EDUCATION-PARTNERSHIP EVENT REPORT AND RECOMMENDATIONS

Events:

1) 22nd New Zealand Geographical Society 2003 Biennial Conference

2) Auckland GIS Institute for Educators

3) Wellington GIS Institute for Educators

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

Locations: Auckland and Wellington
New Zealand

Other USGS Attendees:
None

Event Dates: 7-19 July 2003

Purpose of Events:
(1) Geography research and education conference;
(2) Hands-on GIS workshops.

The conference was held at the University of Auckland, a central-city university with a large, active School of Geography.

Acknowledgements and Funding

I am especially grateful to Anne Olsen and Stephanie Eddy for their professionalism, hard work, and hospitality as we taught together. They were extremely enjoyable to work with, and I learned a great deal from them. I also thank Nick Page, Jennifer Thomas, and Peter Arthur for their excellent assistance with the workshops. I thank the participants in the workshops and conference for sharing their expertise and making me feel most welcome.

I am extremely grateful for Anne Olsen, Stephanie Eddy, and the New Zealand Geographical Society for paying for my airfare and lodging for this trip. It would not have been possible without their efforts. Remaining funds came from my own finances and from the US Geological Survey. I thank the USGS for approving this trip and for paying for part of it.

My Activities at Conference

(1) Conduct plenary presentation at New Zealand Geographical Society conference entitled "Spatial Thinking—Exploring Your World with a GIS."

(2) Conduct hands-on GIS workshop at New Zealand Geographical Society conference.

(3) Co-conduct three day hands-on GIS workshop with educators Anne Olsen and Stephanie Eddy in Auckland, New Zealand.

(4) Co-conduct three day hands-on GIS workshop with educators Anne Olsen and Stephanie Eddy in Wellington, New Zealand.

(5) Operate USGS exhibit at New Zealand Geographical Society conference.

(6) Assist Anne Olsen and Stephanie Eddy with their GIS workshop at the New Zealand Geographical Society conference.

(7) Network with other geography educators and researchers at the conference and at the two three-day GIS workshops.

(8) Attend workshops and presentations at New Zealand Geographical Society conference. Chair one session.

Background

I have been working to promote spatial analysis in GIS for about a decade now, conducting research on the topic, workshops, and creating GIS-based curriculum. In 2000, teacher Anne Olsen from New Zealand won a GIS award for the work she and her students were doing with regards to fire and land use. Next, she was awarded a Royal Society of New Zealand fellowship for a year's professional development. She visited me in Colorado during 2001 along with others in the USA implementing GIS in their curricula. Next, I invited her to participate in our week-long GIS institute for educators in June 2002 in Boulder, Colorado (see my related report). The New Zealand Geographical Society conference and workshops were the latest in our cross-Pacific collaboration and I was thrilled to be a part of it.

About the New Zealand Geographical Society (NZGS)

The NZGS was established in 1944 to promote and stimulate the study of geography within New Zealand at a research and educational level. It supports the publication of two journals—*New Zealand Geographer* and *New Zealand Journal of Geography.* I reviewed both of these publications while at the conference and have a newfound great deal of respect for them. The society's web page is: ***www.nzgs.co.nz***

I met Peter Holland, President of the New Zealand Geographical Society.

This year's conference was co-hosted by the School of Geography and Environmental Science at the University of Auckland. It was held in the geography building and in other buildings on campus. Approximately 360 people attended the conference, including geography professors, secondary geography teachers, and others, like me, who support educators in nonprofit, business, and government organizations.

Sessions at the conference included presentations, forums, papers, and hands-on workshops of interest to the geography research and education community. Approximately five tracks were run concurrently over four days.

The next joint meeting with the Institute of Australian Geographers will be held as part of the IGU Regional Conference in Cairns, Australia during July 2006. The next NZGS conference is scheduled to take place in January 2005 in Rotorua, New Zealand, in conjunction with the Australian Geography Teachers Association (AGTA).

The conference website is:
www.geog.auckland.ac.nz/nzgs2003
and
www.sges.auckland.ac.nz

The conference started off with registration

and a Powhiri welcoming the manuhiri, which was a Maori ceremony that I found extremely interesting. We learned about the traditional Maori greeting as well as the structure and symbolism of the building in which the ceremony was held, a marae, on campus. I submitted a 5-page paper on GIS in education to the conference organizers, which is appended to the end of this report.

In my plenary presentation, I began with an introduction to GIS, and why people are interested in GIS in education. I spoke about the need for GIS to go beyond the walls of geography departments in universities, and to spread beyond geography in secondary education to science, mathematics, history, business, and career education. I spoke about the differences between teaching about GIS and teaching with GIS. I concluded with recommendations to ensure GIS in education success in years to come.

Geography professor Richard LeHeron, one of the conference organizers, greets the attendees. The University of Auckland School of Geography and Environmental Science was the host of the conference. Yes, it is an entire School in the university, not just a department! The conference was very well organized, with excellent technical assistance from students at the University.

The conference dinner was held in the Auckland Town Hall, a magnificent structure containing two large concert halls. One of the speakers, a cabinet-level position with the government, spoke about the importance of geography in political decision-making. That's not something that one often hears from a politician, and it was most welcome!

The conference materials included status reports from the International Geographical Union President Anne Buttimer (whom I met at the IGU conference in London in April 2003), Margaret Robertson's Australia report, Eleanor Rawling's UK Report (whom I have met on several occasions), and Sarah Bednarz's report from the USA (whom I have worked with for nearly a decade).

I attended many excellent sessions at the conference, including:

Graeme Aitken's presentation on the place of geography in the New Zealand social studies curriculum.

Bruce Harold's presentation about Eagle Technology's support of GIS in education and mapping point data.

Pip Forer's presentation about what map enabled surveys can reveal about human lives.

Jinfeng Zhao's presentation about flow visualization.

Lex Chalmers, Jennifer Thomas, Nick Page, and Peter Arthur's presentations on GIS in education. Peter was at the ESRI user conference, but joined us for the Wellington GIS institute (below).

Dave Chapman's discussion on environmental education.

Lesley's workshop on working with data from the New Zealand National Statistics agency.

Alan Pilgrim's presentation on partnerships between education and government.

Spronken-Smith's presentation on teaching research methods in geography using problem-based learning.

Hay's presentation on the electronic image bank for geography.

Gulyaev's presentation on digital libraries of georeferenced data.

Masson and Stirling's presentations on field work with geography education.

I finally had the opportunity to meet Dr Iain Hay from the University of South Australia, whom I have wanted to meet for several years. I also met Dr Peter Newton, Science Director for the CSIRO organization in Australia, and spoke with Dr Elizabeth Leppman, editor for the Journal of Geography (USA).

I found out about an interesting book at the conference entitled The Mapmakers, by John Noble Wilford, 2002, Pimlico, Random House. The book is about mapmakers through the centuries. ISBN 0-7126-6812-8.

Joseph Kerski at the USGS exhibit. The exhibit was held in the main registration room, which ensured good traffic to the materials. The only disappointing thing was the small number of exhibitors.

The USGS maps were the most popular item with the attendees.

Our distribution items included:
--Copies of my new article in the *Journal of Geography* about the implementation and effectiveness of 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.

--sample maps of Antarctica, the World, East Asia, and the Grand Canyon.
-- fact sheets on USGS Geodata, NLCD, The National Map,

--Teachers packets on Exploring Maps, What Do Maps Show, and Land and People
--Map Projections and GIS posters
--Sample CDs from Global GIS project of South Asia and South Pacific.
-- Fact Sheets on GIS in education, GPS, and USGS educational resources..
--GIS and science career information.

The other exhibits featured educational resources and research results.

GIS Workshops at NZGS Conference

Quite a few GIS workshops took place at the NZGS conference. I conducted one, and Anne Olsen and Stephanie Eddy conducted another one. Each of the workshops was attended by between 30 and 40 people, exceeding our hopes. Each of us helped each other with the workshops.

My workshop (I'm at the board), like the other hands-on sessions, was full.

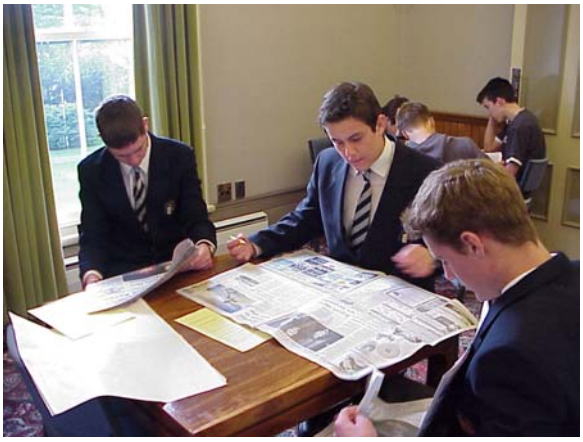
Another full house—this time for Ms Olsen and Ms Eddy's GIS workshop.

Anne Olsen and Stephanie Eddy's workshop included a presentation by some of Ms Eddy's students, pictured above. As always when we have students presenting, it is the highlight of the workshop, and these students were professional, amiable, and impressive.

A three dimensional model of the GIS-based island that one of the students produced, showing that the student really could visualize what he was creating with the GIS.

Two of Ms Eddy's students discussing their island project.

Maatangi Whenua



Secondary geography students participating in a national geography Olympiad event, called the Maatangi Whenua.

One of the activities in the geography competition was to present a five-minute geography 'newscast.' Each team did an excellent job and I thought this was a clever format that we could use in some USA-based educational events.

Another innovative event was where the students had to taste, smell, hear, view, and touch different items from each of New Zealand's major regions, and then identify the region.

The Status of GIS In Education in New Zealand

In my opinion, it was evident from working closely with the educators that all of the correct pieces are in place for spatial analysis to be a success throughout education at the secondary level in particular. They have the software agreements in place, agreements with data providers, and an expanding network of trained teachers who are

enthusiastic and skilled at bringing spatial technologies to the classroom. I was immediately struck by the skills of the secondary geography teachers—they all have a degree in geography, followed by a teaching certification. They really know their subject and are enthusiastic about it!

Organizations such as Land Information New Zealand (LINZ)(www.linz.govt.nz) and the New Zealand National Statistics Agency (stats.govt.nz) . Even private companies such as Geografx (geographx.co.nz) are providing sample spatial data for educators.

Eagle Technologies is the company that is the representative for ESRI software. Schools in New Zealand can obtain free ArcView GIS software through Eagle, after obtaining a community sponsor first. The sponsor can be a municipal or regional government agency or other organization that agrees to support the school in their endeavors.

The New Zealand school system begins with Year 1 (equivalent to K in the USA) through secondary school graduation at the end of Year 13 (equivalent to Grade 12 in the USA). In New Zealand, social studies is required through Year 10, and thereafter is a frequently-offered elective. Its strands include time, continuity and change, people and place, social, economic, and culture. Obviously, all of these strands have a strong geography component. The social studies includes 21 essential learnings about New Zealand, another excellent avenue for Geography and for GIS. The National Curriculum in New Zealand provides guidance on what to teach and when to teach it. The National Certificate of Educational Achievement (NCEA) works hand-in-hand with the national curriculum to provide assessment guidelines for the country. Two GIS standards exist—these include topics such as using GIS to solve problems, using GIS for a specific task, how is GIS useful, data accuracy, and for manipulation of data.

One obvious growth area for GIS in education is to the science teachers, followed by the math, history, computer science, and economics teachers.

I attended the Board of Geography Teachers (BGT) meeting during the last day of the NZGS conference. Approximately 25 teachers attended, and it was excellent to hear their concerns and commitment to geography education. Professor Lex Chalmers led the discussion. Brian Kendrick is the chair of the BGT. The BGT represents the geography education community in New Zealand. Unlike the NCGE, they do not hold their own conferences, but combine their meetings with those of the NZGS conference.

Auckland-Region GIS Institute

We handed out an extensive introductory and advanced GIS in education book compiled by Anne and Stephanie, as well as USGS resources on GIS in education, maps, and geography education.

The structure of the Auckland Region GIS institute, held at Macleans College in Bucklands Beach, Auckland, was as follows:

Day 1:

World Demography Analysis with Whole Group using ArcVoyager software.

Thorough Investigations: New Zealand Tutor

Special Topics: Cell phone tower lesson in Queenstown, New Zealand. New Zealand election data and demographic analysis.

Whole Group: March of Time lesson from Mapping Our World.

Day 2:

Whole Group:
Topo Bingo

Thorough Investigations: 3D Island Project, New Zealand tutor.

Special Topics: GPS introduction
Field Work in Howick: GPS coordinates, number of floors in buildings, pedestrian count. Uploading GPS points into GIS, hotlinking photographs to maps, creating data tables and statistics for pedestrian count and number of floors; mapping data in 2D and 3D.

Nick Page's GIS projects, including an excellent lesson using the NASA image "The World at Night."

Day 3:

Whole Group: Jennifer's GIS project

Thorough Investigations: 3D Island project, NZ sea level change project.

Special Topics: image registration, census projects.

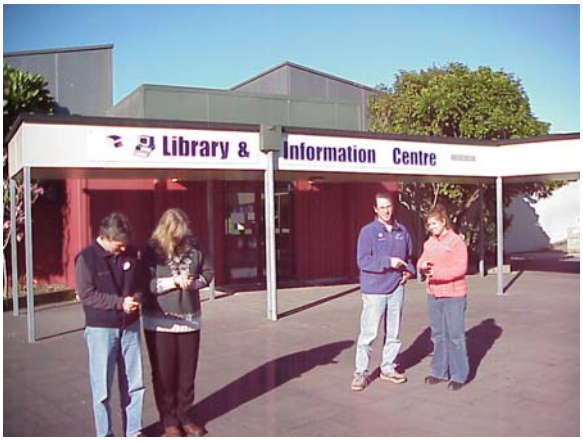
Whole Group: Discussion, summary, data on the CDs, Bali GIS project.

Evaluations and Dismiss.

Stephanie Eddy in her geography classroom at Macleans College. I regard Ms Eddy as one of the best educators in the country. I was quite surprised to see the confederate flag in the classroom, and pleased to see the USGS posters along the walls!

Joseph Kerski: "I must say that the view from the Macleans campus is one of the most spectacular I've ever seen of any secondary school—the ocean, the volcano in the distance, and on the other horizon, the skyscrapers of Auckland."

Anne Olsen, at right, addresses the participants in the Auckland GIS institute. This was held at Ms Eddy's school in the library and information center.



Collecting coordinates with GPS receivers outside the training site, the library.

One of the teachers in the institute giving a demonstration of what she had been working on that day. This part of every workshop is always a special treat and gets everyone excited about analyzing the Earth with a GIS, when they see and hear their colleagues' work.

We collected field data in Howick, a nearby historical village that has recently been surrounded by suburban Auckland, although it maintains many of its village charms and characteristics.

Three-dimensional model of Howick and the field data we collected with graphs and a 40-cm digital orthophoto.

Instructors in the Macleans GIS Institute included (L-to-R): Anne Olsen, Nick Page, Stephanie Eddy, and Joseph Kerski.

Our Topo Bingo activity at the beginning of Day 2 of the workshop. I have used this activity, created by Leslie Gordon of the USGS, all over the world; it is an excellent way to introduce students to map interpretation in a fun way. See my web site http://rockyweb.cr.usgs.gov/public/outreach/ for more details on how to run the activity.

Wellington-Region GIS Institute

We distributed an extensive introductory and advanced GIS in education book compiled by Anne and Stephanie, as well as USGS resources on GIS in education, maps, and geography education.

The structure of the Wellington Region GIS institute, held at Chilton St James School in Lower Hutt, was as follows:

Day 1:

World Demography Analysis with Whole Group

Thorough Investigations: New Zealand Tutor

Special Topics: World Seismicity and USA County Analysis

Whole Group: March of Time lesson from Mapping Our World.

Day 2:

Whole Group:
Topo Bingo
GPS introduction
Field Work in Lower Hutt: GPS coordinates, number of floors in buildings, pedestrian count.

Uploading GPS points into GIS, hotlinking photographs to maps, creating data tables and statistics for pedestrian count and number of floors; mapping data in 2D and 3D. We had a wonderfully detailed set of 10cm-resolution digital orthophotos to work with.
Peter Arthur's GIS projects on field work in geography.

Day 3:

Whole Group: Jennifer's GIS project on land use changes in the Tasman Bay region of the South Island.

Thorough Investigations: 3D Island project.

Special Topics: Cell phone tower lesson, image registration

Whole Group: Discussion, summary, data on the CDs.

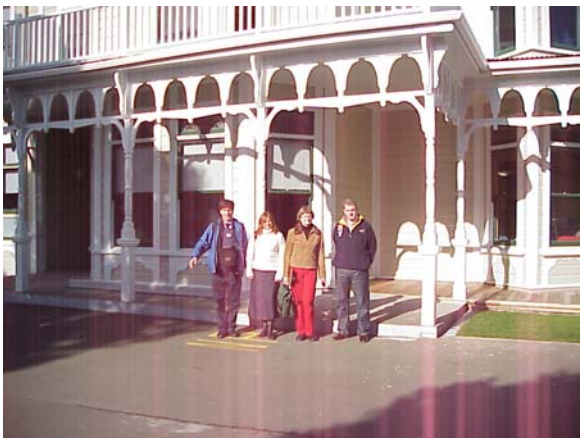
Evaluations and Dismiss.

Day 1 in the Wellington GIS Institute. These included secondary geography teachers and a representative from the New Zealand National Statistics Agency.

A participant in the Wellington GIS institute examines the 10 largest cities around the world as they changed over the past 2,500 years.

Jennifer Thomas, one of the participants in the GIS institute, is one of this year's recipients of the Royal Society Fellowships. The fellowships allows teachers to leave the classrooms, with pay, for one year to pursue full-time professional educational career development opportunities. Ms Thomas has chosen to emphasize geography education, temporal land use change, using GIS and other tools.

Examining topographic maps in the Wellington GIS institute.



Joseph Kerski, Stephanie Eddy, Jennifer Thomas, and a new teacher outside the GIS institute, Chilton St James School, Lower

Hutt.

Everyone intent on collecting their field data!

Factors Encouraging 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.

One nice benefit of working with New Zealand data is that most data is in one coordinate system—the New Zealand map grid. Still, educators there grapple with some of the same challenges as educators elsewhere in the world—access to the computer lab, pressure on the curriculum, standards, and professional development.

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 these events, we demonstrated the leadership that the USGS has in international science and geography literacy. We are the one of the largest

producers 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-based 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 USA.

My Paper for the New Zealand Geographical Society Conference Program

The Implementation and Effectiveness of Geographic Information Systems in Education

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Abstract

Teaching with geographical information systems (GIS) in the curriculum can aid students' understanding of physical and cultural geographic phenomena, processes, and relationships. GIS can also enhance environmental studies, earth science, business, mathematics, sociology, physics, biology, and history education. Students who use GIS to analyze patterns and processes with the same tools that professionals use daily on the job may feel empowered to make a difference in society in a way that students who use paper maps and charts do not. This is because students using GIS do so in a real-world study of current, environmental issues in a problem-solving, issues-based, computerized environment where they use the same tools and data as those in their local communities, regional organizations, and national government.

Training required, existing time constraints in teaching, national assessments, and accessibility to computers pose challenges to the use of GIS in the curriculum in New Zealand and elsewhere. Despite these challenges, using GIS on a local computer, coupled with using GIS-based Internet sites, are impacting the manner in which geography is being taught. These developments are changing students and citizens' understanding of how maps work, the role of spatial analysis in society and education, and the nature of the discipline of geography.

Influences of GIS in Understanding the World

The use of geographical information systems (GIS) in the primary, secondary, and university curriculum can change students' understanding of the world in which they live. GIS has been researched for its usefulness in teaching science (Barstow 1994), geography (Sarnoff 2000), mathematics (Furner and Ramirez 1999), technology (International Society for Technology in Education 2000), inquiry-based methods (Hill 1995b), problem-solving abilities (Audet and Paris 1997), workplace competencies (Hill 1995a), and standards-based content (Geography Education Standards Project 1994). However, the linkages between teaching with GIS (as opposed to teaching about GIS) and education have not been extensively examined. I argue in this paper that teaching with GIS warrants consideration when the goal is excellence in geography education.

The first reason that GIS can influence the understanding of geography is because teaching with GIS engages students in investigations of geographic issues. Through its approach to knowledge and issues, geography education makes a significant contribution to the development of citizenship (Stoltman 1990). Stoltman argued that students should study geography should develop competencies in the literacy of the subject matter of geography, the ability to apply geography to a wide range of political, economic, social, and environmental issues, and knowledge to help them actively participate as citizens in their local communities, the nation, and the world. All three reflect the increasing interest that some educators have in using GIS. GIS is geography applied to real-world issues from the local to global scale. Examples include investigating neighborhood change, investigating tree cover on the school campus, analyzing North American hurricanes, and investigating the Titanic (Kerski 2002a).

Second, students using GIS often examine an environmental issue. In Geography, Culture, and Education, Gerber and Williams (2002) make the case that examining the environment provides excellent grounds for citizenship education. Environmental issues are especially engaging at a community scale because they are easily defined, though less easily solved. Students read and hear about these issues in the local newspapers, on the Internet, on television, radio, and in conversation in the local community. Issues such as water rights, community population growth, zoning changes, traffic, crime, landfills, newcomers to the community, and city government political change usually have a strong environmental component. Students also study global environmental issues using a GIS (Audet and Ludwig 2000).

The third reason for the influence of GIS is that learning about the Earth, when we seriously stop and think about it, really is a complicated matter. To examine the relationships of people, flows, and places means to examine the Earth as an interrelated system. Studying geography encourages students to examine the phenomena of the world in its interrelations (Rice 1985). Learning about the Earth's complexities requires a set of complex and sophisticated tools and methods. GIS tools and methods were created just for this purpose—to model the Earth's cultural and physical features in such a way as to approach the Earth's complexity. GIS allows students to analyze data from many different disciplines in an integrated, computerized environment. As they argue in their book Citizenship Through Secondary Geography, Lambert and Machon (2001), an essential realization in citizenship education is that we all share a globally interconnected environment. GIS was created for the purpose of examining these interconnections.

Curriculum and standards teams in many countries stress the value of Information and Computer Technology (ICT) in creating and

using appropriate information, presenting patterns and processes, exploring geographical relationships, and predicting and solving geographical problems. GIS fits in well with all of these ICT advantages. It allows students to gain access to a wide range of geographical knowledge and information sources, and deepens understanding of environmental and spatial relationships, while helping students consider the impact of information technologies on the decisions they are making.

Fourth, by using the same tools that professionals use daily on the job, students may feel empowered to make a difference in society in a way that students who use paper maps and charts do not. Their engagement might increase because they realize that unlike in most of their classes, they are being empowered through GIS with the same responsibilities as a professional. As one student put it, “Ms. Brooks, this (GIS) is hard stuff. But I can do this!” (Brooks 1998).

Fifth, because they are using the same tools as professionals, students using GIS must also the same data sets as those used by GIS professionals. Data on population, land use, topography, and other phenomena are powerful visualizations of their community and world. Students are attracted to maps in the same way that people have been attracted to maps for centuries for their rich content and ability to clearly convey patterns. GIS includes the advantages of paper maps and is a computer-based tool. Students are familiar with learning on computers, and GIS allows them to be in control of the data in a way that paper maps cannot.

Students are empowered with spatial data, because they can change the symbols, the scale, the classification system, the layers, and the topics examined. Furthermore, they deal with the same sorts of data issues as professionals using GIS, such as whether to use data from unknown or questionable sources, incomplete data, data collected for different purposes, and erroneous data. Grappling with uncertainties and anomalies seems to give them a sense of being responsible for conveying their argument in a professional, responsible manner. In addition, students realize that issues are not clear-cut or easily solvable, no matter how many map layers they can manipulate. Hay and Foley (1998) introduced an approach that asks students to resolve professional ethical dilemmas through publicly defensible means.

GIS gives students the data at their fingertips to defend their position about an issue. For example, as the United Kingdom’s Key Stage 3 citizenship through geography standards indicate, geography contributes to citizenship by enabling pupils to understand how decisions are made about places and environments across a range of scales and appreciate opportunities for their own involvement.

The sixth reason why GIS can aid in teaching and learning about geography is that students using GIS tackle geographic issues in a hands-on way. This hands-on, constructivist, scientific method of examining a problem is usually more engaging to students than through many other methods. GIS with field methods and Global Positioning Systems (GPS) and remotely sensed imagery gets the student out of the computer laboratory and into the field. This means that students may learn more about citizenship through a few GIS-based projects during the semester, even if those projects do not occupy the bulk of the semester’s time. Coupled with this argument is that, ideally, if the data sets are in place, GIS allows an investigator to more quickly move to the analysis stage than with traditional media, instead of spending time gathering and manipulating data. Students examining world demographic variables may more readily understand the issues and challenges of global interdependence, because they can quickly analyze these data, rather than spend time coloring maps by hand or examining the data in tabular form.

The seventh reason why GIS can aid in learning in geography is because students using GIS are naturally tied to the community. Students need local contacts to obtain local data that will help them address the local issues.

Students need three types of local data. First, they need information about the local issue, or problem. Second, they need local data, such as aerial photographs, transportation, hydrography, and topography. Third, they often require local thematic data, such as population, housing, zoning, land use, floodplains, educational and medical facilities, crime, and fire protection.

Because the nature of spatial data is complex, questions on map projections, coordinate systems, symbology, attributes, datums, scale, metadata, completeness, and content often need to be answered in the course of the project. By conversing with community data producers about these topics, a dialogue between students and community professionals begins.

The eighth reason why the use of GIS can aid in geography education is that students using GIS are often required to give back to the community, not just take from it. They may have to justify the best location for a parking lot in an open space park (Knapp 2003) or a wildlife corridor adjacent to a metropolitan area (Kerski 2002b). Students using GIS can reflect on the consequences of their own actions in situations concerning places and environments, another UK Key Stage 3 citizenship standard.

Many community-based GIS projects include a component where students give a presentation on their findings to the local school board, planning commission, or other community group. Students have also found internships and employment with planning departments, community organizations, or agencies using GIS in their community after the project ends. Mohan (1995) suggested that geography could benefit from incorporating service learning in order to enhance its examination of ethical issues.

By participating in the community, using the same tools and data that the decision-makers in the community use, GIS can enhance geography education because students learn to become active citizens. Geography is by nature an active social science (Gerber and Williams 2002), and participating with the community with a GIS-based project may enable students to feel that they have a valid contribution to make to the issue in the community or region. Students using spatial technologies may feel tied to their community because they realize that they do not have to wait until graduation before they have a role and a way to contribute to the community. Rather, they can contribute now, while they are still students.

Because the issue will likely not be “solved” by the time the students need to have their project completed, students get a sense that issues are more complicated than they initially appear to be. Students see people in the community grappling with the same issues who are not in school. They may begin to view understanding and learning as a pursuit that happens over a lifetime, rather than facts to memorize in class.

GIS may also encourage “social constructionism” (Delgado-Moreira 1997). Social constructionism emphasizes the creative activity of individuals and groups, and values living positively with diversity, giving young people an idea of their responsibilities in an interdependent society, and becoming informed citizens. Students become informed citizens through developing their skills of being critical of the spatial data within GIS and of the issues themselves, by communicating, and by participating in responsible action.

GIS can help students develop the

knowledge, skills and attitudes necessary for making informed decisions. Because they are examining the decision-making processes necessary to deal with the real-world issue that they are studying, students discover how to exercise their responsibilities and rights in a democratic society (Wymondham High School 2003). Furthermore, these investigations are most often undertaken at the local, community level, directly meeting essential components identified by many schools, including Wymondham High School (2003) in citizenship education—Discovering the nature of community. Education for citizenship is an opportunity to develop the knowledge, skills and attitudes necessary for exploring and making informed decisions, and exercising responsibilities and rights in a democratic society. It helps pupils by supporting them as they develop from dependent children into independent young people. Eight essential components have been identified: the nature of community; roles and relationships in a pluralist society; the duties, responsibilities and rights of being a citizen; the family; democracy in action; the citizen and the law; work, employment and leisure; public services.

Spatial data availability, a lack of a home in the curriculum, and hardware cost and accessibility pose challenges to the use of GIS in the curriculum (Kerski 2003). Piaget's (1929) statement that "The trouble with education…is that the best teaching methods are in fact the most difficult" is applicable to teaching with GIS. Using the same tool as those used in academia, government, and business

is not to be taken lightly. Yet, case studies have shown that it can be a worthwhile investment of time and money (Knapp 2003). GIS is not going away—it is a critical component of decision-making around the world.

Recommendations

I encourage educators at all levels and in all disciplines to consider applying GIS to their teaching. One does not need to be an expert to use GIS effectively in the curriculum. Many topics in geography lend themselves to analysis within a computerized mapping environment, such as natural hazards, watersheds, land use, population, landforms, and transportation. Using GIS does guarantee good teaching, and it does not provide the answers. It provides tools for the student to investigate the answers.

Therefore, the instructor's role is even more critical than ever—to provide a framework so that the student thinks about the patterns, linkages, and relationships of the phenomena that he or she is mapping and analyzing. Over the past decade in my work with students, I have noted a steady increase in the ability of students to become comfortable with GIS software. However, I have not noted a corresponding increase in the ability of students to understand geographical relationships. This frees the teacher from becoming mired in software procedures to do what they enjoy best and have expertise in—to guide geographic inquiry.

I also encourage teachers not to convert lessons into GIS-based lessons just because it can be done. If the instructor has suitable materials for a suitable lesson, there is no reason to spend time converting part or all of that lesson into a GIS environment. Rather, the instructor should consider lessons that cannot be done well with paper maps, textbooks, and tables to be taught with some level of GIS.

It is also critical that all secondary instructors link each lesson that they create that uses GIS to national curricula and educational standards. GIS must be shown to be a part of the curriculum, not some add-on to an already crowded program.

I also encourage teachers and professors to take advantage of GIS-based Internet sites,

which allow the power of computer maps to be experienced by a wider audience than those who own GIS software. Examples include mapping crop patterns in North America and wildfires in Australia. These provide the instructor and student to quickly make customized maps that can serve as starting points of discussion. These developments are changing students and citizens' understanding of how maps work, the role of maps in society and education, and the nature of the discipline of geography.

To the university instructor, I recommend that GIS be brought to other departments on campus—to physics, economics, history, architecture, environmental studies, geology, mathematics. To the primary and secondary instructor, I recommend that GIS be brought to other subjects. GIS is, in my opinion, the greatest contribution that geographers have made since the age of exploration. It is too important to confine to just geography. By applying GIS and spatial analysis to other disciplines, we can illustrate the contribution of geography to all education.

For More Information

New textbooks, curricular resources, downloadable data from LINZ and Statistics New Zealand, training opportunities, and a growing network of educators using GIS in New Zealand are making the potential of GIS in the curriculum a reality. For more information, contact the author.

Conclusions

Therefore, students can effectively learn about their world using GIS. They examine geographic issues using a complex tool in a hands-on way, using the same data and the same tool used daily by decision-makers in their community and government. Students are usually engaged by GIS, and often guide the inquiry because the data are at their fingertips. They use the community for data and for their study sites, and are often required to give back to the community when they have completed their project. Through community projects, they develop social citizenship. While working on environmental projects, they develop environmental citizenship. They may develop "critical citizenship"—understanding how decisions are made in a democratic process, and their responsibility in participating in that process (Cresson undated). They reflect on and discuss topical social, environmental, economic and political issues, and through GIS, better understand their rights and responsibilities to other people and the environment.

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Final Thoughts

New Zealand is a fantastic country. Its terrain includes just about everything—volcanoes, coastlines, hot springs, plains, hills, and more. I found this out first hand during three confluence visits—to 37 degrees south, 175 East, 40 south / 176 East, and 41 South / 175 East. See photographs below for proof of this fantastic landscape. Most of all, though, I will remember the excellent educators and researchers that I worked with, and their excellence, friendliness, professionalism, and enthusiasm. Again, I am very appreciative of being included in such an excellent community. I look forward to working with them in the future.

Joseph Kerski at 40 South 176 East after quite a hike through the "bush."

The Tasman Sea off the west coast of New Zealand. Australia is (way) on the other side.

Joseph Kerski, Peter Arthur, Murray Ellis, and Anne Olsen in a pinus radiata forest at 41 South 175 East.

New Zealand (flag above) is, in my opinion, one of the world leaders in bringing spatial technologies to education, due largely to the efforts of several key educators.

Auckland New Zealand from one of its many volcanoes.

It is an excellent time to be working in geography!

* * End of New Zealand 2003 Report * *