Second International Symposium on GIS in Higher Education

September 5-8, 1996

Columbia Inn and Conference Center
Columbia, Maryland, USA

Organized by:

World Computer Graphics Foundation
Towson State University
National Center for Geographic Information and Analysis (NCGIA)

Co-sponsored by:

Intergraph
Environmental Systems Research Institute (ESRI)
National Council on Geographic Education (NCGE)
University Consortium for Geographic Information Science (UCGIS)

This Second International Symposium (GISHE `96) follows a series of related workshops held during the `80's and 1990 at Ohio State University, and the first international symposium held in Miami in 1991.

The theme for this symposium is "**Expanding GIS Education through Technology and Outreach**". The purpose is to provide a forum for discussion of today's **strategic issues** in GIS Higher Education. These issues include:

- intra- and interdisciplinary GIS education
- GIS education and the internet

new technologies for teaching: multimedia, web browsers
- funding and designing GIS laboratories
- professional education: educating working professionals
- the role for the 2-year community and technical colleges
- curricula for colleges
- articulation of GIS education across the educational spectrum from elementary school to post graduate programs
- international collaboration in GIS education
- preservice teacher education in GIS

Special Events

K-12 Day - Although the conference focus is higher education, K-12 teachers are invited to attend a special one-day workshop being planned specifically for them. This special session will allow teachers to share their accomplishments in using and teaching GIS and to express their needs. Sessions on GIS education directions, the use of new technologies, and hands-on demonstrations and vendor feedback will be scheduled.

Demonstrations - In addition to paper sessions, demonstrations of multimedia, on-line coursewear and other computer-based materials will be scheduled throughout the program.

Conference structure

The conference will begin on the evening of Thursday, September 5 with an opening plenary followed by a sponsored reception. Friday and Saturday will have a combination of plenaries and parallel sessions. Saturday's paper sessions will end with focus group discussions, followed by a brief plenary and a social event to give us a reward for our hard work. The meeting will conclude on Sunday morning with a breakfast buffet followed by an open discussion session at which plans for future research and activities will be formulated.

Conference proceedings

Abstracts for accepted presentations will be collected in a small proceedings volume to be distributed to participants at the meeting. A small number of presentations will be selected during the conference to be developed into full papers for inclusion in a referreed journal special issue on GIS education.

Exhibits

The conference will feature an exhibit area for commercial organizations offering products of interest to this international group of GIS educators.

Venue

The symposium will be held at the *Columbia Inn and Conference Center* in Columbia, Maryland.

Steering Committee

Robert Aangeenbrug, University of South Florida
Karen Kemp, NCGIA, Santa Barbara
John Morgan III, Towson State University
Steve Palladino, NCGIA, Santa Barbara

Program Advisory Committee

Sarah Bednarz, Texas A&M University
Kenneth E. Foote, University of Texas, Austin
Michael F. Goodchild, NCGIA and University of California Santa Barbara
William E. Huxhold, University of Wisconsin Milwaukee
Susan M. Macey, Southwest Texas State University
Duane Marble, Ohio State University
Susan Nolen, Intergraph Corporation
Michael Phoenix, Environmental Systems Research Institute
David U. Unwin, Birkbeck College, London UK
Richard D. Wright, San Diego State University

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FINAL Conference Program

(last revision September 11, 1996)

- links in the program go to abstracts of talks or summaries of discussions held

- *notes* indicates that a summary of the talk as presented is included in the associated link
- *link* indicates that an external link to more information is included in the abstract

Thursday, September 5

4:00pm - 7:00 - Registration

7:00pm - 8:00 - Opening Plenary

Welcome from the Steering Committee

Karen K. Kemp, Program Chair

Opening Keynote
notes *GE + IM = GISHE? Some Canadian Experiences*
Robert Maher
Independent consultant, Peterborough, Ontario, Canada

8:00pm - 9:30 - Reception in the Exhibit Hall

Friday, September 6

8:30 - 10:00 - Parallel Session #1

F1.1 GIS as an integrator in higher education

Chair: Ken Foote, University of Texas Austin

Integrating GIS into an Undergraduate Environmental Studies Program
William J. Cromartie
Richard Stockton College, Pomona, NJ

GIS Practicals: Case-work as a symbiosis between GIS technology, GIS theory and subject knowledge
Marien de Bakker
Van Hall Institute, The Netherlands

Cancelled *Introducing Model-Building into a GIS Curriculum*
Douglas J. Wheeler
U.S. Geological Survey and George Mason University

Discussion: In what ways is GIS more than a technical subject?

F1.2 Overview of GIS education activities at national levels
Chair: Jay Morgan, Towson State University

Status of GIS Education in China
Zong-Guo Xia
University of Massachusetts at Boston

Cancelled *A Model GIS Laboratory for Higher Education in a Developing Country: The example of the GIS lab, University of Ibadan, Nigeria*
Sylvester Abumere, Olusegun Areola and Bola Ayeni
University of Ibadan, Nigeria

National Training Priorities in GIS - an Australian perspective
Pramod Sharma
University of Queensland, Australia

Coodinated Development in GIS Education and Training in Institutions of Higher Learning in Southern Africa
Musisi Nkambwe
University of Botswana, Botswana

F1.3 GIS in the community colleges
Chair: John Schaeffer, Central Oregon Community College

Community Colleges: Mainstreaming GIS into the Community
Robert Welch
Lansing Community College, MI

Some Tips for Implementing a GIS Program in a Community College

Patricia A. Cunniff and William Lauffer
Prince George's Community College, Largo, MD

link *The MS NASA Community College Initiative*
Lisa Stone
University of Mississippi

Discussion: How is the situation in the Community Colleges different from that in other higher education institutions?

10:30 - 12:00 - Parallel Session #2

F2.1 Approaches to teaching GIS

Chair: David Unwin, Birkbeck College, University of London, UK

Expanding GIS Education through Methodology: The Case of a User Oriented Operations Taxonomy
Micha Pazner
University of Western Ontario, London, Ontario, Canada

GIS Curriculum Design: An International Perspective
Zong-Guo Xia
University of Massachusetts at Boston

From the Electronic Classroom to the Virtual Department: The Geographer's Craft and Virtual Geography Department Projects
Kenneth E. Foote
University of Texas Austin

Discussion: What methodologies can be used to improve GIS education?

F2.2 GIS degree and certificate programs

Chair: Susan Macey, Southwest Texas State University

Teaching GIS as an Undergraduate Major Subject
Mark Gahegan and Bert Veenendaal
Curtin University, Australia

Cancelled *The GIS Certificate: A Need for an Interdisciplinary Approach to GIS Education*
William E. Huxhold
University of Wisconsin - Milwaukee

Changing times Can Lead to a Bright Future: The BS in Geographic Information Science at Texas A&M University-Corpus Christi
Joseph C. Loon and Gary A. Jeffress
Texas A&M University-Corpus Christi

Discussion: What opportunities exist for the development of similar programs elsewhere?

F2.3 Reports from National Science Foundation Community College GIS projects
Chair: Michael Phoenix, ESRI

link *Update on the GIS Core Curriculum for Technical Programs Project* Stephen D. Palladino
NCGIA, University of California Santa Barbara

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Two Year Associate of Technology Curriculum Development for GIS/GPS Technologies
James Keating
Kansas State University, Salina

NASA-CCITT Project in Remote Sensing, Image Processing, and GIS
Patricia Cunniff
Prince George's Community College

Advancing Geo-technology Education: Providing GIS/GPS/Remote Sensing/Computer Cartography Skills for the Workforce of the Twenty-First Century
Dorothy Drummond
Indiana State University

GIS Activities through the Northwest Center for Sustaninable Resources (NCSR) John Schaeffer
Central Oregon Community College

12:00 - 1:45 - Symposium Luncheon
Luncheon speakers

GIS Directions in Government: Implications for educators
John Kelmelis
Program Manager for Cartographic Research and Applications, U.S. Geological Survey

Private Sector Needs in GIS Education
Rebecca M. Somers
Somers-St. Claire GIS Management Consultants, Fairfax VA

2:00 - 3:30 - Parallel Session #3

F3.1 Campus-wide coordination

Chair: Susan Macey, Southwest Texas State University

GIS for the Masses: NCSU's approach to providing campuswide access to GIS
Hugh A. Devine and Carolyn Argentati
North Carolina State University

Organization of GIS at the University of Florida
Scot E. Smith
University of Florida

A GIS Curriculum for Community-Based Technology Transfer and Problem Solving
Yichun Xie
Eastern Michigan University

Discussion: How can these examples serve as models for other coordination efforts?

F3.2 GIS capacity building in developing countries
Chair: Robert Maher, independent consultant, Ontario, Canada

Cancelled *Educating the Masses: Teaching GIS at an African University*
J.H. Botha
University of the North, Sovenga, South Africa

Educational Requirements for GIS in Developing Countries
Paul van Helden
University of Pretoria, South Africa

notes *GIS in the Baltic Region*
Karlis Kalviskis
University of Latvia, Latvia

Discussion: How can the international higher education community help to build a workforce knowledgeable about GIS in developing countries?

F3.3 Panel Discussion on Issues in Community College GIS Education
Chair: Stephen Palladino, NCGIA, University of California Santa Barbara

Starting a GIS Education Program
Panelists:

Robert Lee, Green River Community College, WA
Roberta Garza, San Antonio Community College, TX
Lynne Beatty, Johnson County Community College, KS

Annie Cummings, Pikes Peak Community College, CO
Ann Stefani, San Bernardino Valley College, CA
Claire Correale, Burlington County College, NJ

4:00 - 5:00 - Parallel Session #4

F4.1 NCGIA Core Curricula in GIS and Remote Sensing

Chair: Karen K. Kemp, NCGIA, University of California Santa Barbara

link *The Original NCGIA Core Curriculum in GIS*
Karen Kemp
NCGIA, University of California Santa Barbara

link *NCGIA Remote Sensing Core Curriculum*
Karen D. Kline and John E. Estes, University of California Santa Barbara
and Timothy W. Foresman, University of Maryland Baltimore County

link *New On-Line Core Curriculum in Geographic Information Science*
Karen Kemp
NCGIA, University of California Santa Barbara

link *GIS Core Curriculum for Technical Programs*
Stephen Palladino
NCGIA, University of California Santa Barbara

F4.2 Software to support GIS education
Chair: Michael Phoenix, ESRI

*User Demonstration of GIS Software: Map*Factory*
Micha Pazner
The University of Western Ontario, London, Ontario, Canada

CITYgreen
Chris Daniel
American Forests

Saturday, September 7 (includes K-12 day)

7:30 - 8:30 - Continental Breakfast

- K-12 Day registration

8:30 - 9:15 - Plenary

Saturday Keynote

Chair: Sarah Bedarz, Texas A&M University

The Geographic Eye: Seeing Through GIS?
Roger M. Downs
Pennsylvania State University

9:30 - 10:30 - Parallel Session #5

S1.1 Professional education I

Chair: Brian Lees, Australian National University

Cancelled *Academic GIS Education: What the real world needs and what the academy delivers*
John M. Morgan, III, Towson State University
and Barbara B. Fleury, Maryland-National Capital Park and Planning Commission

notes *Professional Development: a missing brick in the wall?*
David J. Unwin
Birkbeck College, University of London, UK

Cancelled *Intra and Interdisciplinary Education in GIS: the experience of Formez GIS courses*

Sandra Piscedda
Formez Lab*GIS, Naples, Italy

Discussion: What is to be gained from international collaboration?

S1.2 GIS Software to support higher education
Chair: Derek Thompson, University of Maryland College Park

UrbanWorld - An Hypermap Learning Environment Based on Geographical Information Systems
Derek Thompson, David Wong, Frank Lindsay, Paul Davis et alia
The University of Maryland, College Park

S1.3 K-12 GIS: Methods and issues

Chair: Steve Palladino, NCGIA, Santa Barbara

Cancelled *Using GIS in Secondary Education: Curriculum, Implementation and Results*
Monica Ramirez
Florida Atlantic University

Curricular Connections: High School Geography and Geographic Information Systems
Sarah W. Bednarz, Texas A&M University
and Gail Ludwig, University of Missouri, Columbia

Thinking Spatially: Implementing Information Technologies in Secondary Education
S.J. Macklin
University of Maine

10:45 - 12:00 - Parallel Session #6

S2.1 Professional education II

Chair: David Unwin, Birkbeck College, University of London, UK

Geographical Information Systems Education at the University of Zimbabwe: Issues and future prospects
Daniel T. Semwayo and Patrick Matambanadzo
University of Zimbabwe, Zimbabwe

GIS Education and Awareness: a European perspective
Fred Toppen, Utrecht University, The Netherlands, and
Petra Cremers, GEON, The Netherlands

Discussion: How can the availability and quality of GIS professional education opportunities be improved?

S2.2 GIS laboratory facilities
Chair: Richard Wright, San Diego State University

Managing a GIS Teaching Laboratory - Lessons Learned in the Trenches
Susan M. Macey
Southwest Texas State University

Design and Use of a Hybrid Multimedia Facility for Multidisciplinary GIS Education at the Upper-Division Level
Jack F. Paris
California State University, Fresno

Discussion: What important lessons learned should be shared with the GIS education community?

S2.3 GIS software to support K-12 education
Chair: Gail Ludwig, University of Missouri Columbia

link *"Avakeeo" : the construction kit of computerised microworlds for teaching and learning Geography*
Manolis Koutlis and Thanasis Hadzilacos
University of Patras, Greece

The MERLIN System
William S. Burgess
Maryland Department of Natural Resources

Tour of the Exhibition Hall for K-12 teachers

1:30 - 3:00 - Parallel Session #7

S3.1 GIS Distance learning

Chair: Ken Foote, University of Texas Austin

Distance Learning on GIS: Facts, considerations and questions
Petra Cremers
GEON, The Netherlands

UNIGIS Distance Learning Diploma, Technology and User Needs
John Wilson, University of Southern California
and James R Petch, Manchester Metropolitan University, UK

link *Distance Education and the WWW*
Josef Strobl
Salzburg University, Austria

Flexible Delivery and Social Learning : Seeking a new geography of GIS in education
Pip Forer
University of Auckland, New Zealand

S3.2 Using GIS as a learning tool
Chair: Susan Macey, Southwest Texas State University

notes *The Philosophy and Design of a Virtual Field Course*
David J. Unwin
Birkbeck College, University of London, UK

Community-based GIS Education: A Twin Cities Experiment
Robert B. McMaster, Helga Leitner, Eric Sheppard, and Sarah Elwood

University of Minnesota

Cancelled *System Approach in Teaching Geography with the Help of GIS*
Basil M. Kravtsov, Nina V. Gulyaeya and Iouri B. Kravtsov
Novosibirsk State Pedagogical University, Russia

Discussion: What resources are needed to encourage the use of GIS across the curriculum as a learning tool?

S3.3 K-12 GIS: Examples of GIS in the schools
Chair: Sarah Bednarz, Texas A&M University

Teaching Geography with GIS in Ontario's Secondary Schools
Bob Sharpe and Angela Crechiolo
Wilfrid Laurier University, Waterloo, Ontario, Canada

Developing GIS Use in High Schools
Martin F. Schmidt, Jr.
McDonough School, MD

Lessons from the Lake Barcroft Project
Kathryn Keranen
Thomas Jefferson High School for Science and Technology, VA

Conditions Affecting the Classroom Implementation of Geographic Information Systems
Richard H. Audet
Roger Williams University

Discussion: In what ways can GIS software, education, and curriculum-related materials be developed to meet K-12 and preservice educational needs?

3:30 - 4:30 - Group Discussion Sessions

Symposium participants break into several small groups to discuss and identify strategic issues in GIS higher education education.

In addition, special interest groups will be formed as follows:

- K-12 Group: What do teachers need from university and college GIS educators?
- Community College Group: How should these institutions articulate with the rest of the GIS education community?

4:30 - 5:30 - Plenary

notes *Presentation of brief summary reports from discussion sessions*

Sunday, September 8

9:00a - 10:00 - Symposium Brunch

10:00 - 12:00 - Closing Plenary

notes *Discussion of priority needs for GIS Education*

Chair: Richard Wright, San Diego State University

GISHE '96 Program revisions

Wednesday, September 11, 1996

- added extended summary of talk (with graphics) by Karlis Kalviskis, Lithuania

Tuesday, September 10, 1996

- several program changes made to reflect conference presentations
- added notes on session discussions, the Saturday breakout discussions and the final conference summary discussion

Wednesday, August 28, 1996

- removed paper by Cunniff (S3.3) - note Cunniff still on program elsewhere
- added paper by Keranen (S3.3)
- added session chairs
- added names for speakers in F2.3 and F3.3

Monday, August 26, 1996

- added plenary papers by Maher, Kelmelis and Downs
- removed cancelled papers by Simonov (F1.2) and Fabian (old F2.2)
- moved Nkambwe (old F2.2) to F1.2
- moved Toppen (old F2.2) to S2.1
- moved GIS degree and certificate programs session (old F4.1) to F2.2
- moved NCGIA Core Curricula session to F4.1
- shifted all Friday Community College sessions up one time slot (old F4.3 to F3.3, old F3.3 to F2.3 and old F2.3 to F1.3)

Wednesday, August 21, 1996

- added papers by Foote (F2.1) and Loon (F4.1)
- changed speakers to Foresman (F1.3) and Wilson (S3.1)
- changed afternoon times on Friday to accomodate a longer luncheon, sessions end at 5pm

Friday, August 16, 1996

- removed cancelled papers by Omojola (F1.2), Sui (F2.1) and Capek (S2.1)
- added paper by Areola (F1.2)
- revised discussion questions for F2.1 and F3.2

Tuesday, July 16, 1996

- added details about Saturday night bus trip

Friday, July 12, 1996

- switched Macklin and Kravtsov papers

GE + IM = GISHE ?
Geographic Education and Information Management: some Canadian experiences

Robert Maher
Independent consultant, Peterborough, Ontario, Canada

Outline of Keynote as presented September 5, 1996

GEOGRAPHIC EDUCATION

- Geographic Education is more than teaching Geography. It is the spatial context within which we pose our questions.
- It goes beyond a single discipline.
- It has ties into Howard Gardner's seven types of thinking.

INFORMATION MANAGEMENT

- Information Management is more than Information Technology.
- It concerns database design, loading and maintenance of databases, their access and ownership.
- It links to Geographic Education when our problems are about spatial databases.
- This means maps, images and methods of recording and storing location.

PRESENTATION OUTLINE

- teaching GIS at the Community College e.g. College of Geographic Sciences (COGS), Lawrencetown, Nova SCotia.
- professional education in government e.g. Ontario Ministry of Natural Resources
- GIS education consulting e.g. Statistics Canada, Nova Scotia

DEPARTMENT OF MUNICIPAL AFFAIRS

- Action and Future Direction
- Conclusion

EXPERIENCE FORMAT

- History
- Context
- Lessons
- Today

COGS: HISTORY

1980 Nova Scotia Land Survey Institute
- Federal funding for training Scientific Computer Programmers
- Bring in Computer Technology for benefit of other professions i.e. surveying, cartography and community planning
- Later name change from NSLSI to COGS

COGS: CONTEXT

- design of one year post-graduate diploma GIS program followed other programming programs
- focus on programming and database skills
- practical orientation with external cooperative projects
- fixed curriculum

COGS: LESSONS

- prerequisite disciplinary knowledge
- intensive skill development
- employment motivation
- connections to government and industry
- inadequate treatment of 'information systems' methodology
- inadequate treatment of geographic problem solving

COGS: TODAY

- similar curriculum with options
- different vendor relations
- move from one year to two year program
- continue to serve technical niche marketplace

OMNR: HISTORY

- 1980's use of GIS for digital cartography: Ontario topographic base maps and forest inventory mapping
- 1990 pilot projects in Cambridge and Timmins for operational District use of GIS

OMNR: CONTEXT

- Vendor of Record with ESRI Canada for all GIS technology
- Educational partnerships with colleges and universities
- focus on ecological sustainable management
- organizational downsizing and change in mandate

OMNR: LESSONS

- partnerships with Sir Sandford Fleming College and ESRI Canada
- relationship between GIS and other Information Technology
- outsourcing of training and education

OMNR: TODAY

- business re-engineering
- relocation and organizational change
- loss of human investment
- new client server technology
- new Natural Resources Values Information System under development

STATISTICS CANADA

- federal agency responsible for the census
- long time user of GIS
- separate Geography Division
- need Training and Education Plan
- link census concepts with geographic concepts
- use GIS as an educational delivery vehicle
- need to develop educational products

NOVA SCOTIA DEPARTMENT OF MUNICIPAL AFFAIRS

- provincial agency responsible for land records management
- partnership with ESRI Canada and NovaLIS
- need training and education plan
- rationalize business functions: land registration. assessment and mapping

ACTION AND FUTURE DIRECTIONS

- Data Liberation Initiatives
- Keep learning new tools
- Promote geographic concepts: questions of distribution and spatial processes
- Design educational products at the same time as the application system
- Define new programs e.g. Community based GIS and Environmental Management
- Enhanced partnerships with changes in instructional technology

CONCLUSION

- Geographic Education and Information Management are two conceptual frameworks
- For GIS in Higher Education, we need to teach both contexts, recognizing that the content will come from elsewhere.
- Content includes Applied Sciences and INformation Technology
- In relation to the landscape David Quammen says that the 'object-ground relations have reversed'. Perhaps GIS will help us develop a new perspective on this old problem.

Dr. Robert Maher
Peterborough, Ontario, Canada

Integrating GIS Into An Undergraduate Environmental Studies Program

William J. Cromartie
Richard Stockton College, Pomona

The Environmental Studies Program at Stockton College has undertaken an NSF-funded, two-year project to redesign its curriculum, integrating a strong geographic perspective. Faculty are developing and testing a set of core environmental science modules, incorporating GIS and related technologies. Classroom, laboratory and field are linked through GIS and the Global Positioning System (GPS) to campus, county, state, national and global datasets.

In the three core courses (Physical Geography, Ecological Principles and Environmental Issues) students will utilize GIS and GPS to ask and answer increasingly complex questions as they progress. Physical Geography labs will begin with exercises on map scale and projection and progress through basic data collection, analysis and interpretation, using a variety of settings on Stockton's campus. Students in Ecological Principles lab will carry out parts of ongoing studies of vegetation development, nutrient cycling, population dynamics and energy flow in the same study areas.

In the Issues lab, groups of students will design and conduct their own study, utilizing the techniques previously learned. In this project, study of fundamental scientific concepts will be integrated with study of management, decision making, and ethics in a technically sophisticated framework. The project will demonstrate how GIS can enhance problem solving, critical thinking and communication skills.

Advanced Environmental Studies students are involved in developing the new modules and as mentors in the core courses, teaching students how to use the field equipment and software.

Course modules will be disseminated via world wide web as they are developed. There are plans to produce sets of interactive courseware and manuals that other programs can use.

William J. Cromartie
Richard Stockton College
Pomona, NJ 08240

GIS Practicals: Case-work as a symbiosis between GIS technology, GIS theory and subject knowledge

Marien de Bakker
Van Hall Institute, The Netherlands

Different types of GIS computer practicals can be distinguished. Demonstration software and tutorials are examples of computer lab work and most important as a method to show the possibilities of GIS in real life is the GIS case.

A GIS case-study is defined as real life problem studied with the help of a GIS, although many aspects of the problem may be simplified by the lecturer. It should give the students insight what GIS could do as a tool to answer certain (spatial) questions related to real life. But a case integrates also a increase of subject knowledge and GIS theory. Case-work will need in general more than 20 student hours. Some examples of cases (land-evaluation, soil pollution, nature-management, wildlife-management, environmental planning) used in a institute for Higher Education (in agriculture, environmental sciences and animal management) in the Netherlands are discussed.

The difficulties in developing cases (e.g. which materials); the educational aims (e.g. training in GIS software, mixture of GIS theory and practical work, the amount of theory of the chosen subject) and during the execution of the case for lecturers, students and lab-assistants (e.g. how to coach, the marking of the reports) are given.

Drs. Marien de Bakker, Lecturer
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The Netherlands

Introducing Model-Building Into A G.I.S. Curriculum

Douglas J. Wheeler
U.S. Geological Survey and George Mason University

Scientists often develop models in an attempt to emulate nature by manipulating a specific set of variables. Geographic information systems (GIS) provide the means to integrate and analyze spatially-referenced variables in models. Modeling techniques do not have to be complex to be useful. The basic components of models (i.e., elements, function, explanation, prediction) may be applied to building and testing hypotheses in any type of scientific inquiry model. Theoretical and methodological models do not require the assigning of numerical values to elements nor extensive formulae to obtain results, although these conceptual models can not be evaluated statistically. Types of mathematical models used with GIS include binary, weighting, and quantitative models, using nominal, ordinal, and interval/ratio forms of data, respectively. Each type of model has its benefits and drawbacks. GIS provides the ideal tool for learning and applying modeling techniques.

Paper presentation -- need OH projector

Douglas J. Wheeler
U.S. Geological Survey and George Mason University
521 National Center, Reston, VA 22092

GISHE `96
Session Discussion Summaries

F1.1 GIS as an integrator in higher education

In what ways is GIS more than a technical subject?

1. by its very nature, GIS offers potential for promoting interdisciplinary linkages and for improving education in many subfields of individual disciplines. It can be particularly effective in developing problem-solving and crucial reasoning skills in a wide range of fields and in communicating research findings.
2. This potential can be realized through a number of strategies. The use of GIS -based case studies and lab problems are a popular way of carrying GIS concepts into a broader range of courses. But there are many other ways to weave GIS fundamentals into a wide range of courses in many different disciplines. It is even possible o run GIS courses in parallel with topical offerings to stress basic linkages.
3. All of these ideas do hinge on having well-trained and willing colleagues, and getting GIS basics into the hands of faculty collaborators can be a difficult challenge. A step-by-step approach using workshops, classes, and the like was suggested as a means of helping other faculty participate.

F1.3 GIS in the community colleges

How is the situation in the community colleges different from that in other higher education institutions?

1. CCs have a dual role - employment/technology and transfer
2. largest difference is being employment driven; most programs are judged by how employable the graduates are.
    - programs need to do employment surveys, needs assessments to prove demand for graduates, in order to justify programs
    - need to maintain industry contacts, usually through advisory boards, which are usually mandatory
    - emphasis on training in use of the technology and software
    - need to be software specific to meet local market needs
3. variety of students
    - four year schools generally get most students direct from high school, with similar education needs, i.e. a degree
    - CCs get older students with a variety of experience, education level, and a variety of educational needs

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F2.1 Approaches to teaching GIS

What methodologies can be used to improve GIS education?

- there is a variety of methods that can be used. Particular emphasis should be on project based teaching, including field work, to maintain contact with reality
- internships should be employed to improve contact with "real" issues
- consider teaching fundamentals without GIS - using pen and paper to emulate GIS operations manually (e.g. digitizing), map use, even physical devices to illustrate operations
- do not neglect opportunities to help students learn from their errors
- pay attention to the types of choice we make in course design and their influence on student experiences
- involve students with others in their GIS experiences -- group work, Internet "penpals" and so on
- evaluate your work: "listen to the learner"
- Notes:
    - is there anything here which is unique to GIS?
    - what is improvement, can we/need we measure it?

F2.2 GIS degree and certificate programs

What opportunities exist for the development of similar programs elsewhere?

Issues

1. what level for the program/degree?
2. background needs
3. what the courses/curriculum is to include
4. where the program is to be housed - what umbrella
5. Diversity of program types possible, e.g. degree, diploma, certificate, nontraditional
6. need for outreach, e.g. through extension activities
7. allocation of money
8. politics of support

Limitations

1. prerequisites, e.g. credit hours required in other courses
2. skills of personnel
3. awareness of value of GIS lacking
4. amount of information available for practical use

F3.1 Campus-wide coordination

How can these examples serve as models for other coordination efforts?

Issues

1. value of extended infrastructure in a) academic departments, b) availability of technology
2. vital role of the library as a focal point
3. show need through cultivation of external support
4. variety of development model forms - degree, certificate, modules, etc.
5. need for problem solving approach to integrate interests
6. advantages and disadvantages to interdisciplinary model - politics and funding

Barriers

1. differing views, goals, criteria, applications

F3.2 GIS capacity building in developing countries

How can the international higher education community help to build a workforce knowledgeable about GIS in developing countries?

1. 1. in a sense, all countries are developing countries with GIS
2. 2. GIS is an important tool for development

Therefore, for any group to assist another group in a different country there must be:

1. a genuine interest in the people and problems of the other country (often there is a lack of awareness of the different realities)
2. an understanding of the local context, recognition of national priorities (cannot project education/technology without appreciation of circumstance)
3. it must a b win/win situation. Both groups must benefit from the relationship.

Things which can help:

1. easier, cheaper access to information about GIS education, software and data
2. support for local (grassroots) networks. Networks can be defined for different regions, interest groups. Institutions may want to provide support for these networks and nodes.
3. two-way (n-way) sharing of resources, including people - students and faculty: a genuine alliance.

S1.1 Professional education I

What is to be gained from international collaboration?

What can be learned from international comparisons?

How do we facilitate both? -- can we use the EU example?

- need for care. We (US and EU) differ in
  - distance and size/volume
  - educational system and funding
  - status and character of geography
  - differing social and physical environment
  - `random' factors: role of individuals, vendor location, policy, etc.
- needs partnership, network

What is the role of WWW? Do educational resources "travel"?

How do we encourage international collaboration?

- needs motivations, money and sustainability

S2.1 Professional education II

How can the availability and quality of GIS professional education opportunities be improved?

1. formalizing links between professional organizations and universities/colleges to provide/specify training
2. survey job ads/employers to identify user needs
3. provide `reasonable expectation of performance' advice to new employers of GIS staff, link with `1' above
4. uncertainty about the stability of the `industry' and mixed views about the provision of industry structure
5. certification of training and education

S2.2 GIS laboratory facilities

What important lessons learned should be shared with the GIS education community?

1. strong administrative/faculty support
2. design lab to meet purpose
3. clear management policies well enforced
4. adequate funding for maintenance and upgrades
5. adequate staffing
6. be flexible
7. resource management
8. other media to extend capability

S3.2 Using GIS as a learning tool

What resources are needed to encourage the use of GIS across the curriculum as a learning tool?

1. availability of materials
2. applicability of materials
3. key to source materials needed
4. provide venue(s) for cooperation
5. personnel and leadership
6. channel uni-community
7. problem solving focus to foster cross disciplinary efforts
8. access to appropriate data
9. making use of third party sources
10. develop outlet medium for information to generate interest
11. affordability issues?

Status of GIS Education in China

Zong-Guo Xia
University of Massachusetts at Boston

China is the most populous country in the world and is experiencing most radical political and economic changes. Geographic information technologies play an important role in urban and regional planning, resource monitoring and allocation, and environmental management. The development and operational use of remote sensing and geographic information systems are rated as one of the top fifteen priorities in science and technology for the entire country between 1996 and 2000. The educational institutions have made tremendous progress during the last ten years in developing educational programs to meet the country's needs of researchers and practitioners of geographic information science and technologies.

This paper presents an overview of GIS education in China. The questions to be answered are (1) which institutions are providing GIS education? (2) what disciplines are involved? (3) what is being taught at different institutions and for students at different levels? and (4) what resources are available for GIS education? It will also describe the national coordination efforts and research priorities. Similarities and differences between China and western countries will be highlighted.

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A Model GIS Laboratory for Higher Education in a Developing Country: The example of the GIS lab, University of Ibadan, Nigeria

Sylvester Abumere, Olusegun Areola and Bola Ayeni
University of Ibadan, NIGERIA

A major problem facing the development of GIS in higher education in developing countries of tropical Africa is the lack of foreign exchange to purchase the necessary hardware and software. Yet another problem is that of equipment maintenance and the purchase of necessary spare parts and consumables once the systems are set up. The GIS Laboratory at the Department of Geography, University of Ibadan, Nigeria provides a model of how these problems can be overcome through well-articulated bilateral agreements and relationships between institutions in developing countries and those in developed countries. The laboratory has been set up and supported thus far through the Universities Development Linkages Program(UDLP) funded by the United States Agency for International Development(US AID). This Program(now discontinued since de-certification of Nigerian government by the USA) links four higher institutions in the state of Iowa, USA with four institutions based in southwestern Nigeria. The Iowa institutions comprise the University of Iowa, Iowa State University, University of Northern Iowa, and Des Moines Area Community College. The Nigerian institutions comprise the University of Ibadan, the Obafemi Awolowo University, Ile-Ife, the Nigerian Institute of Social and Economic Research and the Ibadan Polytechnic.

The establishment of the GIS Laboratory began with two full years of capacity building involving (1) awareness and training seminars locally to identify research priorities in the areas of spatial decision support systems and environmental monitoring and management and establish a need for GIS technology as a decision-making tool in a problem-solving environment; (2) training and refresher courses for local staff both locally and in the participating institutions in Iowa on hardware and software with a view to drawing up realistic configurations of both hardware and software and peripherals for the proposed GIS Laboratory - local staff had the opportunity to practise with various types of software and got briefings on the capabilities of individual systems and software; (3) the provision and adequate furnishing of laboratory space locally; followed by (4) actual purchase and installation of equipment. The choice of software is aimed at establishing a system that allows the integration of various software for both vector and raster data with import/export capability. This gives a full GIS capacity. The major installed software in this integrated system include ATLAS GIS, ArcCAD/AUTOCAD, IDRISI and ALEXANDER. Other software include MAPINFO, TRANSCAD, MAPTITUDE and ArcView.

The potential for research is enhanced by the continuing cooperation of the eight institutions and the wide spectrum of research interests they represent. In order to ensure effective utilization of the facilities, the laboratory has embarked on the training of post-graduate

students most of whom are drawn from government agencies and corresponding institutions in the private sector. In an environment where awareness is still rather low this is considered important to the adoption and development of GIS in both government and non-governmental agencies in Nigeria.

Professor Olusegun Areola
GIS Laboratory Co-ordinator
Department of Geography
University of Ibadan
Ibadan, Nigeria

National Training Priorities in GIS - an Australian perspective

Pramod Sharma
University of Queensland, Australia

In July the Australian Key Centre in Land Information Studies (AKCLIS) sponsored a workshop in Sydney to review two recently completed reports compiled by the Australia and New Zealand Land Information Council (ANZLIC) entitled "Land Information Management Training Need Analysis - National Report" and a "Compendium of Land and Geographic Information Systems Research and Development Projects 1995". The latter report identified areas where research was required or considered to be desirable.

The participants at the workshop - from Australian universities with major GIS programs and the national research organisation, CSIRO - evaluated these reports in terms of their current and proposed programs and in terms of the national GIS related needs generally. These deliberations will be presented in a forthcoming publication.

This paper presents a summary overview of those discussions.

Presentation format:
It will be presented as a paper presentation. Materials will be prepared in PowerPoint and presented either as 35mm slide or colour overhead transparencies.

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COORDINATED DEVELOPMENT IN GIS EDUCATION AND TRAINING IN INSTITUTIONS OF HIGHER LEARNING IN SOUTHERN AFRICA

Musisi Nkambwe
University of Botswana, Botswana

The development of GIS in most of the countries in the Southern African Development Community (SADC) has been mainly ad-hoc, with training tied to specific projects in various ministries. Institutions of higher learning had no capacity to promote the development of GIS except in the Republic of South Africa. Consequently, the rate at which capacity to use GIS is developing has been very slow in the SADC region. A new program, the SADC Environmental Training and Education Sub-program, (SETES) has been designed to promote the development of curriculla in GIS training and education in these institutions. Eight universities and a training institute have formed a network to develop a coordinated GIS education and training program under the Environment and Land Management Sector of SADC (SADC/ELMS), concentrating specifically on environment related issues and problems of sustainable development. Each of the institutions in the network is a node specialising in one aspect of research, education and training, in the field in which it may contribute uniquely to the whole network. The program will run over a five year period at the end of which each of the institutions participating in it is expected to provide leadership in GIS education and training.

Presentation format:
an overhead projector and a slide projector

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Community Colleges: Mainstreaming GIS into the Community

Robert Welch, Lansing Community College, MI

The community college can be a valuable provider of GIS services and initiator and facilitator of GIS projects with local businesses, industry and government. Lansing Community College in Lansing, Michigan offers a two-year associates of science degree in GIS entitled Geographic Resource and Environmental Technology. The program also offers a certificate for professionals seeking an understanding of principles and hands-on computer experience. A partnership program has been established to provide assistance to local governmental planning offices and park and recreation departments. The City of Lansing, Michigan and Livingston County, Michigan are two such examples. A community outreach program working with local high schools provides GIS training for teachers and makes software and curriculum modules available for their classes. The development of seminars and a series of "GIS Days" provides current information and featured speakers on GIS and GPS for business and industry. A GPS receiving station and computer training facilities round out the offerings for state and local agencies. The development of a local users group provides additional resources for those looking to further understand GIS and its applications. The community college can be a resource center as well as provide quality education and training.

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Some Tips for Implementing a GIS Program in a Community College

Patricia A. Cunniff and William Lauffer
Prince George's Community College, Largo, MD

Prince George's Community College is the lead institution in a coalition of 12 community colleges which are developing faculty expertise and curriculum materials in remote sensing, image processing, and geographic information systems under National Science Foundation funding. Through this effort, PGCC has developed a GIS laboratory and two GIS courses to date. This paper will describe the process of acquiring and linking appropriate hardware, developing curriculum, finding qualified faculty, assigning course numbers, marketing the courses, and linking with the local GIS community.

The talk will also include a discussion of the GIS efforts underway in the other 11 coalition institutions.

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The MS NASA Community College Initiative

Lisa Stone
The University of Mississippi

The Mississippi NASA Community College Initiative (CCI) is a national pilot project for community college faculty training, curriculum enrichment, and other NASA-related activities focused on linking community colleges with resources available at NASA and elsewhere -- for example, within the earth system science initiative. The primary means of integrating GIS/RS/Earth Observation into community college curriculum will be provided through a World Wide Web "Virtual Campus" (http://nasacci.cs.olemiss.edu). The WWW site will serve as a central location that contains Earth Observation data, GIS/remote sensing data, and other NASA data sets as well as on-line laboratories that provide relevant activities to accompany these data sets. Additionally, an on-line Earth Observation Center is being implemented on the "virtual campus". In addition to the WWW site, other NASA materials such as posters, videotapes, and slides including GIS/remote sensing material will be distributed to the community colleges. The goal is to use the Internet and other support materials to enrich existing science community college courses and enhance what community college instructors are already doing rather than adding to their already full schedules.

Lisa Stone
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Expanding GIS Education through Methodology: The Case of a User Oriented Operations Taxonmy

Micha Pazner
The University of Western Ontario, London, Canada

This paper presents the rationale for a use or application-oriented, rather than a functional or a structural grouping of the spatial image processing operations found in grid-based geographic information systems (GIS). These operations process remote sensing, cartographic, and field data organized in pixel, image, and image stack form. Sixteen common types of spatial image processing operations are organized in four groups, using a combined simplicity-and-usefulness criteria. The proposed grouping is first and foremost a teaching methodology which can also be regarded as a classification or taxonomy of spatial image processing operations. Following a brief background, the paper presents and explains the applied taxonomy. The paper ends with a discussion of implications and applications of the applied organizational framework for spatial image processing operations. Insights were acquired by teaching students using an earlier prototype of the proposed grouping. It is concluded that the manner by which operations are organized into groups profoundly affects their learning and use.

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GIS Curriculum Design: An International Perspective

Zong-Guo Xia
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GIS stands for Geographic Information Science which includes cartography, mapping, photogrammetry, remote sensing, geographic information systems, and surveying.

This paper presents the results of an extensive study of worldwide GIS curricula for the purpose of developing a relatively comprehensive and realistic GIS curriculum at the University of Massachusetts - Boston. It will compare the GIS curricula of some better known programs in Australia, Canada, China, the United Kingdom, and the United States. The differences in curriculum design between traditional disciplines will be also discussed. A list of URLs of programs with comprehensive GIS curricula will be presented. An "ideal" GIS curriculum will be proposed on the basis of course offerings in different countries and disciplines. Factors affecting the curriculum design for a particular program will be discussed. Some guidelines for the GIS curriculum design and the development of a specialized GIS laboratory will be provided.

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TEACHING GIS AS AN UNDERGRADUATE MAJOR SUBJECT

Mark Gahegan and Bert Veenendaal
Curtin University, Australia

Curtin University has been offering a full undergraduate degree in GIS since 1992 and diploma since 1988. Rather than offering a minor in GIS, to support a major in geography or surveying, we offer a major in GIS, with the options for students to study a minor in a related discipline, including geology, geophysics, urban planning, environmental biology, etc.. This offers some distinct advantages- graduates have enough in-depth knowledge to work as developers of computational tools for the geosciences. It also raises some challenges; firstly with respect to the teaching of the underlying geographic principles and secondly with respect to student awareness. Whilst our graduates are in very high demand (each student can currently chose from two or three jobs) we still face a problem with recruitment, in that few school leavers (and school careers advisers) have any idea what GIS is. Consequently, we have set up a 'roadshow' and are keen to be associated with any education initiatives in this area.

An overview of the currently offered course is presented, along with a detailed discussion of the rationale and some of the problems that have been overcome on the way.

Presentation format:
For paper presentation or possibly for panel discussion. Need overhead projector and a slide projector.

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THE GIS CERTIFICATE: A NEED FOR AN INTERDISCIPLINARY APPROACH TO GIS EDUCATION

William E. Huxhold
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There are two categories of students who desire an education in geographic information systems: those who plan to use it in their chosen profession, and those who plan to enter a career as a "GIS Professional". For the first group, there are over 800 university departments internationally who offer, plan to offer, or are believed to offer at least one course in GIS (Morgan, Fleury, and Becker, 1996). For the second group, few academic institutions offer a concentrated emphasis in the technology that can prepare the student for a GIS career; and of those who do, formal recognition in the form of a degree or certificate is rare. This paper argues that most universities currently offering GIS courses also offer related courses in other departments that can provide the student with basic concepts and skills needed to complement GIS coursework for the preparation of a "GIS Professional" to enter the workforce. It calls for a comprehensive survey of agencies who hire GIS professionals (modelled after Wikle, 1994) to determine which subject areas besides GIS students should be educated about. Comparing these results to what the university currently offers across its disciplines can provide a recipe that forms the basis of a concentrated program for GIS students. The example of the GIS Certificate Program at the University of Wisconsin-Milwaukee provides a point of discussion for the issue.

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Changing times can lead to a bright future: The BS in Geographic Information Science at Texas A&M University-Corpus Christi

Joseph C. Loon and Gary A. Jeffress
Dept. of Computing and Mathematical Sciences
Texas A&M University-Corpus Christi

The BS in Geographic Information Science at Texas A&M University-Corpus Christi is unique in the country:

- it is a four year program given in a department of Computing and Mathematical Sciences;
- it offers two emphases - geomatics and geographical information systems; and
- it is intimately linked with a campus research institute.

The rationale for establishing the program is described and details of the course structure are given.

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GIS Activities through the Northwest Center for Sustaninable Resources (NCSR)

The NCSR is a coalition of 5 Community Colleges in the Northwest with an interest in improving in natural resources. This group recieved a 3 year NSF-ATE grant to improve education in th areas of Agriculture, Wildlife, Fisheries, and Forest Management. A key component of this grant is developing GIS curriculum that can be used throughout all the other programs.

GIS for the Masses: NCSU's Approach to Providing Campuswide Access to GIS

Hugh A. Devine, Carolyn Argentati, William Branch and Hal Meeks
North Carolina State University

North Carolina State University has embarked on a program to bring GIS functionality to every desktop in the University. Three university administrative units have joined forces to provide hardware, software, and data access to each of the over 4,000 campus computer workstations. The NCSU Computing Center provides the workstations and the computing infrastructure. The NCSU College of Forest Resources supplies the campus software support and teaches introduction to desktop mapping and GIS courses. The NCSU Libraries maintain an extensive collection of online spatial data and provide walk-in and short course support. This paper describes each of the functions identified above and details the first year of program experience. Of particular note is the development of World Wide Web-based help and training for the ArcView software package that provides the base for the campus delivery system.

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ORGANIZATION OF GIS AT THE UNIVERSITY OF FLORIDA

Scot E. Smith
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University of Florida

The University of Florida (UF) utilizes GIS extensively for both teaching and in research. There are over 15 courses at the undergraduate and graduate level that focus on GIS and many more that use the technology. Each year, several hundred students are trained in Arc/Info, Intergraph, IDRISI and other GIS software packages. There are also many courses in database design, geodesy, remote sensing, forest mensuration, planning, geography and zoology that utilize GIS as a tool.

UF is one of the largest research universities in the United States and currently runs a number of sponsored research projects that either study GIS or apply the technology. GIS is clearly a growth area in terms of sponsored research and teaching on the UF campus.

Organizing this large amount of activity has not been a easy task. GIS crosses several colleges (Engineering, Architecture, Liberal Arts, and Agriculture) and departments (Civil Engineering, Environmental Engineering, Computer Science, Electrical Engineering, Urban and Regional Planning, Landscape Architecture, Geology, Geography, Forestry, Botany, Wildlife, Soil Science, Food and Resource Economics, Entomology and others). Coordination was required with respect to software licensing agreements, data sharing, conferences, new course coordination, cross-listing of courses, etc. This effort has gone on since 1989 and is very active today.

This presentation will outline the methods developed at the UF to deal with effective treatment of GIS.

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A GIS CURRICULUM FOR COMMUNITY-BASED TECHNOLOGY TRANSFER AND PROBLEM SOLVING

Yichun Xie
Eastern Michigan University

Geographic Information Systems is becoming a major management tool in both the public and private sectors. This creates a great untapped market for university GIS education. However, as GIS is an emerging technology and the university curriculum responds slowly, there is an increasing pressure upon university GIS educators. Eastern Michigan University (EMU), in response to this challenge has developed a GIS program marked by a multi-institutional curriculum, an interdisciplinary research team, and a community-based consortium for technology transfer and problem-solving.

EMU, in coordination with Henry Ford Community College and Detroit Case Tech High School is developing a joint GIS curriculum facilitating students of various career expectations to develop GIS knowledge and skills to meet their needs. EMU has set up a campus-wide GIS user-group and steering committee, consisting of faculty and staff of broad interests from College of Arts & Sciences, Institute for Community and Regional Development, College of Learning and Technology, and Business School. EMU has also played a central role of organizing a GIS Consortium in South East Michigan. EMU regularly sends its faculty under the Inter- Government Personnel Act to the US Army Corps of Engineers and USEPA to foster GIS technology transfer, and brings back practical skills to classrooms. EMU invites specialists from leading GIS industries as adjunct professors, provides consulting and training services, and places an increasing number of interns and graduates to local governments, agencies, and industries.

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Educating the Masses: Teaching GIS at an African University

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There is a general lack of GIS courses at South African universities, and more so in institutions located in the previously disadvantaged rural areas of the country. The need for GIS training at a tertiary institution is self-evident. The Geography department of the University of the North (UNIN) currently presents an introductory course in GIS to post-graduate students. Within the historical context of the university this presents several problems to prospective GIS educators. Lack of facilities, large student numbers and lack of computer experience by both students and lecturers are just some of the difficulties faced by GIS lecturers. This paper examines these problems and try to present solutions applicable not only to UNINUs situation but also to tertiary institutions in other developing countries which are experiencing similar problems.

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EDUCATIONAL REQUIREMENTS FOR GIS IN DEVELOPING COUNTRIES

Paul van Helden
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GIS has reached most large urban areas in South Africa and it is evident that the industry standard technology (hardware and software) is readily available for this purpose. The level of GIS diffusion however varies substantially from place to place. In a number of cases the GIS is operational but in others cases the GIS has come to a complete standstill. The supply side is therefore no problem and the know-how is available to introduce GIS into an organisation. It seems that the problem in SA is not to get a GIS going, but to keep it going effectively and efficiently. Even in those places where the GIS is operational, the use is very limited and can be categorised as automated mapping and facility management, with hardly any GIS analysis taking place. Many problems exist, but basically all boils down to a shortage of sufficiently trained personnel. An educational programme has been developed to alleviate the problem in a developing country. This education programme as well as the unique problems of GIS in a developing country, will be the theme for the proposed paper.

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Pretoria
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GIS in the Baltic Region

Karlis Kalviskis

GIS laboratory,
University of Latvia

Abstract

GIS in the Baltic began to expand in use only after independence in 1991. Only a few GIS laboratories were established during the Soviet occupation. After 1991, many new university laboratories, as well as some private firms that dealt with GIS topics, were established. Most of them were involved in international projects that covered the Baltic Sea region. The demand for GIS products and specialists in business is growing day by day. There is still much work required for higher educational establishments in GIS in the respective countries.

This paper is mostly focused on GIS development and teaching in Latvia. Some of the most significant international projects that deal with GIS and higher education are covered as well.

Introduction

I will provide a brief overview of GIS education in universities in the three Baltic countries. All three Baltic countries have a very common history, problems and development. As a representative from Latvia, I will talk more about Latvia rather than Estonia and Lithuania. All three countries regained their independence in 1991, ending the Soviet occupation. Only a few GIS laboratories were established in the Soviet era. In Estonia, there existed rather old GIS traditions in the *University of Tartu*, which began in 1969 as a course on mathematical methods in geography. In 1983, the *University of Tartu* held the first workshop in the USSR that was directly focused on GIS [Roosaare J., 1994].

GIS during soviet occupation

At the end of 1970's to the beginning of the 1980's, various ecology and nature protection projects, at a country level, involved complex investigations called "Nature Protection Integrated Schemes". This was a type of GIS without computers. Many members of the

university academic staff were involved in these projects. The theses of many students were used as a resource of data. These schemes were hampered by the Soviet Russian Army security restrictions. The paper base-maps for the republics were in a 1:400 000 scale. The actual accuracy of these maps was less than 2 km. White spots in the data coverages indicated the presence of Russian army bases.

During the Soviet time, it was impossible to work seriously in the GIS field due, to the following:

Lack of maps for civil needs. Any map was an object of security. Only the military had access to maps. Any coordinates were taboo;

Shortage of computers. I suppose the situation of computing technique in universities in the 1980's was similar to the USA, but in 1960's. Even photocopiers were under the control of the *KGB*;

Data security and distortion. As maps, data was the subject of security as well. One of the theses of the Nazi's - lies have to be so great that everybody accepts them as a true - was carried out in the field in collecting data.

First steps in GIS after the occupation

Let's hope that all this is only history now. The development of GIS in the Baltic countries was closely connected with the development of independence in these counties. At the end of the 1980's the first attempts to change the situation were made. The first work was to establish a coordinate system. In Latvia, the leading role in GIS was by the *Department of Geodesy, Riga Technical University* and the *Laboratory of Astronomy, University of Latvia*. At 1990, a substructure under *Laboratory of Astronomy* was created called the *laboratory of Satellite Geodesy and Geo-Information*. Besides the work at establishing coordinates, the digitising of maps in a 1:200 000 scale began. Students were involved in this work as well. For manipulation of digital data, original software was created. At present, this has a grown up into useful product for schools and home use.

After 1991, many new university laboratories and some private firms that dealt with GIS topics, were established. Most of them were involved in international projects that covered the Baltic Sea region. Useful courses in the field of GIS were organised by different organisations.

International GIS courses

Already in October, 1990, the *United Nations Environmental Programme*/*Global Resource Information Database* (*UNEP*/*GRID*) and the *United Nations Institute for Training and Research* (*UNITAR*) organised a seminar devoted to problems of natural resource management and processing of satellite images. The seminar took place in Druskininkai, Lithuania. Later, on August, 1993, similar courses were organised in Arendal, Norway.

In September of 1991, in Slovakia (at that time it was Czechoslovakia) at Vychodna, a summer school on GIS was organised by the *University of Salford* (Great Britain) and the *Czech Institute for Nature Conservation*. Members from Eastern-European countries were invited to these one week courses. The basics of GIS and practical experience in work with IDRISI and SPANS, were given. At the end of these courses, participants received as a donation an IDRISI licence. This was starting point for GIS in *Department of Botany and Ecology, University of Latvia*. This department has an old tradition of teaching Biometry.

During the semesters of 1991/1992 and 1992/1993 GIS, served only as an addition to student theses. Several students from the *faculties of Biology* and *Geography, University of Latvia*, used IDRISI to analyse their data. For example, the examination of the distribution of heavy metals. IDRISI is/was heavily used in the *Institute of Geography, University of Tartu*, Estonia. Interesting work was done in the territorial processing of meteorological data [Jaagus J, 1994]. Already in 1990, a course "Basics of Geoinformatics" was introduced in the *University of Tartu* [Roosaare J., 1994].

There was also long-running courses like the one year (1992/1993) course in Environmental Management (Leiden, Netherlands), organised by the *University of Amsterdam*, the *Free University of Amsterdam*, the *State University of Leiden* and the *Agricultural University of Wageningen*. The course ended with an interdisciplinary research project using GIS. The project was mostly for learning and understanding methods, rather than producing a strategy to solve the problem.

One of the contributions in GIS in Higher Education in the Baltic Countries was made by *the Baltic University Programme*, co-ordinated by the *University of Uppsala*, Sweden. All it starts with idea to start a project "The Environmental Atlas of the Baltic" at the end of 1992. One of the initiators was *Vytautas Magnus University*, Lithuania. To be honest, such an atlas has not be created up to now. This is not surprising - the by-product was placed as a goal. On the other hand, it was a good starting point for another project - the *Baltic University GIS (BUGIS) project*. The goals of this project were (as declared by *BUGIS* co-ordinator Ulf Erlingsson):

- to construct an environmental (in broad sense) GIS over the Baltic Sea drainage area, to be used in research and education. It is to be constructed largely by students for students, and it is to be available as an open data set for research and GIS education at universities in the area;
- to develop, at the university-teacher level, a hands on experience of the problems and pitfalls related with creating and using a full-scale GIS. This experience is essential for GIS teacher, and it is to be achieved by working with this international, and interdisciplinary, GIS.

The first practical step was made on May, 1992, when four people (one from Latvia, one from Lithuania, two from Russia) were invited to attend GIS courses in Uppsala. Several courses followed during the next years. The *Baltic University* was one of the initiators of establishing the *GIS laboratory*, *University of Latvia*, in September of 1992. This laboratory is a natural branch of the *Department of Botany and Ecology*.

One year later, in five universities (Kaunas, Lithuania; Riga, Latvia; St Petersburg, Russia; Tartu, Estonia; Uppsala, Sweden), appropriate hardware was placed (one Macintosh Centris 650 with digitiser tablet). The hardware included a MapGrafix licence. This served as a push for starting GIS related courses in the *GIS laboratory, University of Latvia* and *Department of Environmental Engineering GIS laboratory, Kaunas University of Technology*.

The next stage of *BUGIS* development was the *University GIS (UGIS) Network*. The *UGIS Network* has a more general scope than the *BUGIS Project*. Even more,- *BUGIS* can be considered as one of the projects carried with the help of the *UGIS Network*. In 1994, new contacts were established with England, Ireland, Spain, Greece and Egypt. At present, *UGIS Network* has separated from the *Baltic University Programme*.

GIS teaching in Latvia

Now I wish to return to GIS development in higher education in Latvia. As I have mentioned, the first course related to GIS was given in 1993/1994. This and the next year courses were given to bachelor students from the *Faculty of Geography*.

Starting from 1994/1995, GIS courses were given in the *Department of Geodesy, Riga Technical University*. As base software, Microstation, Geographer and Oracle are used. The courses are given to Bachelor and Masters students. The main field of interest for the participants of these courses are land cadastral systems. These courses were attended also by students from an other university - *The Agricultural University of Latvia*. Now, the *Department of Geodesy* will participate in *CORINE* activities.

At the end of 1994, the *Institute of Geodesy and Geo-Information* was established on basis of *Laboratory of Satellite Geodesy and Geo-Information*. Starting from 1995/1996, this institute offered introductory courses in GIS for students at the *Faculty of Geography*. They have several PC-s with ArcView, available to students. They obtain experience with vector data, creating maps and the use of attribute data bases. Already from September 1993, members of the *Institute* are involved in a country level project - Base map development project for Latvia. This project is run by the *State Land Service* of Latvia and Swedish Space Cooperation Satellitbild.

Starting from 1995/1996, the *GIS laboratory, University of Latvia* is used as a base for teaching GIS basics to Masters students from *Faculty of Biology*. The number of students was limited, due to lack of computers. Only one Macintosh (donation from *BUGIS Project*) and one Intel compatible DX486 (donation from *SOROS Foundation*) were used. The practical work was organised as individual work. Such work can be organised using Windows NT Workstation as an operating system. The practical work is map-algebra orientated. IDRISI is used as software. Exercises begin with simple arithmetic operations with maps and ends with time series analysis and DTM. For instance, students receive data on elevation, forest cover and location of radars, all in vector format. They have to determine which forests are exposed to the radars. They have to take to account that the radars see only 180 together. As an advance exercises, *UNITAR/GRID* exercises books are used.

Starting from this year, GIS will be included in the Biometry and Spatial Information for Biologists course. Besides Spreadsheets and Data Base Management systems, students obtain knowledge in programming, statistical analyses and GIS. Thank to the *Trans-European Mobility Scheme for University Studies* (*TEMPUS*) project, a computer-class with nine 486 PCs was established. This class can be used also for GIS teaching. The only restriction for the moment is software. One solution is to check for appropriate free-ware. In the autumn semester, TNTlite will be used in the cytology course, to analyse cell spatial structure.

Several scientific projects involving GIS are taking place in the *GIS laboratory* and *Department of Botany and Ecology*. One of them is to determine the impact of the Russian Army Radar-Location Systems on organisms in the Skrunda region (Latvia). The object is interesting due its location in a valley, and due to the surprising observed effects. Another object of investigation is Lake Engure, Latvia. The main field of interest here is biodiversity changes. This lake is of great value as a birds nesting and breeding place.

Contribution to GIS teaching

One of the problems in GIS teaching is the lack of appropriate finances. Most of GIS activities are sponsored by different foundations and firms. A great impact to the quality of GIS teaching was made from *Bentley*, *Intergraph* and *ESRI* product resellers in Latvia. In another category of contributors in GIS development, the activities of the *Latvian Fund for Nature* in the field of nature protection, lead to real experience for students in creating and maintaining Geographical Information Systems.

As part of the financing problems, there is also a lack of literature. Most of the available books, journals and proceedings available in Latvia are in one copy. The situation was a bit improved in 1994, when compendium "Geographic Information Systems: Basics and Environmental Applications" by Linas Kliucininkas (lecturer from *Kaunas University of Technology*) was published.

Good support for practical GIS courses are data sets available from GRID-Arendal. The satellite imagery is very useful, since such data is missing in the university environment due to their prices.

A very good resource for update information is World Wide Web. The information covered by different web servers is of very wide range, including theoretical concepts, practical explanations, how to work with particular software, latest achievements in hardware and software and digital maps.

Literature

Jaagus, Jaak, 1994; **Territorial Processing of Meteorological Data**;/ Proceedings from GIS-Baltic Sea states '93, 29 November - 1 December, Tallinn Estonia/; Tallinn

Roosaare, Juri, 1994; **Teaching GIS at the University of Tartu - State-of-the-Art and Future Trends**;/ Proceedings from GIS-Baltic Sea states '93, 29 November - 1 December, Tallinn Estonia/; Tallinn

Session: NCGIA Core Curricula in GIS and Remote Sensing

Paper 1:

The Original NCGIA Core Curriculum in GIS

Karen Kemp, NCGIA, Santa Barbara

In 1988, the National Center for Geographic Information and Analysis (NCGIA) was established by the US National Science Foundation to conduct basic research in GIS as well as to initiate projects designed to enhance the quality of GIS education. During the 1988-89 school year, with the assistance of GIS educators in the US, Canada and the UK, the NCGIA developed a comprehensive set of lecture notes intended to identify and describe a core set of knowledge about GIS that should be taught to beginning GIS professionals. During the following year, over 100 higher education institutions around the world used the materials in their GIS courses and provided thorough evaluation of the contents and structure. Based on this detailed review, the materials were extensively revised and the final version was ready for distribution in August 1990. Now 6 years later, the Core Curriculum continues to be recognized as a landmark in the evolution of GIS education. Over 1400 copies have been distributed by the NCGIA. National distribution sites distribute additional copies in 14 other countries and it has been translated into French, Russian, Japanese, Chinese and Hungarian. This paper reviews the aims of the original Core Curriculum project, its development process and its long-term impacts on GIS education.

For more information see http://www.ncgia.ucsb.edu/pubs/core.html.

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Paper 2:

NCGIA Remote Sensing Core Curriculum

Karen Kline, Remote Sensing Research Unit, UCSB

The "Remote Sensing Core Curriculum" sponsored by NASA's Mission to Planet Earth, developed as an outgrowth of the NCGIA GIS core Curriculum and research Initiative #12 titled "Remote Sensing and Geographic Information Systems". The American Society for Photogrammetry and Remote Sensing (ASPRS) has accepted this national collegiate curriculum project as an education initiative to be administered from the association's Bethesda, Maryland offices. The project will continue to produce university-level educational materials to advance broad-based scientific understanding of the field of remote sensing. The large target audience community includes environmental engineers and scientists, resource planners and managers, and geographers in colleges and universities nationally and internationally. At a time of rapidly increasing types of sensors and satellite platforms, an urgent need exists for developing educational materials stressing the integration of remote sensing, GPS, and geographic information systems. A network of expert researchers and educators, specializing in key areas of remote sensing, are creating a series of lecture material outlines, exercises to build on theory and technique, and applications encompassing a robust set of real-world applications. All educational materials will be distributed via World-Wide Web, CD-ROM, and hardcopy formats. Internet technology enabling rapid updating of educational materials has shifted the core curriculum design to maintain timely links with the most current research advances in remote sensing technology.

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Paper 3:

The New On-Line Core Curriculum in Geographic Information Science

Karen Kemp, NCGIA, UCSB

Given the continuing demand for copies of the original 1990 NCGIA Core Curriculum in

GIS, NCGIA has decided that a major revision is warranted. While it was initially felt that widespread diffusion of the original set of lecture materials would eventually make the Curriculum redundant, it is apparent that the continued rapid development of the technology and the awakening of the concept of geographic information science continues to make such materials of value. This time, the Curriculum will be developed and distributed over the Internet. Using the World Wide Web (WWW) as the main distribution channel has many advantages, including ease of revision, ability to adjust content and structure as the project evolves, reduction of physical distribution demands and the provision of a direct means for referencing related resources on-line. In this new project, we will revive some of the most successful aspects of the original project; in particular, to encourage the full participation of the international GIS education community. However, the new Core Curriculum project will be based on a completely new outline which takes into consideration the many changes and advances during the past 6 years. Contents will evolve gradually as units are added to the web site, new topics suggested and hyperlinks between related subjects established. In order to ensure the quality of the contents, all submissions and suggested links to other web based materials will be subject to peer review and approval by an international Editorial Committee. This paper reviews some of the issues faced during the development of these new materials and some of the insights gained by developing materials in an adaptable, public, on-line environment.

For more information see http://www.ncgia.ucsb.edu/education/curricula/giscc/welcome.html.

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Paper 4:

The GIS Core Curriculum for Technical Programs

Stephen Palladino, NCGIA, UCSB

The CCTP project is directed toward the development of curriculum materials for use by instructors at two year technical colleges. Using the new On-line Core Curriculum in GIScience as a foundation, the project team will create a set of teaching materials specifically designed to help the community colleges meet the increasing need for people trained in the rapidly growing areas of employment utilizing GIS. Beginning at a week-long workshop, a working group of college instructors and education advisors will investigate the unique content and methods that are necessary for effective GIS education in the community colleges. After reviewing the content of the new Core Curriculum in GIScience, they will identify elements which are missing and develop guidelines for authors charged with the

development of new units. A panel of community college instructors will be recruited to test the resulting materials and suggested revisions will be incorporated. Once complete, the materials will be distributed via Internet and CD-ROM. This paper reviews progress on this project to date and outlines the content identified for this special audience.

For more information, see http://www.ncgia.ucsb.edu/education/curricula/cctp/cctp.html.

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NCGIA Remote Sensing Core Curriculum

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The NCGIA Remote Sensing Core Curriculum project is a logical outgrowth from NCGIA's Research Initiative 12 "Remote Sensing and Geographic Information Systems." NASA is currently sponsoring this project, which has been accepted as an American Society for Photogrammetry and Remote Sensing (ASPRS) education initiative and will be administered from their headquarters in Bethesda, Maryland. This project will continue to produce university-level educational materials to advance broad-based scientific understanding of the field of remote sensing. The target audience, instructors employing these materials, includes environmental engineers and scientists, resource planners and managers, and geographers in colleges and universities nationally and internationally. With the rapidly increasing amounts of sensors and data, there is a real need for educational materials stressing the need for integration of remote sensing, GIS and GPS. The four volumes of the remote sensing core curriculum will be distributed via the World Wide Web, CD-ROM, and hardcopy. With the rise in Internet technology, the curriculum will be updated regularly to reflect the most recent advances in remote sensing technology.

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User demonstration of GIS software: Map*Factory

Micha Pazner
The University of Western Ontario, London, Canada

Type of Session: Demo

Map*Factory is an image based mapping package. It couples mapping capabilities with a powerful suite of analytical and modeling tools. Map*Factory can be used to create and view maps, and to mark and measure distances and areas. It also lends itself to more advanced uses including thematic mapping, terrain processing, spatial modeling, and image feature classification.

The interface allows new users to master the system quickly. The powerful map coloring and layout facilities permit fast and inexpensive map publishing and production. Paper maps and images can be entered using a scanner. Files can also be downloaded from the Internet. Applications vary from recreational mapping to professional multicriteria spatial decision making.

Map*Factory software is extremely well suited for teaching computer mapping and Geographic Information Systems. The package comes with a set of instructional manuals that are also available separately for adoption as course texts.

Map*Factory was written by K. Chris Kirby

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CITYgreen

Chris Daniel
American Forests

CITYgreen is built on research produced by several major U.S universities. American Forests has worked with and supported professors and graduate students in Forestry, Wildlife, and Horticultural programs at several U.S universities to develop the formulas and cost/benefit methodologies on which the program is based. It is probably not an exaggeration to say that CITYgreen is getting a lot of research into practical use that otherwise might not see such widespread application.

For many institutions of higher education, particularly those with extension reponsibilities, CITYgreen is an extremely valuable education and outreach tool. Our intention from the start has been to make people think about their urban ecosystems differently--to understand that they have a concrete value that should be taken into acccount in planning and budget processes. Many in the higher education community have embraced this idea quickly and are starting to use CITYgreen to make the point. Universities have, in fact, purchased more copies of CITYgreen than any other group, by a wide margin.

Historically, American Forests has usually worked either with citizens, usually in educational and outreach programs, or with worked with researchers from education institutions to develop fairly technical and specific areas of knowledge in natural resources. CITYgreen has linked our work with these those two groups, making research applicable understandable and useful to the public.

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Academic GIS Education: What the Real World Needs and What the Academy Delivers

John M. Morgan, III, Towson State University and
Barbara B. Fleury, Maryland-National Capital Park and Planning Commission

One issue that continues to be discussed among educators is the extent to which training in the use of commercial software should be included in academic GIS courses. While the function of a college or University should be to "educate" students about important GIS concepts, government agencies and businesses are interested in hiring students even for entry-level positions who have been "trained" in the use of a particular software package as part of their undergraduate program. This presentation will discuss the education v. training debate. Suggestions will be made regarding the need for academia to conduct an "occupational inventory" to provide information as a basis for adjusting academic GIS courses to better meet employer needs, the need for government agencies and businesses to understand the importance of GIS concept education, and the need for community colleges to establish GIS software training courses in support of specific employer needs.

Professional Development: a missing brick in the wall?

David J. Unwin
Birkbeck College, University of London, UK

There has been considerable debate amongst GIS educators about curriculums for schools and colleges. Typically, these efforts have been content and instructor driven, specifying what should be taught under the heading of GIS, and have been intended for consumption before students enter the world of work. However, many GIS practitioners have engaged with geographic information from existing jobs in IT or a related field. The need here is for professional development, with or without some form of certification.

Over the past 18 months the (UK) Association for Geographic Information (AGI) has been developing guidelines for professional development within the geographic information industry. The model adopted is derived from a very mature and successful scheme operated by the British Computer Society which is called the 'Industry Structure Model' and takes a matrix approach. Columns of the AGI matrix represent roles within the industry such as 'data base manager', 'GIS analyst' and so on. Rows represent levels of attainment from the most junior up to board room level. Within each cell of this matrix there is a complete description of the competencies needed to operate at that level, the qualifications needed to enter and any specific training needs.

It is anticipated that the model will be used by individuals to plan career moves and negotiate training, by organisations wishing to specify workforce needs and by other institutions wishing to add a geographic information component to existing professional development schemes.

Outline of talk as presented September 7, 1996

Summary of talk

- a need and a demand
- models and cognate schemes
- defining the AGI matrix scheme
- the matrix in summary
- futures

A need : GIS and GIS educators

- content driven
- learning and doing GIS are different things
- the 'G' word and the location of GIS education

A need : Professional Development in the GI industry

- professional behaviour and ethics
- updating skills and knowledge
- no recognised professional qualification in GIS as such

A need : industrial demands

- a vocational qualification for operatives
- accreditation of individuals to practice
- validation of courses
- continuing professional development in a rapidly changing industry
- the role of the UK Association for Geographic Information (AGI)

Models & cognate schemes

- Royal Institution of Chartered Surveyors (RICS)
- Royal Town Planning Institute (RTPI)
- British Computer Society (BCS)

The British Computer Society Industry Structure Model, Version 2

- Unskilled entry
- Standard entry
- Initially trained practitioner
- Trained practitioner
- Fully skilled practitioner
- Experienced practitioner/Supervisor

defining the AGI matrix scheme : levels & streams

- skilled entry
- initially trained practitioner
- fully skilled specialist
- team leader/senior specialist
- GIS manager / consultant

defining the AGI Matrix scheme: competency `streams'

- DA Data Acquisition
- DM Data Management
- GA Geographical Analysis
- DV Data Visualisation
- DB Design and Build
- HI Human Issues

defining the AGI matrix scheme

- is there a role for an `educator' stream?
- Workshops thought not, you may think otherwise!

The complete AGI matrix

- a typical cell entry contains:
  - cell location & code
  - academic background
  - experience & skill at entry
  - tasks and attributes
  - required training and development
  - additional comment

Cell Entry for HI, Level 3

- RECOMMENDED ACADEMIC BACKGROUND
  - Preferably educated to degree level in a relevant subject. As an alternative, GCSE A level with previous technical experience in IS at BCS level 2, or conversion from within the AGI model with at least five years experience at AGI Level 2.
- EXPERIENCE AND LEVEL OF SKILL AT ENTRY
  1. Either at least five years satisfactory performance at previous level, OR a minimum of 10 years with at least 5 years experience at AGI level 2.
  2. Must have demonstrated a good working knowledge of the employing organisation's policy framework, management structures and reporting procedures
  3. Must possess an up-to-date knowledge of hardware and software in general and be familiar with all aspects of the operationaland development environment with employing organisations.

Cell entry for HI, level 3 (b)

- TASKS/ATTRIBUTES
  1. Be able to carry out gross project estimation, with respect to the geographical scope of projects.
  2. Be able to carry out gross cost/benefit analysis with respect to the geographical scope of projects.
  3. Be able to carry out software evaluation for GIS based on provided requirements.
  4. Be able to carry out evaluation of integration of GIS within the existing IT environment.
  5. A simple understanding of the role of GIS and its implications for specific enterprise and organisation.
  6. A simple assessment of confidentiality, copyright, etc... in relation to spatial data.
  7. A simple assessment of the value of spatial data and costs.
  8. A thorough understanding of and full compliance with the AGI code of practice.

- TRAINING AND DEVELOPMENT REQUIRED
  - not yet completed!
- ADDITIONAL COMMENTS
  - None

Futures

- as a possible direct input to ISM3 of BCS, to enable the definition of e geographical information sub-stream within that scheme
- as an input into any RICS work on the same theme.
- as a source of reference for AGI members which might be used in several ways, for example to identify training needs, in curriculum design, and as a personal development guide.

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Intra and interdisciplinary education in GIS: the experience of Formez GIS courses

Sandra Piscedda
Formez Lab*GIS, Naples, Italy

At the Lab*GIS of Formez education in GIS takes place based on a strong intra and interdiscplinary approach. Education in GIS is addressed to young graduates with different disciplinary backgrounds. Courses structure requires participants to work in intradisciplinary groups: in this phase the task is to provide the class with GIS outputs which will be the input for the work of the interdisciplinary groups which are subsequently formed. In this second phase a specific project is carried out which requires different competences to work together in interdisciplinary groups.

This approach in GIS education has proved to develop cooperative skills in a GIS problem solving environment in different applicative context; to widen personal and disciplinary views; to integrate the latters with other disciplines' perspectives, therefore leading to a deeper understanding of problems and more comprehensive attempt to their solution.

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Session: UrbanWorld - An Hypermap Learning Environment Based on Geographical Information Systems

Derek Thompson, David Wong, Frank Lindsay, Paul Davis et alia
The University of Maryland, College Park

Type of Session:
combination of four papers presentations and computer-based demonstration in a ninety minute session

Geographic information systems software and geographic databases are a powerful combination as an infrastructure for facilitating learning with instuctional technology. We are exploiting such a foundation in the development of a pedagogic environment for fostering student learning about urban landscapes. Over a three-year period the project participants, located at six universities, will design, build, use, and evaluate a resource of nine learning units, a knowledge-base of learning aids and selected geographic content, and a geographic-database for each of five metropolises.

Each learning unit will consist of a particular assisngment, embodying specific tasks for students to undertake. There will be associated examples of targets for students to aim at, links to on-line aids, World Wide Web resources, and other materials. The units cover topics such as What Time is this Place?, Urban Ecology, Changing Neighborhoods, and Urban Transportation.

A geographic database for each metropolis will be founded largely on the base of 1990 census demographic and housing data for blocks and block-groups. Other important themes will include land-use, land-value, zoning, vegetation, and transportation infrastructure. Among other things, the knowledge base will contain examples of visualization techniques, hints on how to construct a portfolio of accomplishments, images of generalizations and theoretical models about the internal spatial variations for urban areas, and evaluation tools for instructors.

The session will comprise short presentations by four principal project participants on some of the work accomplished during the first year of the project. Some of the material will be presented in demonstration mode.

Acknowledgement is made to the principal source of funds for the project, the FIPSE of the U.S. Department of Education. Additional support has been provided by the Environmental Systems Research Institute, Inc., the George Mason University, and the University of Maryland at College Park.

Equipment needed:
LCD projection panel and a high lumen overhead projector

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Using GIS in Secondary Education: Curriculum, Implementation and Results

Dr. Monica Ramirez
Florida Atlantic University

Responsible environmental behavior has been cited as the ultimate goal of environmental education. Existing empirical studies indicate that this goal is not being met in schools across America. Environmental educators have the responsibility to produce human beings with what is called an Renvironmental ethic.S With this in mind, Florida Atlantic University and the School District of Palm Beach County developed a GIS curriculum for grades 6-12, which was approved by the Florida State Department of Education as RGeoscience.S The curriculum was implemented during the 1994-1996 school years at Jupiter Community High School. Based on the success of this course, the GIS program has been expanded to include the middle school level, where GIS is taught as three separate courses in grades 6-8.

Why GIS? GIS technology is the tool that empowers students to solve real-life problems. GIS produces students with an environmental ethic and fosters a transformation in studentUs self-esteem and value systems. The mechanics of GIS reveal the realization that environmental problems are really science-related social problems.

RESEARCH: Research was conducted to determine how GIS instruction was a crucial factor in improving and changing studentsU attitudes in environmental education. The High School Environmental Literacy Instument (courtesy of Florida Institute of Technology), was administered to two high school groups: Jupiter High School students enrolled in the GIS course and Jupiter High School students enrolled in a regular environmental science course using the state-adopted environmental science curriculum. Preliminary results indicate that students who participated in the GIS class were more familiar with ecological issues and foundations than the environmental science group; they also demonstrated improved self-reported behavior on environmental issues, demonstrated a higher awareness in perceived environmental knowledge and action, and were able to conduct a more in-depth environmental issue analysis.

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Curricular Connections: High School Geography and Geographic Information Systems

Sarah W. Bednarz, Texas A&M University
and Gail Ludwig, University of Missouri, Columbia

The number of high school geography teachers using geograpic information systems (GIS) is increasing. These pioneers, however, represent only a fraction of the individuals teaching geography. In contrast, science teachers have adopted GIS as a teaching tool much more readily. The diffusion of GIS among high school geography teachers is hampered by a number of factors, for example, lack of teacher training, hardware and software issues, and time constraints. The more fundamental barriers to implementation of GIS in high school geography include teacher conceptions of the nature of geography, curricular goals and expectations, and a dearth of accessible materials which demonstrate ways GIS can be used to teach typical high school geography. This paper examines these issues and presents an analysis of state-mandated high school geography/social studies curriculum for links to GIS.

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THINKING SPATIALLY: Implementing Information Technologies in Secondary Education

S.J. Macklin
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Saturday morning workshops providing hands-on training for students and high school educators in Maine, are a first step in implementing information technologies in the secondary education curriculum. The University of Maine's Department of Spatial Information Science and Engineering has designed a curriculum which provides a representative picture of spatial information gathering, processing and analysis. Beginning with the information superhighway and search engines, educators and students develop necessary skills to retrieve data from the wealth of freely available satellite-generated geographic databases. Using experiential education, participants then explore cutting-edge tools in geographic information systems (GIS), global positioning systems (GPS), remote sensing and digital image processing. Program materials include public domain GIS software, a web page construction disk, and a workshop manual with exercises and extensive resources. These materials were designed for direct use by educators in implementing information technologies in their respective schools. Participant feedback was overwhelmingly positive. Numerous teachers have indicated a desire to begin development of pilot programs for their schools.

Presentation format:
using Power Point, so overheads, slides or computer is fine

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Geographical Information Systems Education at the University of Zimbabwe; Issues and Future Prospects

Daniel T. Semwayo and Patrick Matambanadzo
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Geographical information systems (GIS) are gaining prominence as a unifying force in multi-disciplinary research. Analysis of complex phenomena of a spatial nature has become so much easier with the advent of this tool. There is growing demand for personnel with GIS skills from within city councils, government planning departments and the private sector.

In response to this demand, the University of Zimbabwe has embarked on training and research programs in GIS and it's various areas of application. The target groups are graduate students from diverse disciplinary backgrounds, university departments and middle managers from government, non-governmental organizations and from the private sector.

The Surveying department has put together two graduate training programs leading to the award of a diploma and a Master of Science degree in Geographical Information Systems. The Institute of Environmental Studies is designing various programs to stimulate interest in GIS within the university departments and to educate mid-career professionals in the use of the information technology.

This paper examines the subtle issues that have to be considered to produce well rounded skilled practitioners in GIS for the good of the intended market.

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GIS Education and Awareness: a European perspective

Fred Toppen, Utrecht University
and Petra Cremers, GEON, The Netherlands

The paper deals with current efforts to promote GIS education and awareness in Europe and identifies some emerging issues. It presents some reflections on research that has been carried out concerning the role of GIS education in several European countries and it describes major activities that deal with cooperation and coordination in the field of GIS education and awareness with special attention to the role of the Education Special Interest Group.

The major focus of the Education SIG was to bring together people from both Western and Eastern Europe, to organize paper tracks and workshops, and to act as a medium for information exchange. The Education SIG was successful in bringing together people and to put GIS education on the agenda of some of the major GIS conferences organized last years. A whole lot of current contacts between people at the European level were initiated during these events and a network of GIS education specialists has been established. Some of these contacts resulted in promising joint education programmes. The Education SIG was less successful in establishing a permanent flow of information between GIS educators and it did not succeeded in promoting and organizing the exchange of GIS curricula. Some possible causes for these activities to work out less succesful are the lack of financial support and the limited number of people that are able to join European GIS conferences.

Some other European initiatives were very important in encouraging the dissemination of information on GIS. Especially EU programs on technology transfer such as COMETT and IMPACT worked out to be successful in stimulating cooperation and information exchange and played a major role in promoting GIS awareness in Eastern Europe.

For the future promising developments might be expected especially in the field of information exchange and a growing number of exchange programmes. New technologies as for example Internet should allow for easier communication and access to information. European initiatives dealing with issues like data exchange, standards, and data availability should at the end be beneficial to all who are involved in GIS education.

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Managing a GIS Teaching Laboratory - Lessons Learned in the Trenches

Susan M. Macey
Southwest Texas State University

This paper seeks to synthesize key issues that arise in the course of both the short and longterm operation of a GIS teaching laboratory. First, initial setup considerations are discussed as they impact future operations. Such considerations include decisions on establishing a single or multipurpose facility, designing for a lecture versus open laboratory layout, hidden costs, and utilizing resources to obtain the "most bang for the buck". Second, everyday operational problems are examined. These include setting policies on laboratory access, strategies for dealing with a high student/machine ratio, provisions for maintenance, staffing, hardware, software and data security. Lastly, more longterm considerations such as avenues for obtaining hardware and software upgrades, networking demands, and generally working around increasing demand with static or limited resources are addressed. Potential policies for avoiding problems at each stage are outlined.

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Design and Use of a Hybrid Multimedia Facility for Multidisciplinary GIS Education at the Upper-Division Level

Jack F. Paris
California State University, Fresno

The paper describes the design of a hybrid multimedia facility for multidisciplinary GIS education at the upper division level at California State University, Fresno. Hybrid refers to the use of computer-based multimedia coordinated with traditional multimedia.

The computer component of the system consists of 12 networked Pentium computers with 17" color monitors and adequate local resouces to support the use of professional GIS software. One unique aspect is the use of a series of analog super VGA splitters stemming from the instructor's CPU to all 12 student monitors. This allows each pair of students (24 student lab) to view up close any action on the instructor's computer. Coupled with dynamic PowerPoint presentations and live GIS software demonstration, this tool overcomes the problem of students not being able to see what the instructor is doing as is the problem with more common projection systems. Students can switch betweend the instructor's computer and the local computer with a simple A/B switch. Via the CSU Campus Data Network, each student can browse the Internet in search of GIS resources.

The traditional component is unique also. Twelve 13" color television monitors are distributed about the room (one for each pair of students again). The instructor controls audio and video feeds from VCRs, Kodak Photo CD, laser disk, campus broadband broadcasts (including distance learning), and a live local TV camera for showing opaque materials.

The furniture layout is by pair of desks. This allow easy access with a minimum of interruption. Hands-on laboratory exercises are scheduled throughout the week in the same room. Each computer has its own schedule (by the half hour). Students are required to work at their own pace seeking help first from another student, then from a teaching assistant, then from the instructor (if present), and lastly from a member of the research staff who is probably working side by side with the students. With the availability of low-cost student editions (TNTlite) of the professional software package for image processing, vector, CAD, and database processing, many students opt to do lab exerciese at home or at the office.

AV/Computer Equipment Needed: Pentium-based computer able to run MS PowerPoint for Windows 95 and TNTlite (110 MB on hard disk, 2 MB graphic card) with projected monitor output to large screen.

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"Avakeeo" : the construction kit of computerised microworlds for teaching and learning Geography

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A methodology for constructing "Geography Microworlds", together with "Avakeeo", an innovative authoring environment developed to implement this methodology, will be presented.

The reported work was motivated from the identification of the need for effective tools to support the "systematic production" of state-of-the-art Geography courseware and what's more, tools that can be creatively used by the programming-illiterate audience of students and teachers. The developed Microworlds should address important issues of spatio-temporal and geographical reasoning such as geographic-scale, navigation, map manipulation and multiple representation of the relative concepts, as well as pedagogical requirements such as exploratory learning, and collaborative, project-based work.

We adopt a "component-oriented" approach: the end-user is provided with a "kit" of high-level, geography-specific reusable software components each with predefined behavior (active-maps, a globe, multimedia books, clocks, compasses, calculators, etc) together with a mechanism that allows the assembly of any number of them into functional Microworlds.

Today "Avakeeo" providing a small number of prefabricated components and a visual Microworld editor, can be effectively utilized to create simple (but interesting) scenarios around the concept of "travel, explore and discover": children manipulate "rabbits" that travel on maps under strict spatial commanding and are able to report the map-features of their position, which in turn can be fed to other components for further analysis.

In its final version Avakeeo will provide most of the functionality typically found in a GIS through tight cooperation of map and data-base components. However, it should not be viewed just as a GIS for children, but rather as a learning environment for the study of Geography in its broad sense. Teachers and/or students can very easily setup new experiment scenarios or alter existing ones, according to their own pedagogical practices, by interactively manipulating the component's interconnections. Finally, Avakeeo's architecture allows the construction of cross-subject scenarios through suitable subject-specific components: geography based geometry (Logo-geometry components have already been developed), mathematics and history are examples of what could follow.

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The MERLIN System

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The MERLIN System is an electronic atlas designed by the Maryland Department of Natural Resources to be an on-line "library" of various maps (base and thematic), data, indexes, photographs, and other geographic information that is used within the department on a daily basis. MERLIN is a collection of logically related objects that are linked spatially in a series of levels. Unlike most computer systems, MERLIN can relate and display virtually any type of data from spreadsheets, databases, maps, photographs, scanned documents, and text documents. The MERLIN System, which is being made available on CD-ROM, uses either the TNTatlas or TNTlite software (MicroImages), and requires a minimum of a 25 MHz 486DX processor, 8 Mb RAM, SVGA color display board and Windows to operate. Copies of the MERLIN CD-ROM are being provided to elementary and secondary schools in Maryland, along with a tutorial for classroom use.

DISTANCE LEARNING ON GIS, FACTS, CONSIDERATIONS AND QUESTIONS

Petra Cremers
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At GEON, Centre of Expertise on Geo-information Studies, we have developed three modules of 40 student-hours in distance learning format. In this paper our experiences with distance education are discussed. The first part deals with characteristics of GIS education, which are classified into three categories. The first one is the content of GIS-education. GIS education consists of knowledge of concepts, skills in using technology and an insight in the organizational aspects of setting up a GIS. The second characteristic is the nature of the field of study: GIS is a very rapidly changing subject. The third characteristic is the fact that GIS is a tool, not a goal in itself. This implies that GIS education is always linked with an application area.

The three categories each have a different impact on the way a distance learning module is designed. This impact has appeared to us in three ways: as facts from experience, as considerations or choices which have to be made and as questions we still have. Those will be presented as statements for discussion.

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UNIGIS Distance Learning Diploma, Technology and User Needs

James R. Petch, MMU, UK and
John Wilson, USC, USA

UNIGIS is an international consirtium of institutions who under a licencing arrangement operate a distance learning diploma programme in GIS. Experience over the last five years could be valuable in scoping and asessing the risks for developing developing education technology. This is important becasue of the high resource costs of technological development. UNIGIS operates a professional level programme with the emphasisi on design and management. The particular point for technology is about UNIGIS is organised since this secures the operating revenue and staff resource base for development. Additionally a clear development pathway for developing educational materials has been devised. Critical to the whole process is the analysis of need. UNIGIS has several technological componenets which have considerable benefits but such developments ingeneral have high costs and high risks. UNIGIS reduces these risks by following a number of principles of organisation and development.

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Distance Education and the WWW

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Due to the high demands placed on GIS professionals to achieve and maintain a high level of qualification throughout their careers, technological changes and progress make continuing education mandatory. Individuals not being able to attend full-time programs and extensive seminars offered at often distant locations value the opportunity telelearning courses present. The growth and success of several such programs in the field of GIS clearly demonstrates this need.

Although there is a substantial demand for distance education in GIS, students still face several disadvantages in comparison to traditional on-site programs. Issues are access to staff and contacts to fellow students, feedback opportunities, maintaining motivation and individual tutoring. The WWW now offers a chance for improvement in these areas while maintaining the undisputed strengths of telelearning programs. Within the framework of the UNIGIS distance learning diploma, Internet-based GI seminars and training courses, strategies and instruments to support telelearning are currently developed. This paper will demonstrate various approaches explored at Salzburg University, Austria.

A key area building on the Internet's inherent strengths is the development of a supportive communications environment. Enhancing and partly replacing the use of phone and e-mail are groupware capabilities merging with the role of newsgroups, textual, audio and video real-time communication ("chat", "conferencing"), bidirection transmission of all kinds of digital materials and increasingly interactive access to various resources. With all of these tools today being readily available. the question of adequate and efficient use for the communications needs in an educational environment arises. While the need for an overall design is generally accepted, few guidelines are currently available.

The presentation of study materials probably benefits most from the combined multimedia and telecommunications capabilities of today's computing. While printed texts still maintain an important role in a flexible mix of delivery modes, still and animated color graphics, interactive applets and forms, integration of "real world" GIS applications and enhanced server-side capabilities greatly enhance the choice of media available to the instructor. One of the overall key ideas is to create an "involved" learning environment, sharply contrasting the passive style of studying a course text.

Starting with experience gained from several prototype applications forming building blocks for a more complete set of interactive tele-study materials, the paper discusses ideas and concepts for different didactical approaches. With basic guidelines for teaching over the Internet still largely missing and the technology continuing development at a rapid pace, dynamic evolution of Web-based educational offerings is to be expected. By trying to play an

active and experimental role, pedagogical and design guidelines will be collected for the future development of more mature educational products.

With the Internet playing an expanding role in overall communications and computing, its use obviously is not limited to full distance education applications. Conventional academic courses will increasingly be supplemented by Internet-based components, and in general various kinds of learning try to use the most appropriate media and presentation styles. The Internet's great advantage is the capability to integrate most of them!

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Flexible Delivery and Social Learning: Seeking a New Geography of GIS in Education

Pip Forer
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This paper starts from the assumption that the changes we are witnessing in the computing and communications arena will be reflected in changes in educational practice. It examines what these might mean in the area of GIS in education, and specifically in respect of the geography of GIS education. The important issues of flexible learning timetables and socialised learning environments are raised. It is noted that, at least in New Zealand, increased competition and changing lifestyles amongst the mainstream student body are stressing the need for more flexible delivery of all courses.

Finally the paper describes moves afoot at the University of Auckland, New Zealand, to develop course structures which increase student choice and flexibility, retain high levels of social contact and are efficient to deliver. In doing this it examines some of the delivery options open to institutions operating across several campuses, particularly in respect to the question of how the geography of traditional tertiary learning can best adapt to changing student needs for quality education. Some practical experiences of remote supervision of project work using video-enabled groupware are reported.

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The philosophy and design of a Virtual Field Course

David J. Unwin
Birkbeck College, University of London, UK

A student field course, in which a class is taken for a week or more field instruction away from the home institution to work on a variety of geographical problems, is an established feature of geography programmes in UK and elsewhere and in several other disciplines. It is intended to address a variety of educational aims, and is in many respects similar to laboratory work in physical science. Increased student numbers and a decline in the teaching resources available make it imperative that field courses are seen to be efficient and effective. To most, this implies embedding them better into the curriculum, with greater emphasis on preparation, debriefing and the kinds of work that currently simply cannot be accomplished in the lecture theatre or inside laboratory.

Our virtual field course (VFC) plans to use GIS, multi-media, visualisation and virtual reality software to create a digital environment in which students can re-create landscapes, generate sample data, and access knowledge about the chosen areas. The uses of such a system are many, and almost all involve enhancement of the existing field programmes.

The paper describes an approach to be adopted by a joint Birkbeck, Leicester and Oxford team to engineer together a software toolkit for the creation of VFCs. In educational terms, the work involves a clear specification of the aims, objectives and styles of field work. In software the problem is essentially one of integrating components which already exist in public domain. Finally, there is a need to provide rich, non-copyright spatial and other data to act as a demonstrator for the concept.

Outline of talk as presented September 7, 1996

Two anecdotes

- Steven Mann at MIT
- combat aircraft pilots

Some morals to be drawn

- for some activities we prefer virtual worlds.
- digital virtual worlds can be easily shared via WWW.
- people/machine integration is not SciFi

What do virtual worlds allow?

- immersion in an environment
- sense of presence
- become uninhibited by usual `rules'

Potentials in the classroom

- simulation of complex systems
- macro and microscopic views
- fast and slow time simulation
- sense of non-real time

A curriculum need

- educational objectives
- development of observational skills
- learning about unfamiliar environments
- the design, conduct and reporting of research

Difficulties

- expense and maintenance of a programme
- maintaining equity for environments and students
- curriculum integration
- sharing experiences, knowledge and methods between institutions

Alternatives

- courses based at `home'
- using CBL to teach field skills
- using authoring systems to present field knowledge in multi-media environment
- virtual (eco)systems and simulation

Failings

- no accessible digital geography: content is `pre-loaded'
- no support for active work in the field
- all `one off': failure to produce generic tools
- inadequate computer power for the ideas (e.g. Domesday LaserDisk)

The virtual field course

- a collection of hardware, software tools to address learning objectives of the same type as in the real world but in a digital virtual world

What it might provide

- map access to a rich multi-media data base
- a student interrogation system
- a note taking facility
- data entry and modification
- landscape visualisation in `interpreted views'
- a point/line/area query facility

Educational Contexts

- enhancing field work before, during and after the event itself
- extending field work into physically challenging, remote or otherwise expensive regions
- perhaps replacement for differently-abled students

Similar Work

- Virtual Antarctic /www.terraquest.com
- Virtual Cities /www.city.net
- Virtual Florida /www.eds.com/jason/ecmd0000.htm
- Virtual Stonehenge /www.intel.com
- Virtual Field Course /uts.cc.utexas.edu/~mr/gvdvft/wrkgrp.html
- .. and probably many others!

Key differences in the JTAP VFC are the use of a GIS as controller and the use of computation to derive information.

Technical problems and decisions

- choice of tools
- WWW delivery is essential
- VRML
- JAVA applets
- GRASS as GIS

The role of Immersion

- `Through the window' approach but with an immersive VR experiment

The need for demonstrators

- Dartmoor
- North Norfolk
- the World?

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Community-based GIS Education: A Twin Cities Experiment

Robert B. McMaster, Helga Leitner, Eric Sheppard, and Sarah Elwood
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In the Twin Cities area, many neighborhoods are beginning to use the opportunity presented by the City of Minneapolis' Neighborhood Revitalization Program to address longstanding environmental concerns. These communities are poised to make a substantial impact on future environmental quality for the city.

The paper will report on a research project in Minneapolis to educate community groups on the potential for GIS in assessing environmental quality and in conflict resolution around environmental issues. Within the academic community, the Toxic Release Inventory (TRI) database, created as a result of the Federal Act of 1986, has become widely used to assess social and spatial inequities in the risks associated with potential exposure to these chemicals, triggering a widespread debate on environmental justice. The methodologies being developed for this research are of direct relevance to communities wishing to assess and respond to the risks associated with the local presence of firms both manufacturing and storing toxic and hazardous chemicals.

Working through the Neighborhood Planning for Community Revitalization, and in conjunction with Citizens for a Better Environment, three neighborhoods have been identified as case studies. Currently, we are setting up relationships with community groups in these neighborhoods to complete the following:

1. As part of the project, a variety of spatial data on hazardous materials, the location of various institutions (e.g, day care centers), and census data will be provided, at no expense, to the community organizations. A data inventory of existing public domain sources will also be provided, and communities will be invited to add their own information and data needs to this directory.

2. We will provide expertise to the communities in digital mapping, geographic information systems, and rudimentary geographical analysis. At least one half-day workshop on GIS will be provided in each neighborhood.

3. We will do everything possible to make GIS software available to members of the community groups and will provide basic training.

4. We will provide each community with the detailed findings of the study. Since our primary goal is to ascertain how, exactly, community groups might utilize GIS in the analysis of environmental risk and in solving locational conflict issues, we plan to work with each group as they learn the capabilities of such spatial technologies. One of our major research objectives is to empower such organizations, to the extent possible, with these technologies.

The paper will report on the overall goals of the project, and provide a status report on initial responses from the community to GIS education/training and the spatial needs assesssment.

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Panel discussion: System approach in teaching geography with the help of GIS

Basil M. Kravtsov, Nina V. Gulyaeya and Iouri B. Kravtsov
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Students' standard of knowledge analysis makes us conclude, that their accomplishments are fragmentary. Students keep in mamory sizable extend of programme material, but they can't use it even in area of one subject. Potential of geographic disciplines isn't utilized completely in scientific world outlook forming. Such situation is defined by many reasons. Essential contradiction between sizable strains of students' knowledge and absence of perception of Universe as a single whole arises.

Authors have some experience in solution of this contradiction. The system paradigm is accepted as a basis of activity. This basis makes students come nearer to understanding the mechanism of organization of complex natural systems. System paradigm is realized by usage of GIS. Authors made several didactic complexes for geographic subjects in higher school. The main idea of them is perception and learning geographic objects as GIS. Such complex includes: minimum of knowledge and skills, which students are to master great number of different tasks for studing the information about every feature of natural objects as GIS (form, size, composition, structure, emergent peculiarities, etc.); entertaining and little known dates, questions and tasks for self-control and self-appraisal.

Such didactic complexes make possible carry out distance learning of geographic systems.

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Teaching Geography with GIS in Ontario's Secondary Schools

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Until recently GIS has been limited to the resources and students of postsecondary institutions. This situation is now changing in Ontario. In the early 1990's, the Ontario Ministry of Education adopted mandates to develop guidelines for the integration of computers into all areas of the secondary school curriculum. Although the process is now well underway, teachers have been frustrated by limited access to hardware, insufficient pre-service training, and by the paucity of teaching resources. There is a growing literature on teaching GIS at the pre- collegiate level, but it lacks clear guidelines that apply GIS functionality to the teaching of geographic concepts and skills at the pre-collegiate level. This paper first outlines aspects of the history and current status of GIS in Ontario schools by describing various efforts to promote the use of GIS in the classroom. It then describes the research undertaken at Wilfrid Laurier University to foster GIS education continuity between post-secondary institutions and secondary schools. In particular, it proposes a model of curriculum and teaching exercises for the integration of GIS into the geography classroom.

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Developing GIS Use in High Schools

Martin F. Schmidt, Jr., McDonough School, MD?

Although GIS use is expanding at a rapid rate, instruction in or even demonstration of GIS remains rare in high schools, where such learning could inform future citizens, and start some students on a useful and rewarding career. This presentation will discuss how a high school teacher has introduced GIS to his classes as a means of helping students better understand their world. Topics to be discussed will include the applications used to get students involved in GIS, some of the hurdles encountered along the way, and the need for active technology transfer from GIS professionals to secondary school teachers in order to facilitate GIS use in high schools.

Conditions Affecting the Classroom Implementation of Geographic Information Systems

Richard H. Audet
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This paper reports the findings of a one year study that investigated conditions associated with implementing GIS in pre-college classrooms. Questionnaires and interviews provided the principal data sources. Key implementation issues were identified and organized into an Implementation Model. This visual framework, when used in conjunction with the GIS Readiness Instrument, enables a GIS user to assess the factors that contribute to the effective introduction of GIS technology into the curriculum.

When the findings from the self-administered readiness questionnaire are applied to the GIS Implementation Model, an implementation profile results that graphically depicts an action plan for addressing all components of a GIS. Examples of implementation profiles derived from three existing programs are discussed.

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GISHE '96
Plenary session, Saturday afternoon

On Saturday afternoon, large focus groups were formed to itemize the critical issues which had arisen during the session discussions. K-12 and Community College educators formed special focus groups to address issues of particular relevance to them. The following is a summary of these discussions.

Group 1 - K-12 education

- Detailed lesson plans, cookbook GIS -- with CD, "GIS for Dummies", all inclusive, easy to get it up and running
- Training -- hands on workshops
- Data -- in GIS ready formats, i.e. ArcView, Idrisi; it is difficult to find data and put it in the proper format
- Partnerships -- schools/universities/business, business involvement is important
- Network/communications, GIS list, web site, central place -- K-12 GIS center

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Group 2 - Community College

Issues

- transferability -- standards, certification, technical courses, introductory GIS course; GIS across the curriculum
- job outlook -- study, needs assessment, define job levels
- territoriality -- 2 year <--> 4 year; 2 year <--> 2 year; partnership, interdepartment, equipment, hardware/software, lab support, sharing data; training in GIS/using GIS to teach other content/GIS education (partnerships)
- professional development (regional, local); outreach -- K-12/industry/community colleges should be support for K-12; network of community college GIS programs

Action items

- develop community college GIS network
- set standards for "introductory GIS course" that can be transferable
- needs assessment that can be shared
- continuation and expansion of professional development "GIS 21st century" (CCTP?)
- outreach to K-12

Group 3

1. vertical articulation of GIS education (K-12, 2 year, 4 year); geographic information science vs. use of GIS for teaching spatial knowledge and skills; integration of learning models and GIS; professional programs
2. Use of the Web -- sharing GIS knowledge, distributed model of educations, coordinating data access & sharing; sharing practical advice & information
3. International sharing & building capacity globally

Group 4

Issues

1. Multidisciplinary use. Geography? (other disciplines use geography/GIS classes because it isn't offered in their department)
2. What are the key concepts?
3. Effective use of resources
4. Training vs. education (geography vs. technology)

Action items

1. Define level and content of courses
2. Push for more diversity at our conferences

Group 5

Strategic

1. Continua in education
    - K-12 <--> community college <--> university
    - students <--> employers
2. Communication between science, geography, systems, applications/disciplines (survey, planning, etc)
3. Didactics of (GIS) "labs"
4. onsite <---> distance learning

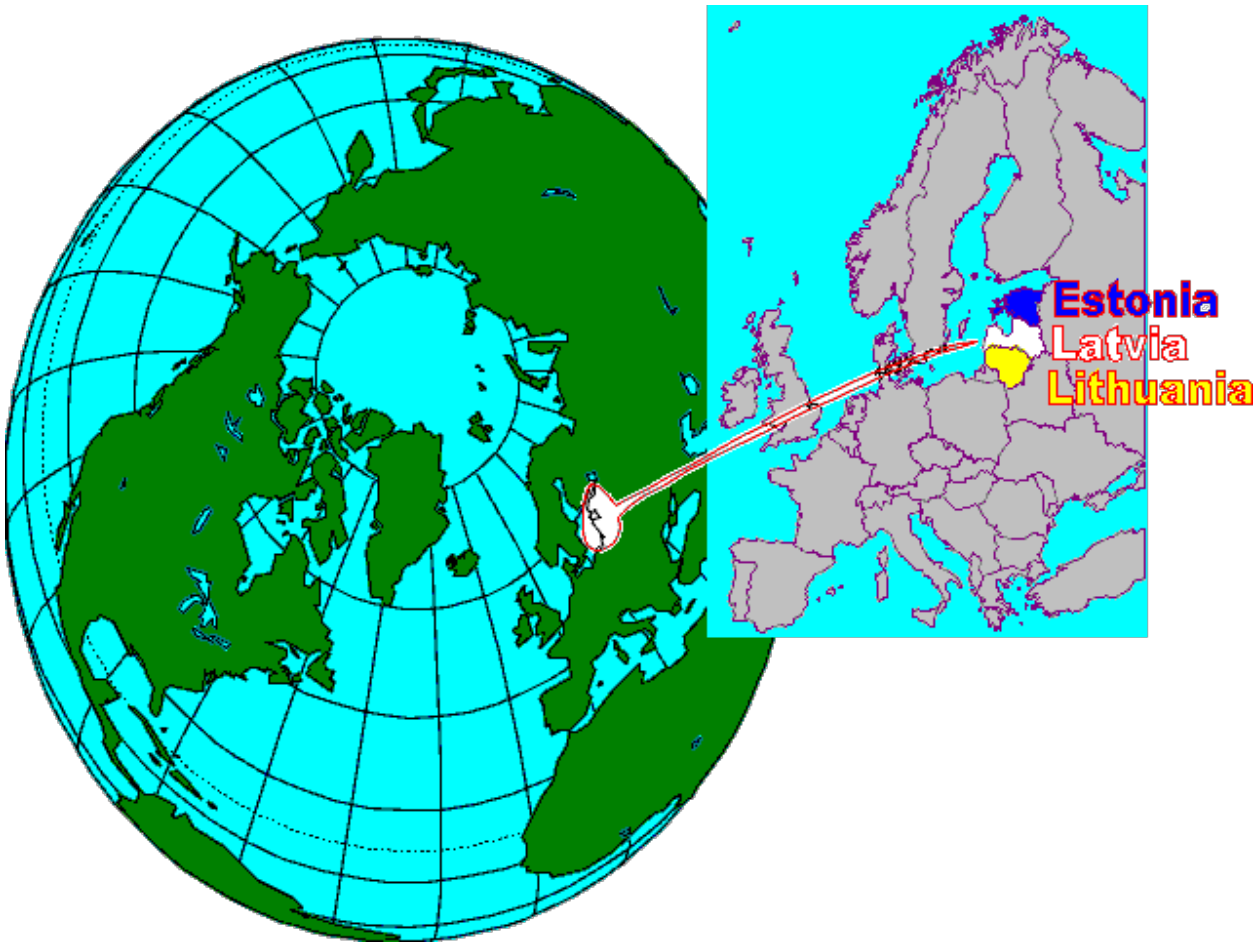
Action items

1. research outcomes of programs, job descriptions, advertisements
2. exchange information on courses, programs, flexible, WWW/discussion list
3. collection on didactics, new media
4. What is the GI-animal?

GISHE '96
Conference Summary Topic List

During the final session of the conference, approximately 40 conference participants, working in small groups, drafted action statements addressing a number of the items identified in Saturday's breakout group discussions. Following is a summary of those statements, listed in no specific order and with many obvious areas of overlap. Action items listed following suggest themes for further discussion at future conferences or as activities to be addressed by associated organizations.

Return to GISHE '96 main page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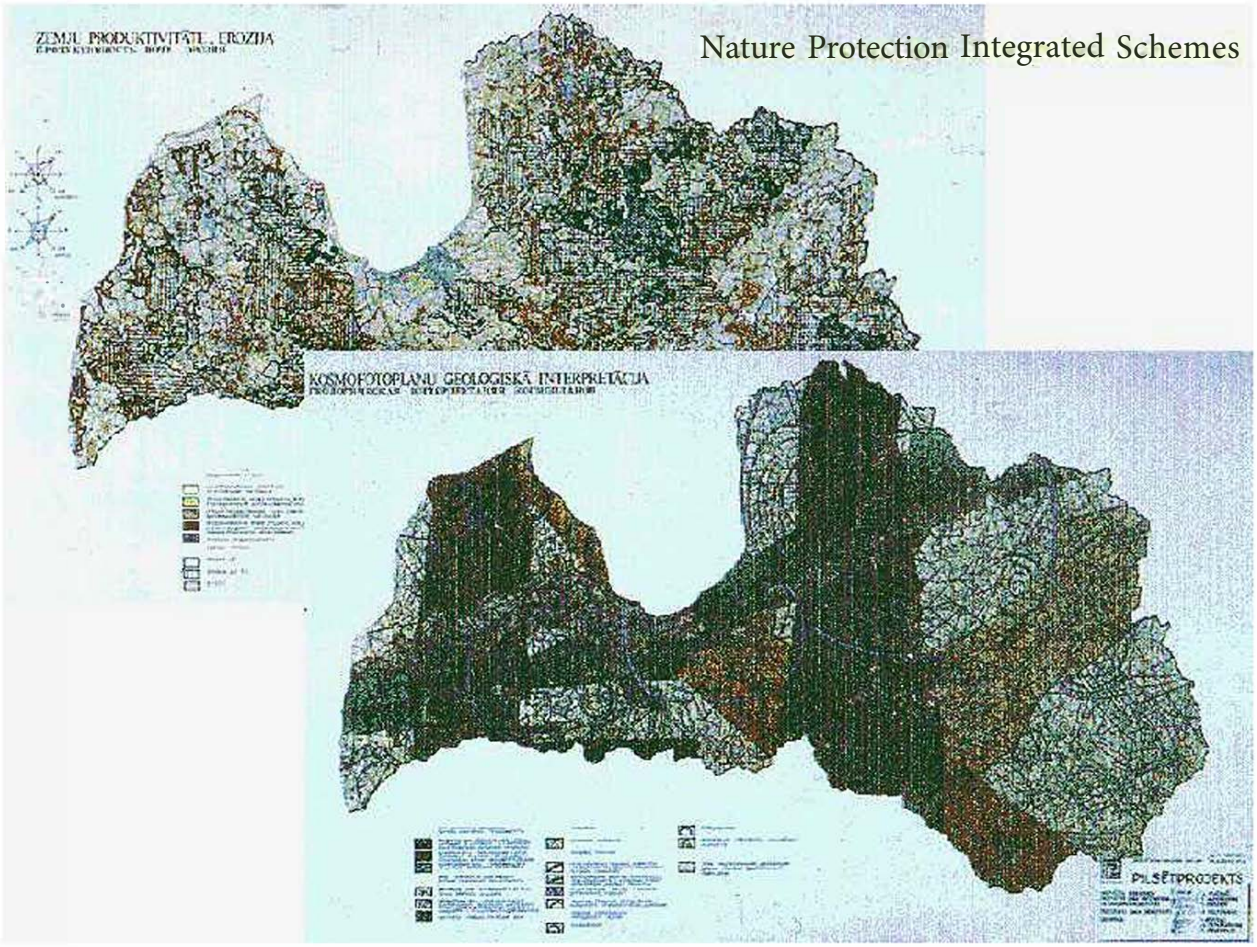

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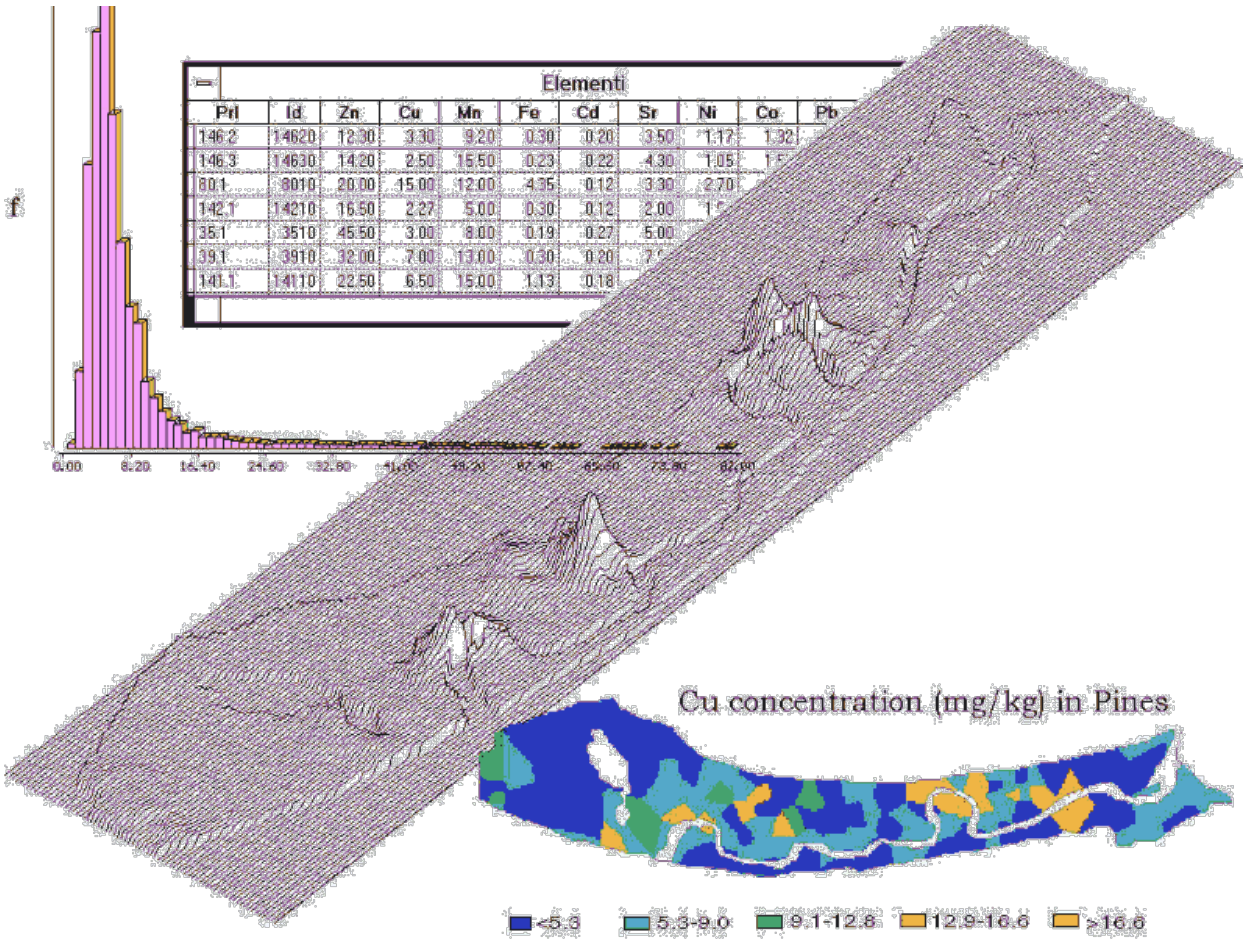
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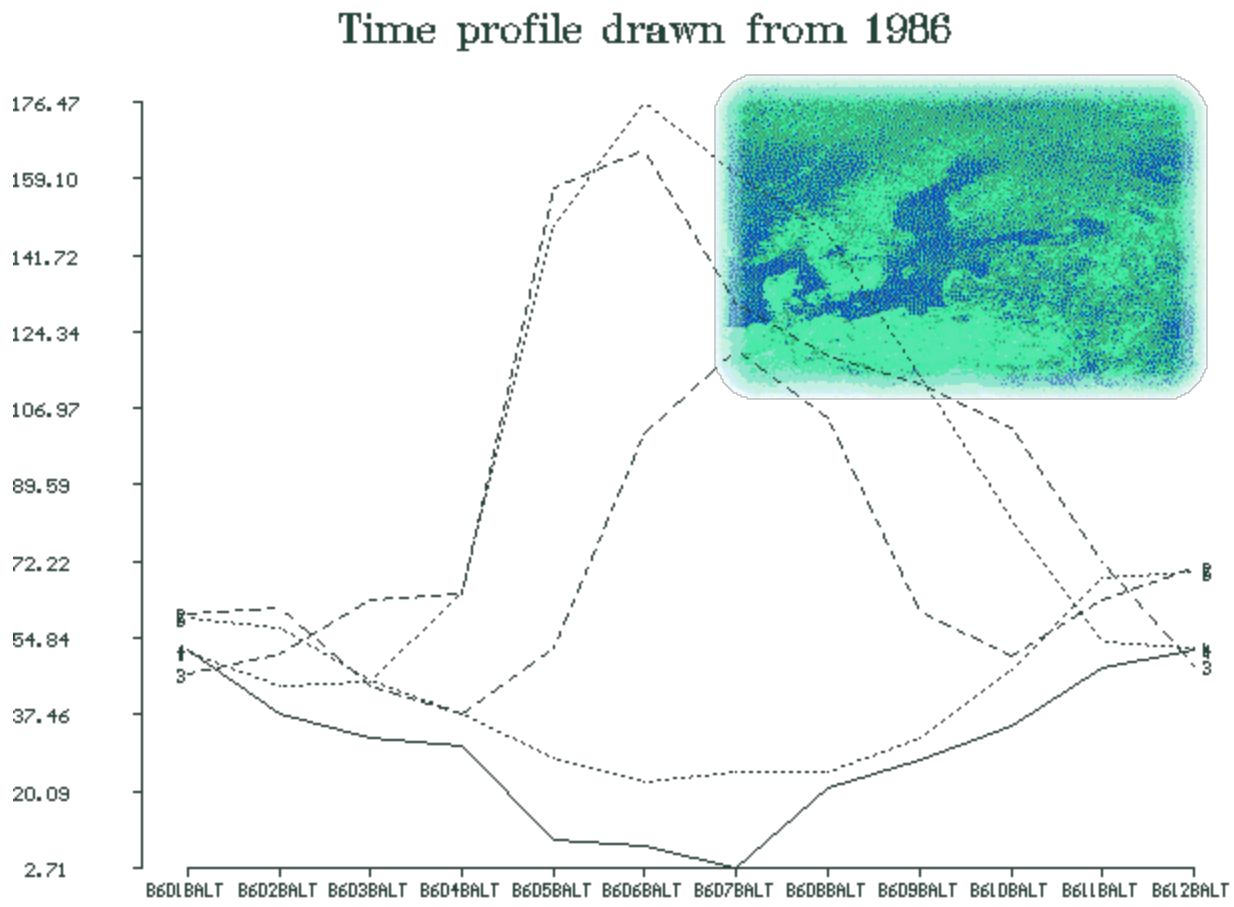
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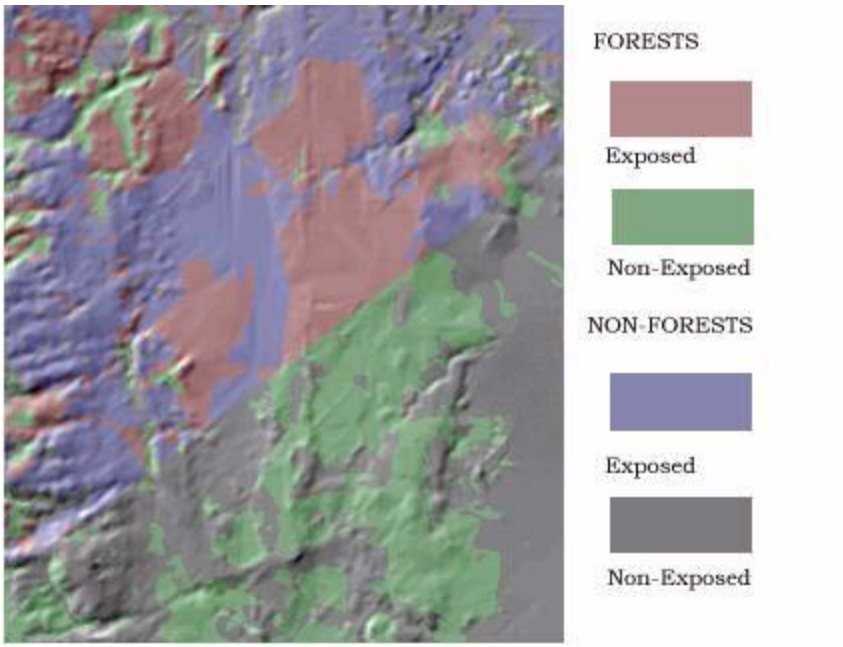
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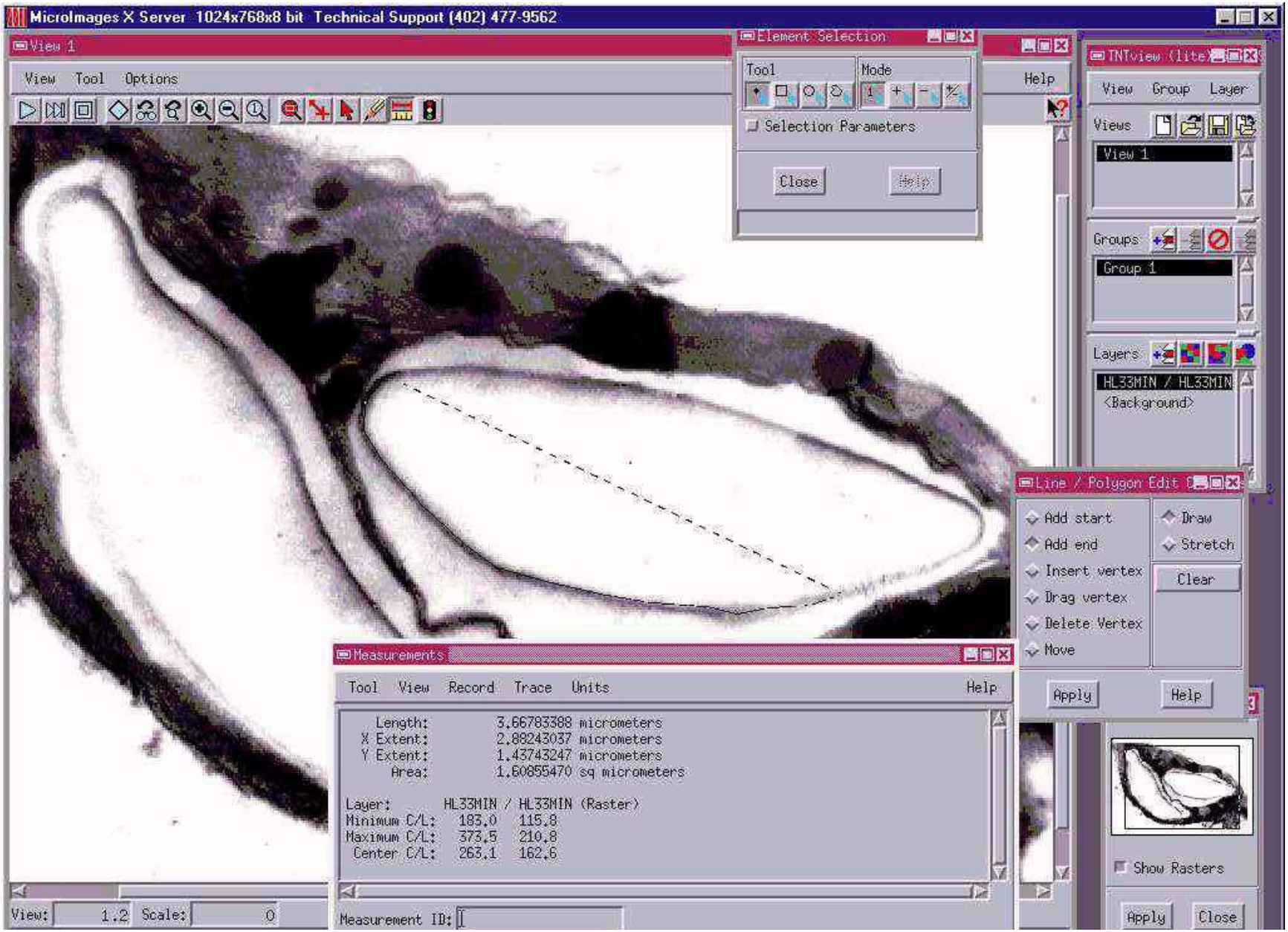
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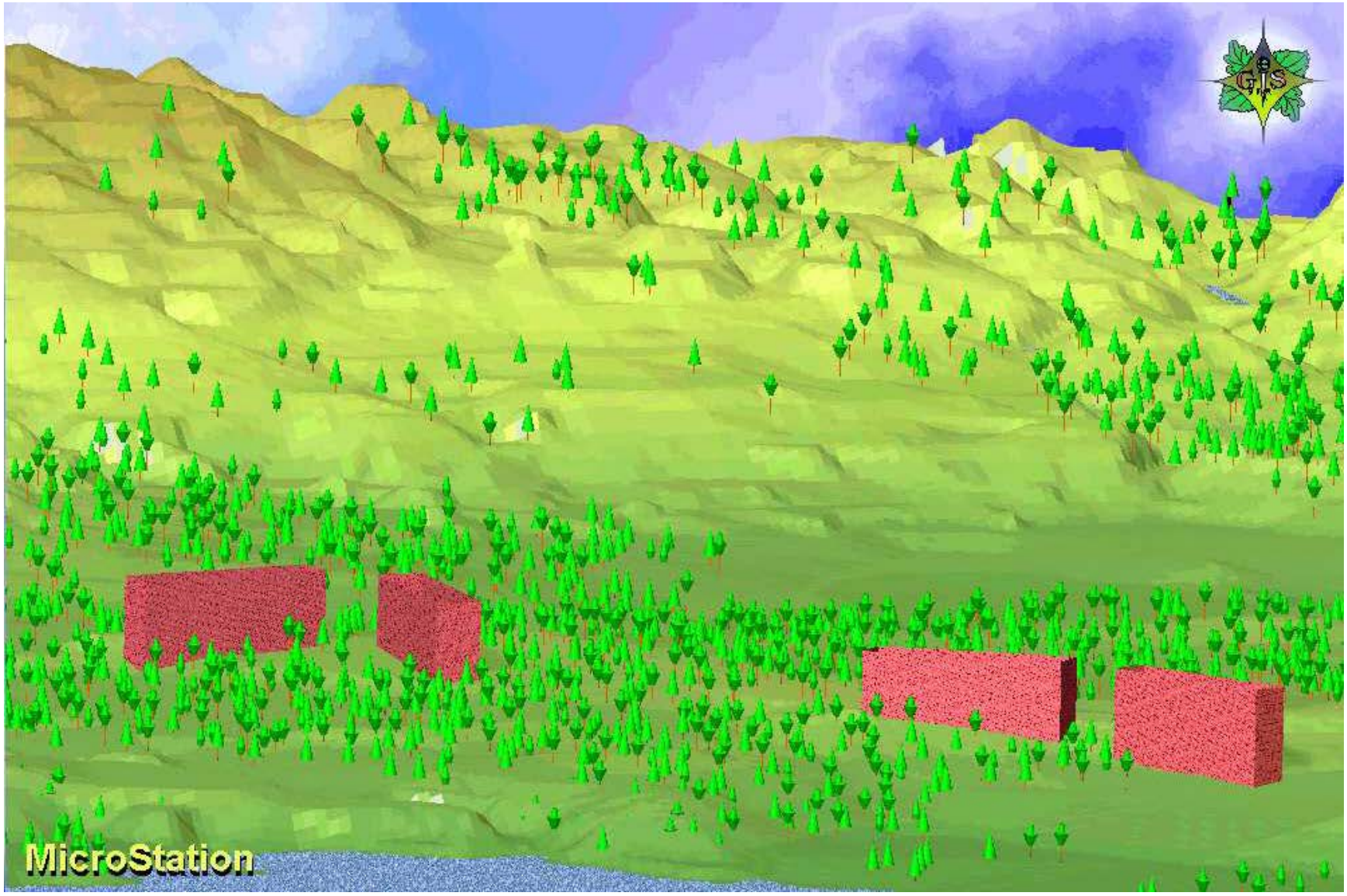
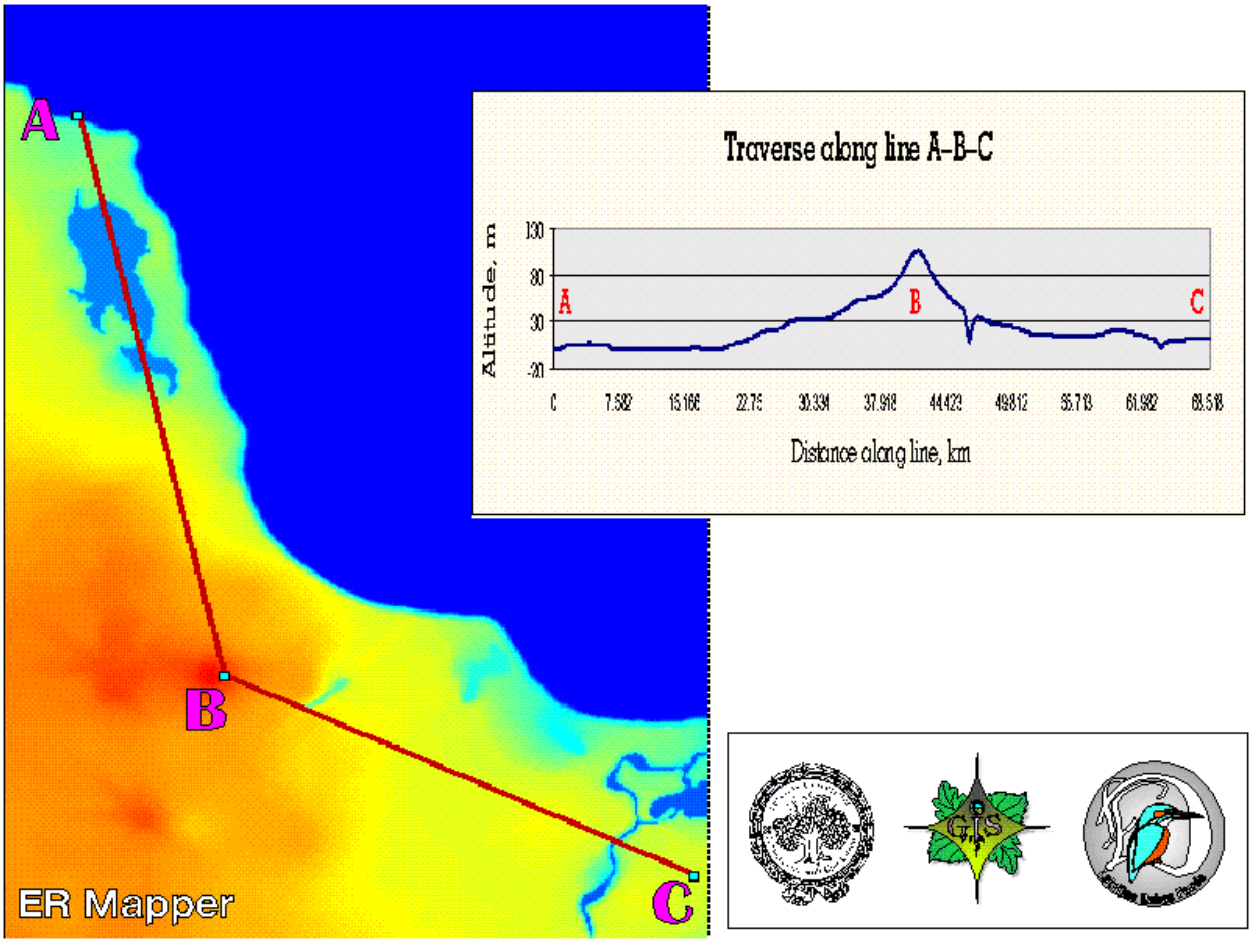
Apply
Close
View: 1.2 Scale: 0


GIS
MicroStation


A
B
C
ER Mapper
Traverse along line A-B-C
Altitude, m
130
80
30
-20
A
B
C
0
7.592
15.166
22.75
30.334
37.918
44.423
49.812
55.713
61.982
68.518
Distance along line, km
GIS

GISHE '96 Conference summary

During the final session of the conference, approximately 40 conference participants, working in small groups, drafteed action statements addressing a number of the items identified in Saturday's breakout group discussions. Following is a summary of those statements, listed in no specific order and with many obvious areas of overlap. Action items listed following suggest themes for further discussion at future conferences or as activities to be addressed by associated organizations.

Networking

Issues

Mechanisms are needed for the sharing of information regarding GIS education, particularly academic programs, course curricula, distance learning, hardware and software, data and instructional materials. The current GIS periodicals do not adequately address the issues confronting GIS education, or convey information needed by GIS educators

Action items

- develop a newsletter for GIS educators (paper or WWW format?)
- form a GIS discussion list on the Internet
- schedule a GIS education conference for 1997. Expand the conference to include GIS education at all levels and disciplines, not just higher education.
- compile a downloadable catalog of free or low cost data and instructional materials

Jay Morgan, Dick Scott, Weihong Fan, Craig Caupp

Building private and agency partnerships

Issues

In order to target student skills and knowledge to more effectively meet societal needs, it is imperative that partnerships with private and government agencies be established. These relationships have a great potential to build practical application into student projects. In addition, these partnerships can rejuvenate the curricula of academic institutions.

Action items

1. establish interdisciplinary advisory boards to guide program development
2. establish internship/apprenticeship opportunities
3. plan curriculum to include knowledge, skills and professional relationships

4. identify grant opportunities to infuse change
5. involve agency professionals in the instructional mission

Roberto Garza, Andrew Nazzaro, Freda Brown, Zong-Guo Xia

Capacity building

Issues

For successful application of GIS within an organizational context, there is a need for capacity building. Capacity building is defined as the development of the human resource. This does not preclude the need for other resources, e.g. money, equipment, data and infrastructure, but the focus for educators is upon the people. Capacity building can take place at several levels in a hierarchy -- local, regional or national.

Many organizations are already embarked upon this activity, however their plans are often carried out as isolated activities without regard for lessons already learned. There are benefits to be gained from a better understanding of the process and recognition of critical factors.

Action items

1. Articulate a generic, multi-level model for capacity building to guide organizations and individuals.
2. Collect and analyze case studies at various levels and in different parts of the world.
3. Organize conference sessions to present models and case studies and to move towards better understanding of the issues.

Robert Maher, Richard Wright, Karen Kemp

Identifying GIS employment needs

Issues

There is a major problem defining the scope of GIS employment opportunities within this rapidly expanding field. Information about current and predicted GIS employment needs is required. The following types of information should be compiled:

1. The scope of employment in current and potential new fields and industries that use GIS, including:
    - list of job titles
    - list of potential users of GIS and new markets
    - names of major firms in key related industries
2. Skill levels required by employers:
    - what education level is desired
    - specific software experience

    - how much GIS is needed?
3. Wage ranges
4. Advancement possibilities
5. Need for additional education for existing employees
6. Appropriate survey methods for collecting this information

Actions

1. Define GIS markets and related job markets (existing and potential)
2. Conduct a survey of completed surveys on GIS employment, collect data from Department of Labor and Commerce and state equivalents, compile that information and make it generally available.
3. Prepare a survey to identify employment needs
    - Survey identified markets
    - Contact GIS World, GIS Europe, EOM, vendors, etc., to acquire lists of users and/or to help distribute the survey

John Schaeffer, Ann Stefani, John Albasini, Fred Toppen

GIS laboratory facilities

Issues

When establishing new GIS laboratory facilities, several issues should be addressed, including

- make a clear decision of the objectives and functions of the lab. Will the facility be used for teaching, research, exercises and/or project work?
- ensure an initial allocation of a dedicated space with room for expansion
- make an appropriate match of technology to the required tasks
- evaluate the lab capacity in terms of student to machine ratio
- provide for adequate access
- ensure sufficient staffing and security

Action items

To address these issues, a number of action items can be enumerated:

- develop a series of laboratory facility models, broken down by type, scale and budget
- make available information sources of funding and other resources for facilities
- encourage recognition of the need for ongoing funding for maintenance, replacements and upgrades and provide suggestions for means by which it may be obtained
- develop and disseminate automated or easily accessed instructional or tutorial materials for immediate technical assistance to users of the laboratory
- produce and make available laboratory instructional materials

Susan Macey and others

GIS training for educators

GIS training for educators will occur in two principal contexts:

- *inservice* professional development for teachings (K-college) and
- *preservice* experiences for those preparing to become teachers

Inservice education emphasizes discipline-based applications. It is designed to assist faculty in making curriculum connections between GIS and spatial concepts taught in a variety of subject areas.

In preservice education, GIS should be a broad-based enabling technology that students apply whenever spatial topics are being explored. In this manner, GIS will eventually become another tool in their teaching repertoires.

Preservice action items

- support development of teacher preparation models
- continue research on the integration of GIS/SIT (spatial information theory) into:
    - educational methods
    - spatial cognitive processes teacher preparation programs

Inservice action items

- continue to inform the uninitiated by sharing existing outreach materials
- outreach to those who show interest in teaching with GIS
- formation of teams of educators who are able to:
    - devise instructional materials
    - link GIS potentials to curriculum standards
    - facilitate training workshops

Richard Audet, Bob Sharpe

Professional Development

Issues

Current formal education and training provision for employment in the Geographic Information industry does not cater to the needs of a range of entrants into the profession or existing IT professionals newly acquiring GIS capability. There is an associated need for continuing Professional Development (CPD) and skills updating driven by technology change. As well, there is a need to provide for individual accreditation to work in the field, for external validation of education and training opportunities, and for tools to allow individual

career assessment.

Presently, provision for the necessary continuing Professional Development is ad hoc and arbitrary, being provided by a mix of system vendor courses, some community colleges and the universities. Often such programs are characterized by model partnerships among these providers and the user community, but they lack the involvement of professional associations and there is no self-evident infrastructure which might provide this.

To rectify this situation, it is recommended that the GI community:

- seek out examples of good practice in GIS continuing professional development as models for wider dissemination
- establish an infrastructure involving all interested parties to provide continuing Professional Development in this area, and
- work to develop standards to support the development of programs, definition of their content and evaluation of such activities

Charles Monsma, David Unwin

Distance Education and the use of the WWW

Distance education (perhaps better termed "Mediated" or "Distributed" education?) is likely to emerge as an important component of GIS education at all levels, but particularly for professional and continuing education. The World Wide Web is an obvious technology to support such distributed education.

Action items

Realization of the potential of distance education will entail:

1. sharing didactic, practical information about what works and what doesn't
2. exploring appropriate ways to support students, promote student-faculty interaction and reward faculty for their efforts in distance education
3. create or expand consortia for distance GIS education to reduce risk, spread costs and share expertise
4. support research on computing delivery technologies

To use the Web effectively for distance education, access, distribution, sharing and collaboration will involve:

1. creation of a clearinghouse -- needs to be well planned, organized and indexed
2. consideration and improvement in the quality of access to the net

Ken Foote, Petra Cremers, Joseph Strobl, Joseph Betit, Karlis Kalviskis, John Wilson

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Key spatial concepts

(This topic includes a recognition of the issue of geographic information science versus the use of GIS in teaching spatial concepts.) We teach spatial concepts to learn spatial thinking. We need to use multiple representations -- numbers, text, graphics -- in learning spatial concepts. GIS is *one* tool to stimulate cognitive spatial thinking.

Action items

- extract/distill spatial concepts from the new GIScience Core Curriculum
- develop a number of "modules", including:
  - modules based on the GIScience Core Curriculum
  - "GIS free" modules -- with minimal technology
  - modules using GIS systems
- determine how do we evaluate that spatial thinking is taking place? (possibly by solving spatial problems?)

Joe Loon, Carlson, Jamie Cromartie, Micha Pazner

Learning models for GIS

There is a need for research concerning the effectiveness of different learning models (combined with computer-student interaction methods and issues). This research must take into account the cognitive level of students (their "geographical eye", their spatial concepts).

Action items

- exploit the knowledge and experience gained from other research fields regarding computer-based learning (mathematics, physics, ...)
- develop evaluation and assessment methods to evaluate student's progress (through computer practicals)
- design and develop new GIS-based tools with the educational requirements in mind.

Vertical Articulation

At the conference, K-12 educators expressed a desire for fostering ways to work with universities in obtaining guidance, some training, information about data, etc. Community college educators expressed an interest in guidance about curricula for 2 year colleges and to ensure articulation with the content of university courses. Therefore, there is a need to identify a core curriculum of what fits best at different levels, articulation for course credit transfer, to help high school programs know what to aim for, and to know what spatial concepts are important.

The function of articulating programs is to provide pathways for students to travel through the education system in an efficient method in order that they can attain their individual goals. By using established and standardized curricular objectives, competencies and commonalties can

be identified. Leveling of courses can be based on these competencies and commonalties. Thus we may be able to answer the question "what should be learned in a course called "Introduction to GIS" "?

Action items

1. identify needs of the marketplace and education communities
2. define undergraduate competencies in GIS
3. identify the commonalties in order to articulate necessary competencies

Derek Thompson, Carol Bowen, Jack Paris, Michael Stumpe, Paul van Helden

Return to Program