16, 2006 to March 15, 2006, our project website attracted **43,565** visitors in total, with **13,779** unique IP-address. We have various users from more than 50 different countries, including the Netherlands, South Korea, Japan, Germany, Canada, etc.

Summary of the National Visiting Committee meeting, April 16, 2007.

The National Visiting Committee (NVC) recently met with faculty and staff of Mesa College, SDSU, and Helix High School teachers to discuss and review the project. In their committee report of April 16, 2007, the NVC stated they were *"We are impressed with the amount of progress that you have made this past year and the focus that you have maintained to reach the stated grant objectives. We also note that you have addressed the themes important to ATE and workforce education while broadening the scope of work in areas which we believe will have significant impact."*

The NVC concluded their report by stating they were encouraged about the future success of the NSF project. Results of the NVC report findings are summarized below.

Figure 1. The National Visiting Committee Meeting on April 16, 2007.

National Visiting Committee Report
Monday, April 16, 2007

We are impressed with the amount of progress that you have made this past year and the focus that you have maintained to reach the stated grant objectives. We also note that you have addressed the themes important to ATE and workforce education while broadening the scope of work in areas which we believe will have significant impact. You are not only teaching GIS, but using GIS as a tool to help students and faculty develop their use of technology, critical and spatial thinking, and problem solving skills.

We also compliment you on the materials provided to the committee and the well organized meeting with useful presentations. We also appreciated the participation of the Vice Chancellor Ingle and President Dr. Rita Cepeda in the meeting and the recognition of the importance of your work to the college and the support provided by Dr. Lee, Dean of Computer Science and Technology. We also acknowledge the cooperation and input from your adjunct faculty and their dedication to the grant objectives. You are truly working as a team.

Recommendations:

1) We recommend that a full time faculty be appointed to lead the GIS program because a vision of this magnitude requires a tenure track faculty member to champion and guide continuing program development and expand the use of the technology across the campus.
2) We also recommend that the DACUM process including the knowledge and skills assessment tools and modules linked to identified competencies for college level programs be completed. Modules created under the grant should use local data focusing on issues relevant to San Diego and be keyed to the identified Skill Competencies. The Modules can then serve as models of how to use the resources by other two year colleges.
3) While developing the full Skills Certification program proposed in the project proposal would be desirable, we understand that it is a massive undertaking that may not be achievable within the timeframe and staffing resources available under the grant. In order to successfully move towards this objective, we recommend the project team aim at least to outline the needs, requirements and process for possible methods for a Skills Certification program, describe the problems and impediments to such a program, and make recommendations for possible future work. Be sure to document any research into what has been achieved in this context by other organizations and institutions that have related Skills Certificates.
4) Publish and disseminate results of the mapping of the UCGIS Body of Knowledge to the skills and competencies identified by the DACUM. The publication should be in venues accessible to community college and university faculty.
5) Continue to explore ways to support activities initiated under the grant.
6) Work on qualifying the GIS 104 class as a GE course at Mesa. Partner with other college and universities in California to support qualification of their introductory GIS courses for GE credit.
7) Collaborate with other colleges in the San Diego region to promote articulation with the university systems.

Committee Action Items

:

1) Help identify speakers for the Millennium Speakers Program related to GIS or Interdisciplinary topics on Spatial Thinking. Audience: Students, business leaders, faculty,
2) Write a letter to the Chancellor supporting the need for a full time, tenure track faculty to oversee the GIS program.

Suggestions:

1) Identify teachers at the City Science Fair with projects that could use GIS and try and get them interested in GIS.
2) Create an advisory committee or add to existing committee representatives from local high schools to review resources and work on articulation.
3) The NSF grant is from the ATE. Because this is “Advanced Technology Education”, the emphasis should be on grant outcomes and resources that support “occupationally aligned education.”

Training and Development:

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 Ting-Hwan) can immediately contribute to our project and only require minimum training and advice during the development of project Website and Web-based GIS modules. One computer science graduate student (Deepthi) 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.

Journal Publications

Books or Other One-time Publications

- **Tsou, M.H. (2006).** Bridging the Gap: Connecting Internet-based Spatial Decision Support Systems to the Field-based Personnel with Real time Wireless Mobile GIS applications. Book chapter in *Collaborative Geographic Information Systems* (Edited by Shivanand Balram and Suzana Dragicevic). Idea Group, Inc., pp. 316-339.

Web/Internet Site

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

Other Specific Products

Product Description:
Project Website Overview & Guide
Sharing Information:
Workshops, Meetings, Outreach activities

Product Description:
The GIS Career Awareness learning module ONE: The Digital Earth --- Virtual Globes and Computerized Maps (create interests and funs for high school students by using Google Earth and Google Maps. Introduce latitudes/longitudes and coordinate systems).

Sharing Information:
Workshops, meetings, outreach activities, downloadable from the project website.

Product Description:
The GIS Career Awareness learning module TWO: How Can GIS Help Us? --- GIS

Applications in Various Fields (criminal justice, business and marketing, environmental protection, etc.)

Sharing Information:

Workshops, meetings, outreach activities, downloadable from the project website.

Product Description:

The GIS Career Awareness learning module THREE: The Cutting Edge and Future of GIS Including Mobile GIS, Multimedia GIS Visualization, and Participatory (Collaborative) GIS applications (Mapping Where You Want to Visit in the World in Web-based Community Maps)

Sharing Information:

Workshops, meetings, outreach activities, downloadable from the project website.

Product Description:

The GIS Career Awareness learning module FOUR: Putting It All Together: Our Future with GIS. Submit an GIS Career essay (three pages around 500 words) about their learning results from three modules and their future GIS career plan.

Sharing Information:

Workshops, meetings, outreach activities, downloadable from the project website.

Product Description:

DACUM Chart for GIS Technician

Sharing Information:

Website, meetings, workshops, surveys

Contributions

Contributions within Discipline:

GIS education: We have completed a new DACUM Chart for GIS Technicians which identifies specific work-based competencies, analyzed by specific duties and tasks within these duties. The DACUM results will change the design of entry-level GIS courses in participating Community Colleges and Universities and may be adapted by others.

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.

The new development of a GE-level GIS course (GEOG 104) Geographic Information Science and Spatial Reasoning will become the first national model course for integrating multiple geospatial technologies and skills (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. Its effectiveness is indicated by the fact

that our research website had **43,565** visitors during the last year. Compared to the second year number of 13,779 or first year number 6,650 unique visitors, our project website users have been increased significantly during the third year.

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.

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 geospatial skills.

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.

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None