EDUCATION EVENT REPORT AND RECOMMENDATIONS

Event:
ESRI Education User Conference (ESRI EdUC) 2002

Attendee and Report Writer's Name:
Joseph Kerski, Geographer:
Education/GIS, Denver, RMMC, USGS.

Location: San Diego, California

Other USGS Attendees:
See "acknowledgements."

Event Dates: 5-7 July 2002.

Purpose of Event:
Educational Applications of GIS.

Report Note

Note that this report contains my own personal observations and opinions that do not necessarily reflect the opinions of the USGS. If any errors exist in these notes, they are the result of my own misinterpretation and do not reflect the high quality of the presentations.

Related Report

Email me at jjkerski@usgs.gov for my report on the ESRI User Conference, 8-12 July 2002. The report you are reading now covers the Education User Conference only.

Acknowledgements

I am very grateful for the help that the following individuals gave me in the USGS exhibit, at the USGS office in San Diego, and during my workshops: Wes Bills and Molly Dougherty (ESRI), Felicia Retiz (TNRIS), and USGS employees Steven Predmore, George Scott, Connie Hoong, Beth Wrege, Donna Knifong, and Norrie Robbins. In addition, I would like to express my appreciation for Molly Dougherty and the entire ESRI Education Team (Milton Ospina, Ann Johnson, Angela Lee, Charlie Fitzpatrick, and George Dailey) for their professionalism and for their work in creating this valuable and enjoyable event.

My Activities at Conference

(1) Conduct hands-on computer workshop on "Accessing and Using USGS Vector Data within ArcGIS".

(2) Conduct hands-on computer workshop on "Accessing and Using USGS Raster Data within ArcGIS".

(3) Conduct hands-on workshop on "Bringing GPS Data Into GIS" with Elizabeth Matlack of the Orton Foundation.

(4) Operate USGS exhibit at education expo.

(5) Display 3 posters for Map Gallery:

1] Exploring Biodiversity Along Colorado's Front Range, 2] The Implementation and Effectiveness of GIS Technology and Methods in Education, 3] Exploring the Titanic With GIS.

(6) Meet with "Virtual Immersion in Science Inquiry for Teachers (VISIT)" board.

(7) Meet with ESRI Education Staff to discuss continuing review of new ESRI book for education.

(8) Attend technical workshops.

The site and spectacular view from the 2002 ESRI EdUC, the San Diego Marriott and the San Diego harbor.

Conference History and Description

The fact that this conference has been successfully held two years in a row should lay to rest any notion that GIS is confined to a few school districts, universities, or isolated teachers. Although this conference followed several others on GIS in education, beginning with TERC's 1994 conference, none had been as large as this one. Approximately 500 educators from 30 countries and from elementary to university level attended this conference. The EdUC featured three days of workshops, presentations, a map gallery, and an education exposition. Approximately 30 workshops were conducted and 30 exhibitors operated in the Expo.

Sessions at the conference included presentation, hands-on workshops in data, tools, and software, and other items of interest to the educational community. Approximately five tracks were run simultaneously over three days.

TERC's 1994 Conference on GIS in Education was followed by two in 1996 and 1997. In 1998, I attended the International Conference in GIS in Education in Michigan. In 1999, during the ESRI conference, a meeting of those interested in promoting GIS in K-12 and college curricula met. In 2000 and 2001, International Conferences on GIS in Education were held at the California State University-San Bernardino campus (see my report from the 2000 conference).

In 2001 and 2002, ESRI has held the EdUC immediately preceding the UC, the largest GIS conference in the world (see my report from the 2002 User Conference). ESRI has been incredibly supportive of GIS in education for 10 years. The conference was organized by the ESRI education team (see photographs), with whom I have enjoyed 8 fruitful years of work.

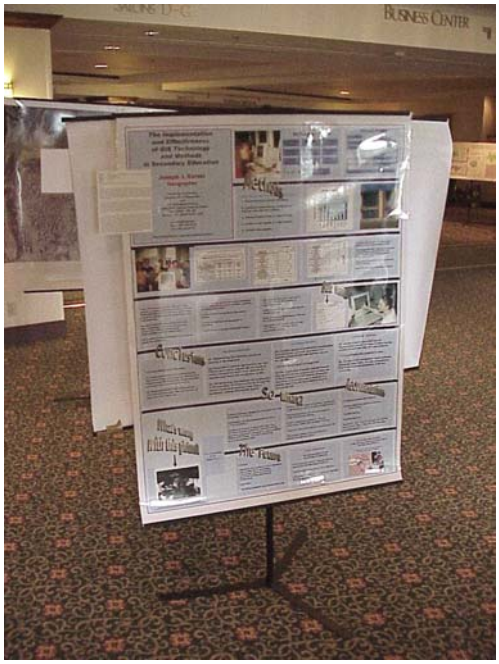
Ann Johnson and Milton Ospina (top), Charlie Fitzpatrick and George Dailey (bottom), along with Angela Lee, form the ESRI Education Staff. This team organized the conference and was key to its success.

The number of researchers and practitioners interested in teaching with GIS, in a content area such as environmental science, geography, history, science, or mathematics, is growing, but still forms a relatively close-knit community. Therefore, it is not difficult to understand why many people knew each other at this conference, and why it has such a "family" feel to it. It was excellent to further these relationships as well as form new ones. These people are interested in learning and are passionate about what they do.

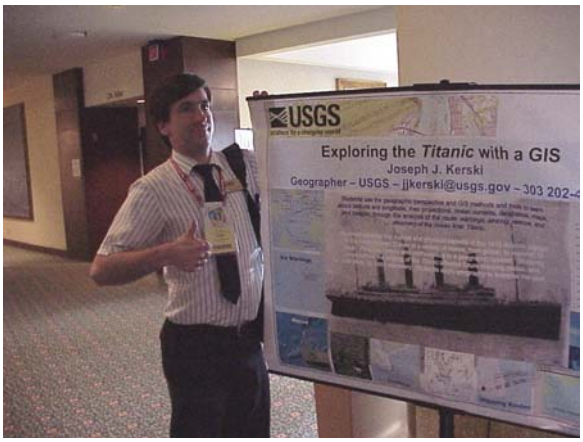
Despite the fact that they both use the same tools and methods, there exist fundamental differences between teaching *with* GIS versus teaching *about* GIS. This conference emphasized both--how to use GIS in teaching science, history, geography, chemistry, and other disciplines, but many sessions existed for those teaching GIS courses, particularly in universities. More than half of the attendees were from universities.

Map Gallery

The Map Gallery operated for one and one-half days during the conference, in an area that all attendees passed through. These included a spectacular Lewis and Clark map (see my ESRI Conference report for photograph) as well as interesting applications of and investigations using GIS that educators and their students have developed. I displayed three posters in the Map Gallery, as follows:



Poster highlighting my research on the implementation and effectiveness of GIS technology and methods in secondary education. This included a nationwide survey of 1,520 educators who owned GIS software and case studies and experiments about the effectiveness of GIS with 400 students and teachers.



Poster illustrating the Exploring the Titanic lessons I created with GIS. I have posted the lessons on www.esri.com/arclessons.

This poster won third place at the Map Gallery. This was a special thrill, particularly given the memory problems I had while plotting it!

Poster illustrating the Colorado Front Range Biodiversity project. This project, funded by National Geographic Society, brought together the USGS, the Colorado Natural Heritage Program, universities, K12 school districts, and the Colorado Division of Wildlife. I emphasized the fact that through education, new spatial data and maps were created (by the Colorado Natural Heritage Program) as well as lessons that incorporate biodiversity and geography into science teaching.

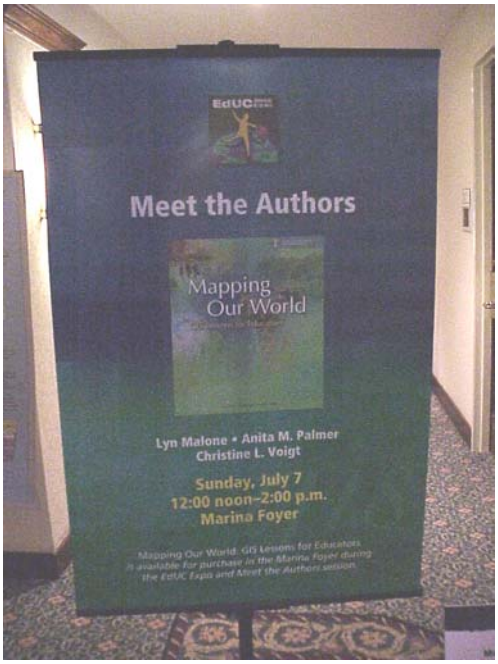
Mapping Our World Book and Community Geography Book

A new book from ESRI Press received a great deal of attention not only at the EdUC but at the User Conference (see my related report), entitled *Mapping Our World--GIS Lessons for Educators.*

The book contains standards-based GIS lessons in physical and cultural geography, with the data included so that educators can run these lessons in their classrooms. The authors conducted a book signing event and hands-on sessions at the conference. I was thrilled to have a small part in this, as I was one of the reviewers of the book before it was published. The USGS also had a presence where all of the teachers received some of their training in GIS.

Anita Palmer, Christine Voigt, and Lyn Malone hold up a copy of their book, Mapping Our World: GIS Lessons for Educators.

At the conference, I met with a team of authors and reviewers for the next educational GIS book, *Community Geography.* I am thrilled to serve as one of the reviewers for this book. It will be a perfect complement to *Mapping Our World* because it brings spatial analysis right to the community. Often, students are disconnected with school because they don't see the relevance to their own day-to-day life. This book will show teachers and students not only how and what to analyze on the local level, but that they can make a positive difference in their local communities! The book will tell the story of successful projects, contain exercises for projects, and provide tools to do these projects in a community. Lesson modules will include water quality, pollution, crime, weeds, trees, and other topics. The geographic inquiry method will be emphasized throughout--acquire geographic resources, explore geographic data, analyze geographic information, and act on geographic knowledge. Publication is set for early 2003.

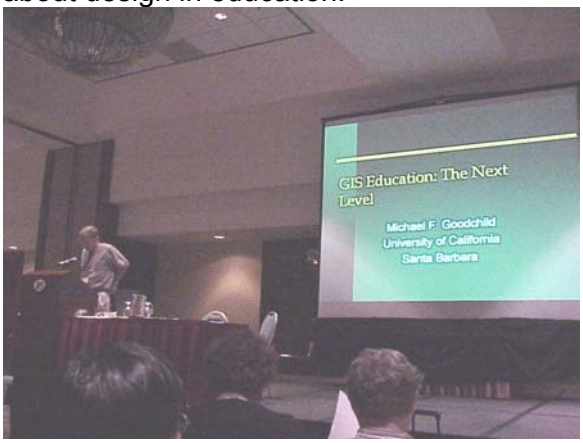


Meet The Authors poster at the EdUC.

Keynote Address

Michael Goodchild of the University of California-Santa Barbara gave the keynote speech on GIS Education--The Next Level.

Before Dr Goodchild spoke, Bill Miller, Director of ESRI Educational Services and the founder of the Virtual Campus, spoke about design in education.



Dr Goodchild is one of the founders of GIS and one of the most esteemed people in the entire field.

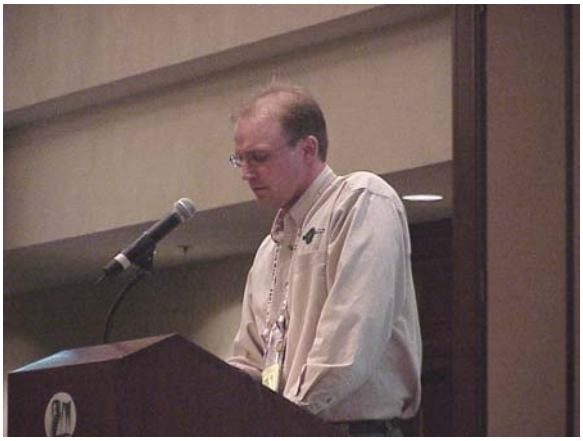
Dr Goodchild began with an interesting history of GIS from the 1960s to the present. Today, 25 GIS texts exist and GIS is taught in thousands of institutions. However, it is still in the process of taking hold in K12 education.

Dr Goodchild mentioned that today, we are teaching more of database design and management, Internet services, and the social context, and less of operating systems, algorithms, and analysis. The thought that we are teaching less analysis today than during the 1970s is rather *disturbing* to me. If it is true, then I don't think that is the direction we want to go. We want students and researchers to be doing more analysis, not less. I agree with Dr Goodchild that we need to be focusing on investigating the Earth, not investigating computer tools. The emphasis must be on the land, not the computer.

Dr Goodchild spoke about issues including educating for the workplace versus educating for research, balancing computers versus geography, balancing training and education, and balancing pedagogic style. He stressed the importance of spatial thinking in all areas of life, not just in geography. GIS is a key to science, technology, engineering, and math education as well. He mentioned something that frequently comes up in our discussions, the need for preservice education--GIS in programs that accredit and equip our next generation of teachers.

Closing Session: Lewis and Clark

Bryant Ralston (ESRI) and Bob Pawloski (University of Nebraska) spoke about the Lewis and Clark (L&C) bicentennial effort.



Bryant Ralston, ESRI Lewis and Clark Coordinator, addresses the attendees.

The "Corps of Discovery II" represents an opportunity to integrate GIS into K-16 education. The project seeks to develop a L&C clearinghouse for learning, index this information with metadata, implement a GIS interface with L&C information, and digitally archive stories of L&C impact as presented in many voices.

Bob Pawloski, Educational Technology Liaison to the National Park Service on behalf of the Peter Kiewit Institute at the University of Nebraska-Omaha, gives the closing address.

See www.lewisandclarkgnet.org for more information. The model for the project is the MERLOT--Multimedia Educational Roundtree for Learning and Online Teaching. The guiding questions are what was life like in 1803, what is it like today, and what will it be like in 200 years? They are working with www.lewisandclark.org, the Lewis and Clark Heritage Foundation.

Books recommended include *Captains Dog,* a L&C book for Young Adults from the perspective of their dog, and *Passage of Discovery.* I would like to add that I read *Undaunted Courage* a few years ago, which was incredibly inspiring.

Attendees at the closing session.

The speakers mentioned the EOS Education Project, a web based system and one that I mentioned in last year's EdUC report.

Alex Philp, Bryant Ralston, the Montana EOS staff, and others presented at a Lewis and Clark strand that ran throughout the conference. L&C efforts involves state, tribal, local, and federal agencies, foundations, private industry, the state library, universities, K-12, and many others, including the USGS:

http://www.eoscenter.com
http://www.lewisandclarkeducationcenter.com.
http://www.corps-of-discovery.com
http://www.2003-2006.com

Last year at the EdUC, I signed up to be an online mentor with the University of Montana's GIS courses run by EOS. I helped in particular with 2 weeks of the course in February 2002 as guest instructor. This was

a fantastic experience. I invited one of the participants who seemed to be above and beyond in terms of being helpful to the others to our National GIS institute for educators in Boulder. It turned out that he was a high school student and doing amazing things with GIS! It was excellent to have him and the other 3 students there so that the teachers could see that the students will run with the technology. The teacher does not have to be an expert at it to use it in the classroom.

USGS Exhibit

The USGS operated an exhibit with approximately 30 other exhibitors in an expo on the Saturday evening of the conference. It is an understatement to say that it was continually busy for the four hours of the expo. The exhibit cost was expensive for the duration of the exhibit. However, the exhibitors were helping defray the cost of the conference, and the exhibit provided an excellent service to the attendees and a good place to network with them. It was well worth it.

Joseph Kerski, Donna Knifong, and Connie Hoong at the USGS exhibit.

It was quite impressive to hear from these students what they are doing with GIS. I recommend we find ways to bring more students to this conference in 2003.

USGS exhibit at the Education Expo.

Our distribution items included:
--A 15-page version from the 2001 ESRI Conference Proceedings of my research results on GIS in education.

--sample lessons on the Titanic, studying *Stipa comata* (needle grass) and *Earthquakes Everyday t*hat I have written based on USGS data and GIS technology and methods.
--Article reprints that I and others have written that highlights work that students and teachers have accomplished with GIS.

-- Nat'l Land Cover Dataset fact sheet
--USGS GeoData
--Aerial Photographs and Satellite Images
--Exploring Maps

--What Do Maps Show
--Land and People
--Map Projections
--Landsat cards
--Sample CDs from Global GIS project.
--Educational Fact Sheet.
--EarthExplorer Fact Sheet.
--Earth Science Week flyer with web sites from USGS
--Other items.

Other exhibitors included GIS and education organizations, college and training programs, software, and education-related applications. These included: National Geographic, GITA, the GLOBE program, NASA's EOS Education Project at the University of Montana, Books/Cole, and the University of Redlands.

Joseph Kerski working at the USGS exhibit.

Illinois educators at the USGS exhibit.

***Thinking Spatially* -- National Research Council Study**

Roger Downs is the chair of the National Research Council study "Thinking Spatially--The Incorporation of GIS Across the K12 Curriculum." He spoke at last year's conference. I represented the USGS at one of these meetings for Barb Ryan (see my March 2001 report). We were updated that the report will be published in 2003. This will be an excellent resource for all of us working in this field.

My Workshops

I received the following statement from one of the conference attendees. It sums up why I believe we should conduct such sessions--they can really help someone:

> Joseph.....just to let you know that you were FANTASTIC at the conference! Your material was right-on-target and basically, your sessions made the conference a success for me! PAT-PAT-PAT...good job!!!!!

I conducted three workshops at the EdUC. Two were entitled, "Accessing and Using USGS Vector Data within ArcGIS", and "Accessing and Using USGS Raster Data within ArcGIS". The high attendance (50 each) showed that educators want to know how to use USGS spatial data in the curriculum. We need to make it as easy as possible for them to access it, order it, and download it. This has implications for how we format and serve our data.

We went through the following data sets in the workshops: DLG, DEM, DRG, DEM, National Land Cover Data, and National Hydrography Data set. This is a great deal to cover in a 90-minute workshop, but the participants persevered and were excellent to

work with. I distributed handouts of my presentation at the workshops as well as some sample USGS maps. Fortunately, I found a shopping cart in the parking garage that was a big help in carrying all the materials into the Marriott. As I was returning it to the parking garage, people asked me if I had quit the USGS and become a hobo!

In the workshops, we spent time downloading data from one of, in my opinion, the most useful geospatial sites on the Internet, www.gisdatadepot.com. It was a privilege to have Glenn Letham, one of the founders of this site, and the editor of *Spatial News,* at the workshop as well.

Participants at one of my "Using USGS Data in ArcGIS" workshops.

The third workshop was with Elizabeth Matlack of the Orton Foundation. I have worked with the Orton Foundation since 2000, including two workshops on GIS in Steamboat Springs, Colorado, and one workshop in Dallas. The workshop at EdUC emphasized how to collect and upload coordinates from GPS receivers into ArcView GIS.

Participants in the GPS to GIS workshop collect coordinates adjacent to San Diego harbor. I must say that it was a spectacular setting in which to conduct field work!

VISIT Meeting

I attended a meeting of the VISIT board. Since 1999, it has been a privilege for me to be on the advisory board of this program, along with university professors, ESRI staff, and other excellent individuals. VISIT stands for the Virtual Immersion in Science Inquiry for Teachers. VISIT is an Online Collaboratory for secondary school science teachers to participate in ongoing scientific investigations of contemporary problems in their localities through applying spatial analysis technologies. GIS is a major component of VISIT. VISIT is a three-year project supported by a grant from the National Science Foundation Teacher Enhancement program. See http://www.emich.edu/visit/ for more information.

Steve Wanner, Boulder High School Teacher, and I helped bring the VISIT program to Colorado in Fall 2001. Teachers receive three graduate credits through Eastern Michigan University for the online course for free, because the registration is paid with the NSF grant money.

At the San Diego meeting, we discussed improvements in the VISIT interface, lessons, and how to bring VISIT to a wider audience.

Notes on Other Sessions I Attended at the Conference

ArcGIS

First, I attended a hands-on workshop by ESRI staff Jamie Parrish and Brian Parr on ArcGIS 8.2. ArcGIS has three levels of functionality from the least to the most-- ArcView, ArcEditor, and ArcInfo. Extensions include spatial, 3D, geostatistics, StreetMap USA and Europe, ArcPress, SID Encoder, TIFF LZW, TOPO, and Publisher.

As most people are aware, ArcGIS includes ArcMap, ArcToolBox, and ArcCatalog. It also includes a new data model called the geodatabase. The reasons for converting data into the geodatabase include scalability, custom features, domains and subtypes for editing efficiency, geometric networks, multiuser access, and the fact that all data is stored together as an mdb (database).

I noticed that exporting to an image file has been improved over ArcView 3.2. One image is a PMF, a Published Map File. This is analogous to PDFs, but for maps. ArcGIS Publisher extension is required to create them, but anyone can view them with the free ArcReader program. ArcReader allows for panning and zooming on the map.

The only thing that I still find odd in version 8 is the "1 layout for each map document." But one can make multiple .mxd's to get around this issue.

Migrating to ArcGIS

I attended a session by ESRI staffperson Jamie Parrish on Migrating to ArcGIS. When she brought in an ArcView 3.2 apr to an ArcGIS 8 mxd document, each view came in as 1 data frame. In a data frame, the layers are in the same geographic area. Event themes, charts, and Avenue scripts don't port over to the new version.

For project repair, missing sources are identified with an exclamation point, allowing the user to locate the files. The best part of this was that once the user fixes one of them, the others are automatically repaired if they are in the same folder!

One can also store .mxd files as relative path names, useful for moving files among computers and writing to CDs. File→ Map Properties→ Data Source Options → Store Relative Path Names.

Changing symbols: One can click on "more symbols" to see the wealth that exists in the new platform.

Adding event themes in ArcView 3.2 can be accomplished by adding a layer in version 8, as a .txt file. If one right-clicks on the layer, one can display xy data. This creates an event layer.

Layers represent the paths and symbols of the data, not the data itself.

One can import symbol definitions from a 3.2 .avl file, but then one should make a layer file out of it such that the AV 8 symbology will be saved.

Projections: ArcCatalog→ new personal geodatabase. This uses MS Access and a new features class. Spatial reference→ one can select from a predefined list, use coordinates from an existing layer, or import.

Defining the projection in ArcToolBox makes a .prj file. Projection wizard in ArcToolBox actually changes the data you are using.

A data frame takes on the projection of the first layer you bring in.

ArcGIS's projection on the fly is really quite impressive.

Geography Network

I attended a session from Angela Lee of ESRI on the Geography Network. I use the GN quite often but have difficulty at times finding what I need on the site.

GN is a framework for sharing (disseminating), discovering (searching), and viewing GIS data and services on the Internet. It provides application services and allows users to access these services. It serves 750,000 to 1 million maps *each day!* One can view data on the web OR bring in and view in ArcGIS OR ftp, in many cases. Ms. Lee used the GN Explorer to view a Paris street map.

Much weather data exists on GN.

If you initiate the GN connection within ArcExplorer, GN has a button→ add to ArcExplorer. Same thing holds with ArcMap. File→ add data from Internet. This is amazing to be able to manipulate and view data that is not residing on one's own computer, but on the Internet. Truly is the wave of the future.

GN allows for NSDI searching as well.

American FactFinder

I attended a session conducted by ESRI Staff Mirjam Stadelmann and Rick Ayers on the Census Bureau's American FactFinder. This is the front end for 2000 Census data and was quite useful.

I also attended a lively discussion in a session on the ESRI K-12 Authorized Training Program.

I wanted to attend the Image Analysis for Arc8 session, but putting up my posters for the Map Gallery took more time than I had anticipated.

Why GIS in Education?

Many factors are encouraging the use of GIS in education, such as:

- Technological innovation
- Constructivism
- Integrated, authentic practice
- Authentic assessment
- School-to-career movement and funding
- School-to-community emphasis
- Active, student-centered learning
- National, state, and district content standards [see warning above].
- Public accountability demands for education
- Globalization
- Inquiry emphasis
- Information literacy
- Computer literacy
- Professional societies.
- Universities.
- Private companies, especially GIS companies, particularly ESRI.
- Government agencies' outreach staffs such as the USGS.
- Research groups (CIPE, TERC, UMAC).
- Advances in data availability and usability.
- Advances in hardware capability.
- Advances in software capability.

Observations and Recommendations

USGS Role in GIS in Education

How does GIS in education fit into the goals and mission of the USGS, and how can the USGS contribute to such an agenda? Our "Future Science Directions" and our USGS strategic plan each indicate how GIS in education ties into our mission. Our

emphasis is integrated information for societal needs. GIS provides one of the best tools and science for integrating land-based information. The National Map effort, AmericaView, Gateway to the Earth, and research projects show clearly that we need scientists who can analyze data from a variety of disciplines. Integrated studies are recommended by education scholars in K-12 curricula also, rather than the traditional model of separate subjects that do not overlap. In 2000, a National Research Council study identified 8 critical world environmental themes, and I believe that 6 of them require spatial data and a populace that can interpret such data.

Data from the USGS Customer Satisfaction-Outcome Survey showed that for 18 products, an average of 55% of the customers reported that they use our products for educational use.
I believe we must continue to support GIS in education by participating in and conducting GIS training for educators, creating GIS-based lessons using USGS and other spatial data resources, and by participating in GIS Day and other activities.

By participating in this conference, we demonstrated the leadership that the USGS has in international science and geography literacy. We are the largest producer and one of the largest users of digital spatial geographic data. These are data sets not only used by geographers, but by anyone interested in solving a project that has to do with space—hydrologists, biologists, demographers, seismologists, geologists, sociologists, psychologists, environmental planners, public works officials, marketers, business analysts, and others. Someone has stated that if physics was the science of the 20th Century, then earth science will be the science of the 21st.

This wealth of data that we create at the USGS will be worthless unless we proactively create a scientifically literate populace.

One reason for attending this conference was to illustrate USGS strength in integrating science with education. The growth in geographic technology presents an excellent opportunity for the USGS to get our data and products into the hands of students and educators across the country. Students familiar with our data will form an expanded future USGS customer base. We also sought to inform the educational and scientific community that our strength does not end with maps and digital cartographic data, but it includes hazards, water resources, energy, and biological research, for example.

By working with educators, the publicity generated for the USGS could be enormous, particularly with increasing media attention on both the need for geographic and science skills as well as the need for geographic and environmental research. Teachers are a powerful voice for the USGS and all science agencies and represent the largest single professional group in the country.

Furthermore, I believe the USGS will benefit from participating in this initiative because we will learn from the committee members about how to package our data for the educational community. This is a question that the Director's Education Team, of which I am a member, has been working on for years. We have all of the pieces, but need to write the interfaces, links, and guidelines.

Implementation Issues

Implementing a GIS is not primarily about hardware or software! Technology is a "process; a systematic blend of people, materials, methods, and machines" (Ely et al. 1992). GIS is both a technology and *a set of methods*! There are challenges in teaching with GIS--GIS is a system! Costs exist, the user is confronted with a blank screen, and the user must decide which data to use, find data, manipulate data, present data in a

usable format, and then design a lesson around these data. Integrating GIS into classroom practice is a complex process. Educators must match the computers and software with instructional goals, subject matter, the students, and the context of instruction.

Guided inquiry entails changes in the technology, curriculum, social organization, and management of the classroom, teaching approach, and in basic beliefs about the nature of knowledge and the roles of teachers and learners. For example:

- unpredictable results
- student-directed learning
- broad vs deep learning

Students and teachers may have confusion about the fundamental representational and spatial concepts upon which an understanding of GIS rests. This is something that the USGS can directly help change through our education and outreach programs.

Geo-technology in education must be done within context of reform for long-term impact.

Standards

Content standards, which specify what students should know and be able to do, in technology, science, geography, social studies, and history, repeatedly emphasize hands-on exploration.

"The power of a GIS is that it allows us to ask questions of data."
--Geography Education Standards Project, 1994, p. 256.

However, the current manner in which standards are being assessed is a serious danger to the use of exploratory tools. The current assessment instruments are emphasizing memorizing facts, directly opposite to what is desired with the use of GIS and other spatial tools in the curriculum! This is a serious issue that needs to be addressed by the NRC.

Use GIS in the Right Way

I believe that we need to use GIS in the right way.

1) Don't use it to exchange one form of time-consuming, rote tasks for another.--for example, entering data into tables or making the perfect map. These use only technical skills.

2) Don't use GIS just to add more information, but to use information more effectively to arrive at a decision. Use GIS to emphasize generative knowledge, not inert knowledge (Dede, 1995).

3) Use GIS to make decisions given incomplete information, inconsistent objectives, and uncertain consequences--just like the situation in the world outside of the classroom.

4) Design modules that can be directly used or easily modified and transferred--sustainable projects.

5) Design short lessons that a teacher can feel confident in accomplishing with a class at first, rather than a long project.

Benefits and Challenges

From a learning perspective, GIS is highly praised. Lessons around the country illustrate community-based, fieldwork based, interdisciplinary, open-ended projects involving ill-structured problems with real-world data. These projects help students use the same tool as is used in research and business to enhance motivation and learning, explore the world, and provide real employment skills.

From a teaching perspective, challenges exist, such as the traditional dominance of Macintosh computers, while most GIS software is written for Windows operating systems. ArcView, for example, runs on Macs, but only the 1997 version of the software. A lack of training in GIS and the perceived and real complexity of GIS tools is another challenge. The lack of preservice training means that the future implementation rate will continue to be slow. Other challenges are that:

- GIS is a complex, open-ended tool.
- Teachers must process data as well as develop lessons.
- Increases complexity of teachers' jobs.
- A lack of geographic training and thinking in both teachers and students.
- Inadequate time to learn software.
- Few lesson plans.
- Lack of training, funds, and technical support.
- Insufficient openings in curriculum for GIS.
- Few incentives for teachers.

Teachers ideally need to be paired with at least one other teacher in the school for increased likelihood that these methods will "take root," and they need some start-up lesson plans, and training. In my survey of 1,520 teachers, training was cited as the number one need.

GIS alters communication patterns and traditional roles of students and teachers, for example:
- Coaching
- Small group instruction
- Working more closely with weaker students
- Assessment based on products and progress
- Cooperation

GIS appears to be effective with non-traditional learners.

Students with GIS may learn at different rates and not all learned the same content or skills.

With GIS, there is a shift from *covering* material to *sampling* material. There is a shift from unilaterally *declaring* what is worth knowing to *discovering* what is important. Students are examining processes over space and time.

In Binko's (1989) 4 stages of learning: awareness, understanding, guided practice, implementation, GIS is barely in the awareness phase for most teachers. In the diffusion literature (championed by Everett Rogers), GIS is in use by the "early adopters"--there could be a big wave to come, but we must be bold in considering these comments and those of the NRC.

GIS implementation will be slow because it relies on inservice training. Therefore, the USGS and others need to address what future teachers are learning in colleges of education in universities.

There is value in requiring students to "dig out" information, rather than handing it to them. GIS involves data management skills and a whole host of other skills besides spatial analysis. It is one of the few tools to take advantage of many computer skills, relational skills, and content skills.

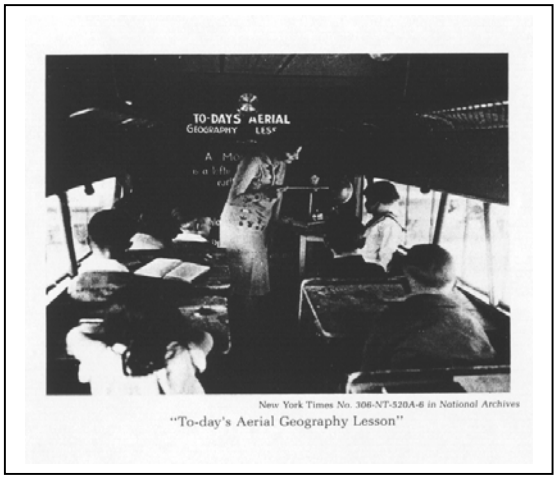
The teacher's role is still critical to learning with GIS, and training teachers needs to be emphasized. Teachers are more likely to adopt GIS if they have previous computer experience, a problem-solving approach, a geographic perspective, a positive attitude toward work change, and active networking and communication skills.

GIS implementation cannot be effective without educational reform. This group can help instigate such reforms.

Our approach should not be: "How can we get GIS into the curriculum?" But: "How can GIS help meet curricular goals?"

I would like to summarize a recommendation

with the following photograph. This photograph illustrates the inappropriate use of technology. Here, a class is using the latest technology of 1927--an airplane--over Los Angeles. However, this new technology is used within an outdated model of education—all eyes are on the teacher, instead of looking at the terrain below, where they could be noting patterns of human impact, land use, and the physical environment. Even the old desks have been brought on board and arranged in the old educational paradigm: teacher as dispenser of knowledge. Let's not make the same mistake with GIS!



Reproduced with permission from Cuban, Larry. 1986. Teachers and Machines: The Classroom Use of Technology Since 1920. New York: Columbia University, Teachers College. I finally met Dr Cuban at the 2002 ASCD conference in San Antonio!

I feel that this quote is quite appropriate:

"The trouble with education…is that the best teaching methods are in fact the most difficult."
--Piaget, Jean. 1929. *The Child's Conception of the World.* London: Routledge.

Despite the challenges, GIS is too important a tool and method to ignore.

Teacher Training

Several EdUC presentations dealt with the topic of teacher training. I believe that the use of GIS has been slow because GIS training, conducted by myself and others, has primarily targeted inservice teachers – teachers who are already practicing in their profession. One exception was a one-week training at Roger Williams University that ESRI education staff (Charlie Fitzpatrick) and I conducted in January 1999, which was geared toward faculty in departments of education who are training students to become teachers. This *inservice* training needs to be more fully embraced. Teachers teach in large degree, and follow the practices of, how they themselves were first taught in their preservice days.

Teachers are under pressure these days as never before, such as being forced to adhere to district, state, and national content standards. These standards specify what students should know and be able to do in science, technology, math, geography, history, social studies, and other areas. Schools are also pressured to perform alternative means of assessment that includes portfolios, field work, computer-based presentations, and other means, in addition to standardized written tests.

During the next five years, schools will be faced with a massive retirement in the system. These new teachers need to be trained in a wide range of technology and methods. I believe that the USGS should capitalize by this massive turnover by emphasizing preservice training for the new teachers coming on board. Schools are also pressured to reduce class sizes, and provide alternative pathways for students, such as educational vouchers. They are expected to recruit and retain high-caliber individuals who must work long hours all during the year, but whose salaries are lower than most other professionals.

At the same time, national and state budgets

are constrained, and the likelihood that teachers' salaries will be increased is low. At the same time, growing national population requires a massive number of new teachers over the next decade. In light of the teacher shortage, some areas are lowering the requirements that teachers must have. These individuals who are not required to have a teaching degree also represent wide-open territory for the USGS, for they will be even less aware of our products and services than teachers who have at least had a science methods or social studies methods course.

Discoveries

I found out about an excellent book that I believe that everyone involved with teacher training should read:

Loucks-Horsley, Susan. 1998. *Designing Professional Development for Teachers of Science and Mathematics*. Corwin Press-Sage. ISBN 0-8039-66628. The National Institute of Science Education. I found it on Amazon.com for $34.95 paperback.

I also learned about a National Institute of Science Education--a professional development and outreach program at the National Research Council's Center for Science-Math-Engineering Education.

NRC Study

I recommend that everyone interested in this topic review the 2001 published study by the National Research Council of the National Academy of Sciences, on the future of the USGS. The report is available online from the National Academy Press at:
http://www.nap.edu/books/0309072646/html/

This report, by extension, can help us design our education program so that it more fully embraces societal needs.

View from the top of the conference site, the Marriott.

*** End of 2002 ESRI EdUC Report ***