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Making a Place for Technology in Teacher Education with Geographic Information Systems (GIS)

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In North Carolina in the Spring 2000 semester, an experimental 'Geographic Information System (GIS) in Education' course for pre and inservice teachers was introduced at North Carolina State University (NCSU). Participants mastered a complex technology and overcame barriers as they collaborated with university faculty to coconstruct the course through reflective discussions and e-mail. Mostly social studies educators, the students chose final projects that applied GIS to analyze social problems spanning scales of local community history to international migration patterns.

In New York in the Spring semester 2000, components of GIS were added to an existing methods course for students pursuing secondary social studies certification through the education program at Hartwick College. As part of a 2000-2001 college/community partnership for learning, Hartwick social studies students collaborated with social studies classroom teachers at Oneonta Middle School to design ways to align GIS with existing units of instruction in the middle school social studies curriculum.

As a technology for conducting social studies, GIS offers new ways of viewing, representing and analyzing information for transformative learning and teaching. The two models presented in this article offer ideas for changing the role of technology use in social studies teacher education. This approach of 'conducting social studies' (Alibrandi, Beal, Wilson, & Thompson, 2000) is one that engages students, promotes learning of authentic social studies skills through problem-based research and community collaboration.

What is GIS?

GIS maps are seen daily on TV weather, in newspaper maps, and on the Internet (Figure 1). If you've ever used a MapQuest locator map or National Geographic's Map Machine you've used a GIS. This simple but powerful and versatile application has proven invaluable for solving many real-world problems from tracking delivery vehicles, to recording details of planning applications, to modeling global atmospheric circulation. (See ESRI page About GIS, online at http://www.esri.com/library/gis/abtgis/gis_wrk.html).

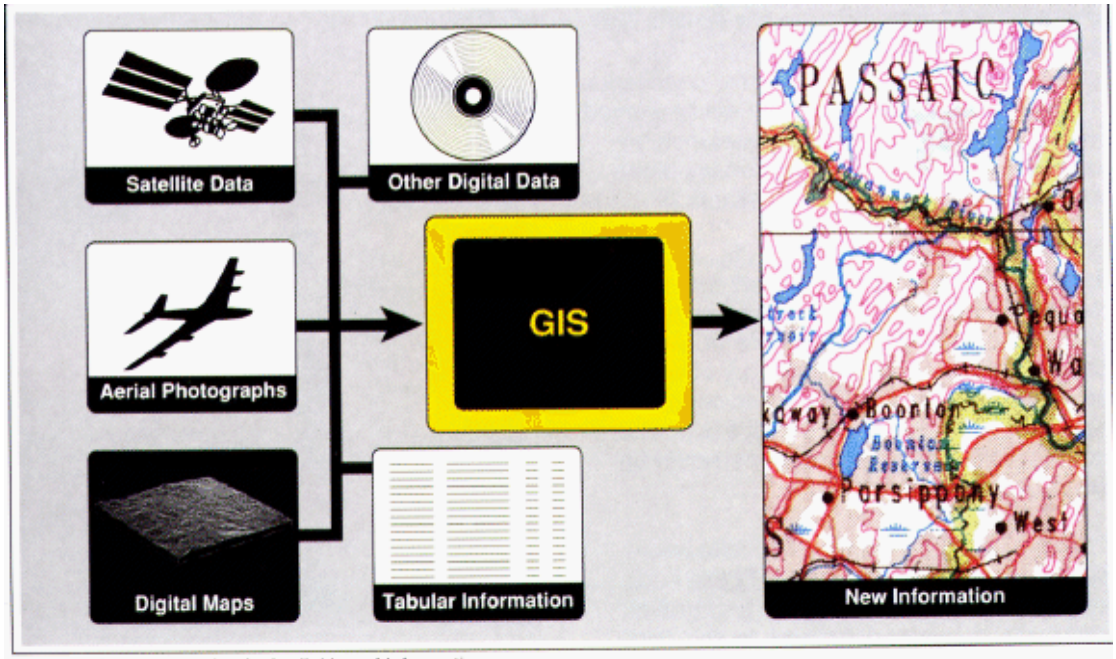

Figure 9. Data integration is the linking of information in different forms through a GIS.

Figure 1. GIS maps

Together with global positioning system (GPS) and remotely sensed images, GIS is one of the geotechnologies used to study physical and human geography. A GIS stores information about the world as a collection of thematic layers that can be linked together through common fields in databases that have geographic references. Geo-referenced data having any kind of address, be it a street address or a latitude/longitude coordinate, can be located on the coordinating point in a digital map. Data that are gathered and aggregated by units such as nations, states, provinces, counties, or other regions, can be represented in that area (or polygon) in a digital map. Data that are arranged in lines, such as streets, rivers, highways, rail, or utility lines, can also be layered onto the coordinating lines in a digital map.

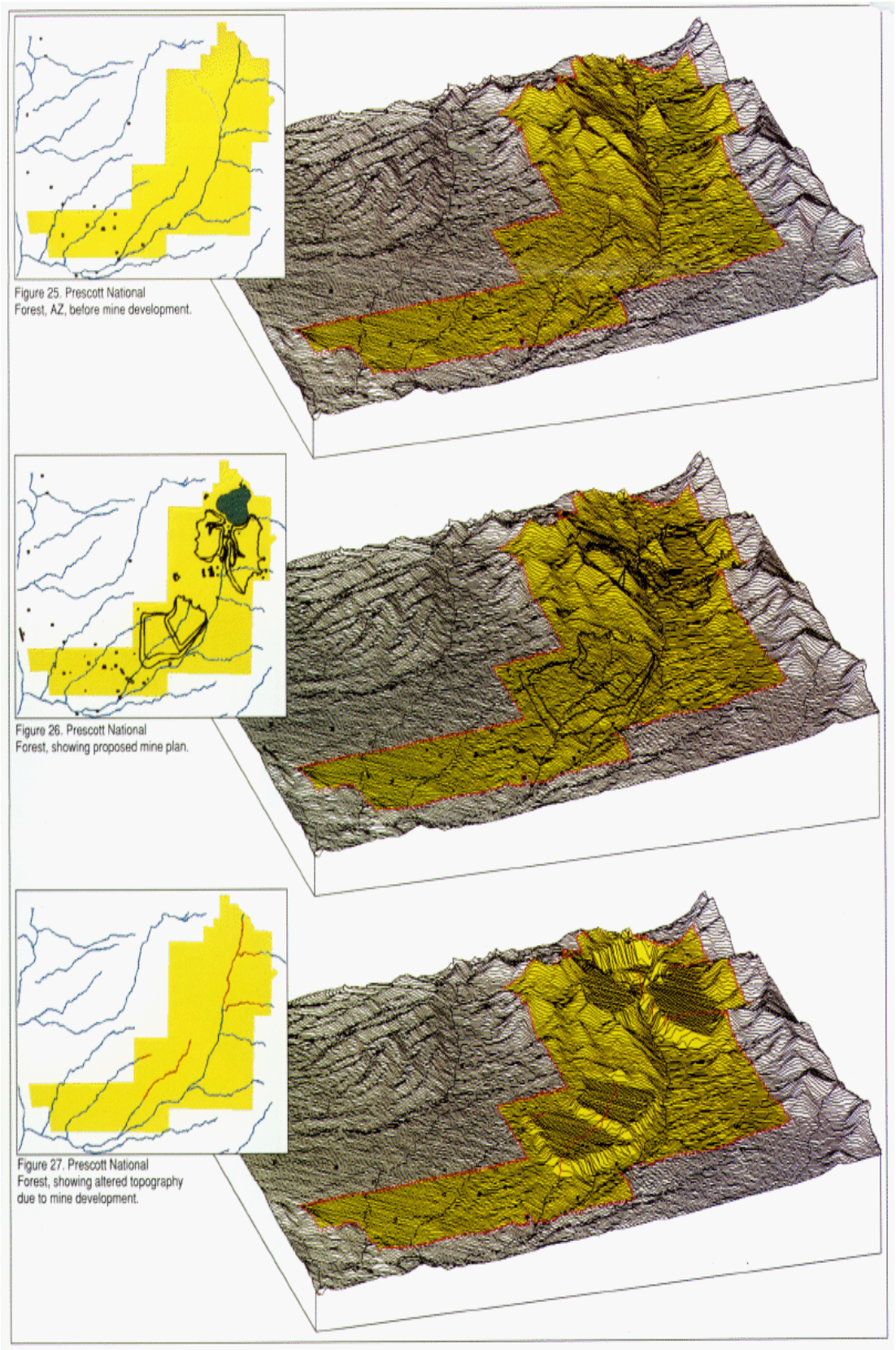

Figure 2. Digital Map

Most government agencies, utilities, industries with distribution networks, real estate, and travel agencies use GIS daily. The analytical applications made possible with a GIS are its most important contributions. When otherwise "invisible" spatial relationships can be viewed in a GIS, new analyses are made possible. If there is a geo-coded database of historic resources in a community, those resources can be mapped. If the features were then categorized by historic periods, both spatial and temporal views of the community through time can be represented.

Why Integrate GIS Into Social Studies Education?

> Social studies teacher education faculty members who effectively integrate technology in methods courses provide students opportunities to explore applications for the K-12 classroom and to consider how technology is changing the way we teach and learn. As social studies teacher educators, one of our roles is to model appropriate uses of technology for our preservice teachers...(Mason, Berson, Diem, Hicks, Lee, & Draille, 2000, p.1)

At the dawn of the 21st century, with unprecedented population growth and its ensuing competing demands for water, arable land, housing, education, and economic development, spatial analysis has become more critical. Governments and international agencies are all using GIS for planning and analysis. (see Figure 3, Alibrandi, 1997). The question is: When will social studies teachers become aware and prepared to incorporate the methodologies being used in the social sciences? Beyond standards and mandates, it is critical for social studies teachers to know how to pose spatial and geographic problems and to integrate the technologies now used to conduct social studies in its constituent disciplines.

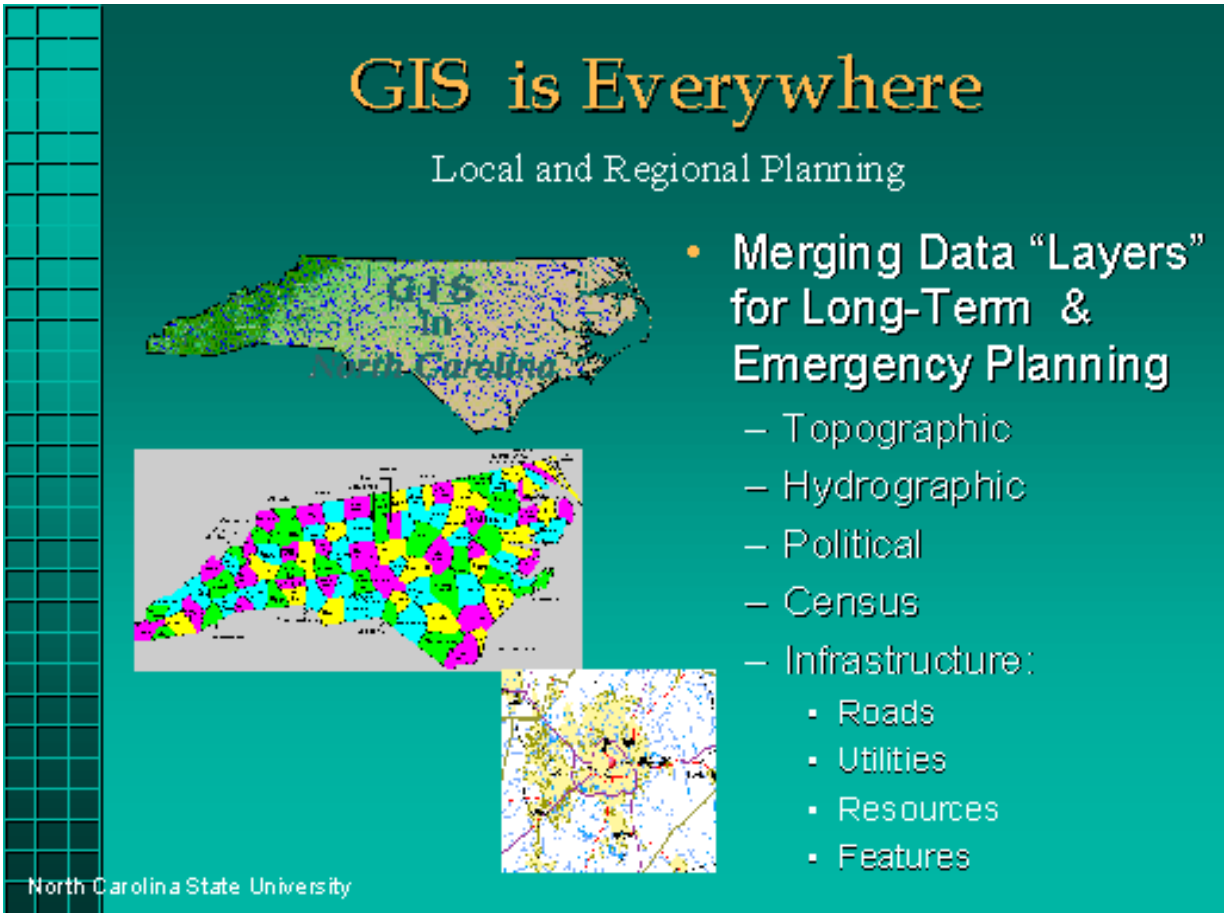

Figure 3. Front page of GIS is everywhere (<http://www.ncsu.edu/gisined/gis4/sld009.htm>)

At the 2000 National Council for the Social Studies (NCSS) conference in San Antonio, GIS was received as a 'new' technology by in-service social studies teachers. Because the majority of social studies educators are prepared in history or political science, awareness of GIS has remained limited to those teachers active in geographic education. While school social studies projects combining GIS and history are just beginning to appear, GIS in social studies is still in its infancy. Yet its promise, especially for integrating technology and social studies**,** is great (Alibrandi, Thompson, & Hagevik, 1999).

NCSS 2000 Conference keynoter, James Billington, current Librarian of Congress and Director of the National Digital Library described the massive project underway at his agency. The significance of mounting millions of public documents into Internet-accessible files is a project that will have immense impact on social studies education in this century (the Library of Congress' American Memory website is http://memory.loc.gov/ammem/ndlpedu/index.html) . While the study of history has been traditionally limited to erudite scholars or elite academics, it will now be accessible to the public who 'own' the documents.

In itself, this single phenomenon occurring in our time represents a significant historical development. But what of this windfall? How will we make use or sense of this plethora of Internet-accessible information in social studies classrooms? This is an unique opportunity to transform social studies through developing what James Percoco (1995) called "applied history." We can expand this approach to what has been called 'conducting social studies' through problem-solving and original research. We can add value with the capacity to represent historic archival material in maps using GIS. In this way, both temporal and spatial relationships can be constructed by teachers and students.

Though 'science generally, and geography specifically, are two disciplines that have benefited greatly from recent technology advances' (Audet & Ludwig, 2000), GIS has not made in-roads into many teacher education programs'especially those focused on social studies certification. It is more likely for preservice science students to have had exposure to GIS in their undergraduate content area courses than in their education methods courses. For undergraduate, preservice social studies students with content majors in history, political science, anthropology, sociology, economics, psychology, or geography, it is likely that GIS is entirely lacking. Ironically, the data gathered in many of the social sciences is now being analyzed in GIS, but undergraduates are mostly unaware of the methodological technologies being used in their own fields of study.

Generally, in teacher education programs, GIS technology has not been integrated into content-area methods classes nor would teachers expect to use GIS in the classroom. In his paper, *A Nationwide Analysis of the Implementation of GIS in High School Education*, Joseph Kerski noted that 'despite the interest and the claims, GIS has been acquired by only an estimated 2% of approximately 106,000 K-12 schools in the United States' (Kerski, 1999). Citing Crechiolo's work of 1997, Kerski goes on to explain that adoption barriers for K-12 schools include 'limited access to hardware and software, insufficient preservice and inservice training, and the paucity of appropriate teaching resources' (1999).

From a set of high school teachers whose schools own *ArcView*, *Idrisi*, or *MapInfo* GIS softwares, 1,520 surveys were sent to a nationwide random sample. With 27% of surveys returned, Kerski (1999) found that GIS is 'much more frequently adopted by science teachers (52%) than geography teachers (28%)'. He suggested that science teachers are trained traditionally to experiment and to deal with open-ended systems such as GIS, and that science students have better access to computers. Based on our experiences, however, it is critical to point out that many schools do not offer stand-alone courses in geography (Palmer-Moloney & Bloom, in press). As can be seen in the New York school system website, (http://www.nysed.gov/home.html), geography is to be covered in social studies classes as one of many disciplines included in social studies learning. In North Carolina, geography is infused throughout the K-12 curriculum, and is offered as a stand-alone, only as a senior elective, described at http://www.dpi.state.nc.us/curriculum/socialstudies/worldgeog.html .

Why Integrate GIS in Teacher Education?

GIS is being used as a learning tool in some school settings, as showcased in the 1995 video, *Explore Your World: GIS in K-12 Education* (ESRI) and in the book GIS in Schools (http://www.esri.com/library/esripress/giss.html) (see Figure 4) (Audet & Ludwig, 2000). This first volume on the subject is published by the Environmental Systems Research Institute (ESRI), publishers of *ArcView* and *ArcVoyager* software. This introductory book could be used to acquaint teacher candidates with GIS to help them lead studies in life science, environmental science, and in social studies. While there are some exemplary K-12 teachers who use GIS in their schools, these teachers do not represent the norm.

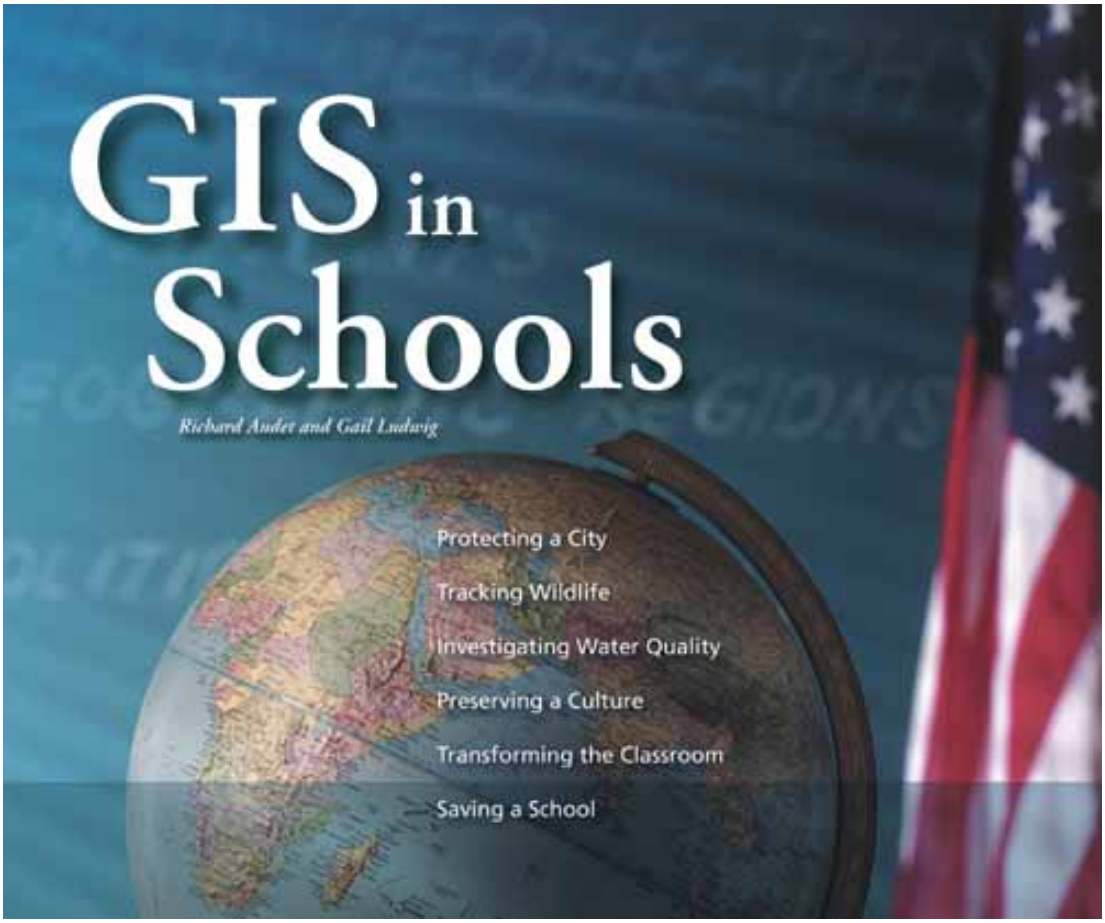

Figure 4. Cover of *GIS in Schools* (available on the Web at http://www.esri.com/library/esripress/giss.html)

The word about GIS in K-12, however, is getting out. In July 2000, ESRI sponsored the first GIS in Education conference (www.esri.com/index.html) in San Bernardino, California. The National Council for Geographic Education (http://www.ncge.org) continues to share GIS technology with those inservice teachers attending the annual meeting, and a number of state geographic alliances have included GIS workshops (http://multimedia2.freac.fsu.edu/fga/alliances.html) as part of their summer offerings.

The evolution of the two models presented here occurred in response to state education requirements in North Carolina and New York to incorporate technology in teacher education. Because of our individual interests and our institutions' lack of geography departments, we each developed different ways to address similar problems, those problems being:

- A need to infuse technology in teacher education
- A lack of geography departments and courses for social studies preservice students

Because each of our institutions lacks a geography department, and because national and state frameworks now include geography in K-12 curriculum and social studies (SS) teacher education, we have each tried to address our common needs. Because our two approaches evolved within contexts of different institutional capacities, our models are quite different. As GIS integration develops in teacher education in general, and in SS teacher education in particular, we hope that our early experimentation can help to inform further discussions.

Incorporating GIS in Teacher Education: Two Scenarios North Carolina Research I Scenario: A GIS in Education Course (by Marsha Alibrandi)

At North Carolina State University (NCSU), a Research I institution with a separate College of Education, there is a very small graduate program in elementary education and both undergraduate and graduate programs in secondary teacher education cross two departments. The current GIS class is offered through the Department of Curriculum and Instruction, which includes social studies and instructional technology. Secondary teacher certification programs are offered at both undergraduate and graduate levels. The university is considered the premiere institution of technology in the state university system. While there is no geography department, excellent resources in GIS are centered in the university library, and GIS courses are offered in several colleges across campus.

In North Carolina, the state implementation of a Technology Portfolio requirement for all initial teacher licenses issued after January 1, 1999, precipitated significant changes in preservice teacher education. New licensure demands for *competence* in several computer-based applications meant necessary additions to already-crowded methods courses across the disciplines (Noth Carolina Department of Public Instruction's Advanced Competencies can be viewed at their website: http://www.ncpublicschools.org/tap/advance.htm).

To integrate the technologies "seamlessly," a weekly computer lab session in Social Studies Methods (ECI 460, http://www4.ncsu.edu/~mlalibra/sshmpge.html) is included. Currently, Social Studies (SS) Methods undergraduates are introduced to GIS in only one or two sessions presented on geography as a framework for teaching SS using Gardner's (1983) theory of multiple intelligences. The eight-week preservice methods class must now address the technology portfolio requirements of word-processing, spreadsheet, *Power Point*, effective and ethical Internet searching and accession. In addition, students develop webquests and websites related to their first two weeks of instruction in the practicum. Subsequently, the website piece has found popularity with the cooperating teachers hosting these student teachers.

Figure 5. Videotaping of GIS

Our current focus in GIS integration is on a new course, GIS in Education, offered experimentally in the Spring semesters of 2000 (http://courses.ncsu.edu/8020/classes/eci496e002/website/eci496.htm) and 2001 (http://courses.ncsu.edu/eci496e/lec/002/). In its first year (y1), we recruited heavily from among SS candidates at the undergraduate and graduate levels. In the current course (y2), most of the students are M.Ed. candidates in Instructional Technology, and most are inservice teachers.

From prior research in five schools in which GIS instruction has been sustained, I had found some critical factors that supported GIS. GIS lasted at least three years where there was

- Collaboration with a community partner or partners.
- Interdisciplinary collaboration between teachers.
- Room for the development of electives and/or experimental courses.
- Institutional commitment to technology integration.

From this understanding evolved our current focus on introducing GIS to instructional technology candidates as technical support collaborators for SS and other teachers.

In y1 of the GIS in education course, graduate students were asked to respond weekly to questions reflecting on their learning of GIS. The course was coconstructed with student input, integrating their learning and needs as the syllabus was altered from week to week. By semester's end in May 2000, our instructional team was amazed at the progress students had made. Some had arrived not knowing how to save to a floppy disk, how to cut and paste, or how to open multiple windows. Over the course of the semester, each student developed his or her own .apr (ArcView project) with data gleaned from a variety of sources and had designed related lesson plans for integration with North Carolina curriculum.

By y2, the need for additional 'lab' time was mediated by the university's purchase of a number of 'seats' at ESRI's Virtual Campus course, Introduction to *ArcView*, the GIS software of choice in North Carolina. This builds in an asynchronous lab experience intended to provide practice and facility with the software application. Important to us were the social studies and science, technology, and society (STS) foci of critical reflection and ethical issues. O'Looney's *Beyond Maps* (2000 see Figure ?) is an excellent starting point for developing this understanding.

Figure 6. GPS field experience

In previous articles, I have written about the need for basing technology integration in *actual* experience, applying *virtual* technologies, raising *critical* issues and perspectives and practicing *ethical* use of the technology. But in y1, that actual component was limited to a single GPS experience. This year, the field component toward partnership development is an application of my own theoretical perspective. If my prior research is an indicator, the field visit will be an important component in sustained GIS integration. In Table 1, structural components of the course are compared.

The New York Scenario: Social Studies Methods Integration (by Jean Palmer-Moloney)

Hartwick College, a small, private, four-year college in upstate New York, is accredited by the New York State Education Department to recommend for certification those students who complete its secondary (7-12) education program. Students who want to become social studies teachers must major in history, sociology, anthropology, psychology, economics, or political science and must complete an equally full load of education courses to meet the requirements for social studies certification. In addition to content expectations, all upcoming teacher candidates must have had training in the use and application of technology for education.

Changes in the Regents New York State Education Department Regulations, dating to July 28, 1998, not only detailed what was required of preservice teachers for certification purposes, they specifically mentioned preparation standards for colleges and universities that offer education programs. The Regents Task Force on Teaching generated standards for teachers and policy regulations for teacher preparation programs aligned to the standards for teachers. Standards for teachers (and associated education programs) were stipulated in the NYSED document *Teaching to Higher Standards: New York's Commitment* (1998). The teacher was to have a solid foundation in the arts and sciences, a breadth and depth of knowledge of the subject to be taught, and an understanding of subject matter pedagogy and curriculum development. Response to the state regulations varied from institution to institution. Having a Department of Education with only two full-time, tenure-track faculty members, Hartwick College did not have the same options as did many larger state and private

institutions in New York.

According to the New York State Board of Regents Learning Standards for various content areas, the teaching of geography is the job of the social studies teacher. Because GIS emphasizes the process of spatial inquiry, it can be used in social studies classes for solving problems through spatial analysis (Palmer-Moloney, 2000).

Figure 7. Two teachers from Oneonta Middle School working with Arc Voyager at one of the training sessions offered by the Education Department at Hartwick College

All social studies students must take EDUC 328, Methods for the Teaching of Secondary Social Studies, in which these students study ways to teach social studies as content and ways to use technology to enhance their teaching and learning (see Handler, 1993,147-48). Because it allows greater differentiation of instruction, GIS technology has become an expectation for social studies students' lesson planning and instructional design.

Evolution of an Idea

Phase 1'The segment of New York State Highway 28 that runs through the upper Susquehanna River Valley became a focus of attention in Otsego County in 1999-2000. Eddie Einhorn, one of the owners of the Chicago White Sox, proposed the building of Cooperstown Baseball World (http://www.cooperstownbaseballwld.com/), a baseball camp that would attract players from around the country. His proposed park would be located on Hwy. 28, in the town of Hartwick, approximately 8 miles south of the village of Cooperstown, 'where it all began.' Einhorn felt that both he and the local residents and business owners could benefit from this new addition. However, his proposal was not universally accepted. Many of the locals voiced opposition to the plan, while others supported it. By March and April 2000, tension began to build, and town meetings in Hartwick were filled with supporters and opponents of Einhorn's proposal. Because of unresolved issues, Einhorn's camp opened in June 2000 in Oneonta, NY, not in Cooperstown.

Seizing the moment in the Spring 2000 semester, education students enrolled in the Social Studies Teaching Methods class at Hartwick College participated in an experiential, community-based project focused on the

Cooperstown Baseball World proposal. Using generalized USA information from ArcView and spatial data from the Otsego County Planning Office, the students were challenged to use GIS to *see* and *make sense of* the connection between the topography of the Susquehanna Valley, existing land use (farms, housing, commercial, restaurants, entertainment), the proposed baseball park, location of existing roads, and public opposition to and support for the proposed development. The importance of GIS was clear for understanding spatial relationships, for asking geographic questions, and for understanding, but the GIS analysis of the students was not represented in the exhibit. (For a look at this community-based project, see http://www.hartwick.edu/TLC/field/index.htm).

The 'Fields of Dreams' findings were organized into a museum exhibit that opened at the Upper Susquehanna Cultural Center on May 17, 2000. Although local schools were invited to bring social studies students to visit the exhibit, none came. Personal contacts with local social studies teachers revealed that this contemporary local issue, while interesting, would not be on the state tests. Teachers did not feel they could take time from the required curriculum to cover an interesting, contemporary social studies topic.

Phase 2'Though the 'Fields of Dreams' project had the potential for helping social studies teachers bring out the geographic aspects of social studies for their students, it did not happen. Upon reflection, this can be explained from the perspective of need-based community projects. Though the Greater Milford Historical Association and many of the citizens of Cooperstown, Milford, Hartwick, and the City of Oneonta were interested in having college students build an exhibit focused on Hwy. 28, local social studies teachers were not asked if they could take advantage of such a project. In typical ivory-tower fashion, Hartwick College's Education Department called to inform teachers of one more interesting resource they might want to use. The students and I did not work with the teachers to determine their needs beforehand.

Because it was important for me, personally and as a New York Geographic Alliance member, to see geography and community-based learning included in social studies education, I felt that it was critical to implement these ways of learning in the social studies methods class. However, if I wanted these students truly to use geography and GIS once they became teachers, I would need to try a different tack.

Phase 3'In April 1999, Hartwick College and Oneonta City School District (OCSD) entered a formal partnership sponsored by the New York Partnership for Statewide Systems Change 2001/Higher Education Task Force on Quality Inclusive Schooling to study ways to meet the learning needs of all students in general education classes. To initiate the partnership, Hartwick College Education Department offered five workshops on multiple intelligences theory and differentiating instruction for Oneonta's secondary educators (Gardner, 1983). As part of the learning process, teachers were asked to evaluate their own personal intelligence strengths'linguistic/logical/mathematical, musical, spatial, bodily/kinesthetic, intrapersonal, interpersonal, and naturalist. Then teachers were asked to generalize the intelligences of their students. Thanks to the special education teachers who participated, the general education teachers were reminded that many of their students'especially the special education students'don't always get it' through language, that is, books (reading and note-taking), discussion, or lecture. However, many of the students do 'get it' when they see/visualize what they are being taught'they tend to have stronger spatial intelligences than linguistic.

Figure 8. Jessica, a Hartwick education student in the combined Social Studies and English Teaching Methods class, comments on the effect of the project

Social studies teachers who participated in the workshops recognized the need for varying the way content was presented (http://www.hartwick.edu/tlc/Pedapractice.htm). For the students to learn by seeing/visualizing, they realized the need to present social studies using maps, graphs, and charts. These teachers began to understand the role of geography/GIS in social studies when Hartwick faculty affiliated with New York Geographic Alliance presented geotechnologies as tools to help them differentiate their instruction. However, these same teachers have many different levels of comfort with computers and technology in education and not all felt comfortable working their way through *ArcVoyager* (Wetzel, 1993, pp. 22-27).

Phase 4'In Fall 2000, Hartwick College, through its Teaching and Learning Community, identified five key public agencies as 'community partners.' One of those partners was Oneonta City School District. This joint partnership opened the door for Hartwick preservice teachers and faculty and Oneonta City School District administrators and in-service teachers to work collaboratively. Instead of bringing ideas from the ivory tower to the schools, we began to work together to define needs and to propose ways to meet the needs.

The social studies methods class was redesigned to fit this new paradigm. It was Hartwick's charge to educate the preservice teachers in methods for teaching social studies. In-service social studies teachers were expected to include geography because it is one of the Social Studies Learning Standards for New York State. Also, because both teacher preparation programs and K-12 schools in New York are expected to bring more technology into the classroom, the place of GIS became obvious. The methods students are expected to learn to teach social studies *with* GIS technology, but they do not have to become experts in learning to *do* GIS. The social studies methods students are now expected to collaborate with in-service social studies teachers to bring GIS/geotechnology to existing social studies curricula. To accomplish this, the following specific goals and objectives have been added to the methods class:

Goals

- To develop a working partnership between Hartwick College and Oneonta City School District.
- To familiarize in-service and preservice social studies teachers with geotechnologies (GIS, GPS, and remote sensing).
- To provide GIS resources for in-service social studies teachers at Oneonta Middle School/Oneonta High School.
- To encourage preservice and in-service social studies teachers to add GIS technology to their classes.
- To provide spatial-learning tools to help pre- and in-service social studies teachers differentiate instruction.

Objectives

- Collaboration between preservice students and in-service social studies teachers
- Collaborative review of existing curricula.
- Developing understandings of what GIS can offer social studies curricula.
- Developing a geography/GIS rich resource base to support social studies curricula.

The class itself has been designed to fit the timeframe presented in Table 2:

Table 2. Hartwick EDUC 328 Methods for the Teaching of Secondary Social Studies

Week 1	Students become familiar with geotechnologies and ways GIS and remote sensing data are useful.
Week 2	Students meet with middle school social studies faculty to review current curricula. Student/teacher decide units that need imagery.
Week 3	Students work with the following data areas to find fitting geographical images/maps/spatial information to fit with unit lessons · *ArcVoyager*, *ArcView* 3.2, the ESRI lesson bank · SPOT satellite imagery CD, · Landstat/NASA images, the NASA web site http://www.nasa.gov · National Council for Geographic Education's Remote Sensing Task Force web site (http://www.oneonta.edu/~baumanpr/ncge/rstf.htm)
Weeks 4 & 5	Students work on aligning images to lessons and to Learning Standards for Social Studies.
Week 6	Students present revised unit lessons to in-service teachers at a Middle School faculty meeting

At the time of this writing, Methods for Teaching Secondary Social Studies has been restructured, students have registered, and *ArcView* and *ArcVoyage*r software programs have been installed at Hartwick and at Oneonta Middle School. The Hartwick Center for Learning and Teaching with Technology has been informed of this new approach to the social studies methods class, and the technical support staff is on the alert. The Oneonta Middle School social studies faculties are waiting to meet the students and to begin the collaboration. Now the real work of research and development on the effectiveness of GIS/geotechnology in social studies education begins.

The partnership has morphed into a collaborative action community (as in Pierson & McNeil, 2000), where the college students and the middle level teachers work together toward a common goal: improving social studies education. There must be effective articulation between the college and the middle school. We must all work collaboratively to make the partnership/community effective and to make the addition of GIS and geotechnologies effective, since 'just because it's happening doesn't mean it's working' (McLaughlin, Watts, & Beard, 2000, p. 284).

Conclusions and Implications

In our experimentation, each of us has learned certain lessons, and each has tried to inform her practice accordingly. Both university-based and community-based nodes have important roles and places in collaborative networks that support GIS integration. Those forging GIS integration know well the necessity of networking with fellow educators, with students, and with industry and agency partners. GIS integration more directly reflects the networked landscapes of the 'information age' workplace; the workplace in which today's K12 students will spend their working lives.

Both authors are involved in the research and development of social studies education in such a landscape. At this point, there is no map to follow. The addition of GIS technology into social studies education means stepping into the unknown, taking risks, creating pathways and experimenting. Indeed, these are the very landscapes we ask teachers to create for themselves. It requires constant articulation and reflection to determine what worked, what didn not, what worked in unintended ways, and what could be done to facilitate the work to make it more effective in its next iteration. This requires institutional support and personal time and dedication. The time commitment is often overwhelming. Both authors strongly believe that there are transformative benefits to GIS integration in social studies. Moved to take the challenges for social studies and technology from our respective state education departments, we have met them by incorporating GIS.

Developing distributed collaborative learning environments means acting as teachers and learners and requires infrastructural support. The learning curve is steep for each of us, even now. There is still a lack of research to support the bridging of GIS technology with social studies education, yet our research and development is in the experimental *practice* of GIS integration. GIS integration requires technical support. Neither of us is a GIS technician. As professors in departments of education, we walk between the worlds of education and geography and see the use of GIS as a bridge in that new landscape.

We navigate the dangerous divide across the 'love/hate' relationship between education and innovation. Social studies is largely the domain of those who love history; the stories that have been told and retold. To think differently about what history *is*, how it is shaped, documented, represented, stored, archived, and reinterpreted by whom, in whose interest and through which media is where we see the horizon for 'conducting social studies.' In the historical context of standards and testing driven by publishing interests focused on traditional contents of social studies, there seems little hope for integrating GIS for 'conducting social studies.' Yet many await the inevitable return of the pendulum. The skills of interpretation, research, and representation are those embedded in the social studies and can be enhanced by GIS. With its application are opportunities for integrating actual experience, virtual application, critical reflection, and ethical practice of conducting social studies.

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Table 1. Comparative Components of a GIS in Education Course, Years 1 & 2

(shaded areas in progress)

	Year 1 2000	Year 2 2001
Instructional Team	• Professor • In-service Instructional Tech teacher • 2 Graduate student TAs • 1 Eighth grade student TA	• ' Professor • 3 Graduate students of GIS** **1 an instructor in the previous year; 2 students in the previous year
Student Population	• **4** Undergrad SS pre-service • **7** M.Ed. students: 4 SS (1 IS) 2 I Instructional Technology (2 IS) 1 SPED Total 3 Inservice) teachers (IS)	• **8** M. Ed. Students; 6 Iinstructional Technology (5 IS) 2 Science Education Total 5 In-service teachers (IS)
Texts & Computer applications	• *Getting to Know ArcView* • ArcVoyager • ArcView • *Beyond Maps (1997)* (selections)	• *GIS in Schools* • ArcVoyager • *Getting to Know ArcView* • ArcView • *Beyond Maps (2000)* • *Spatial Anallyst*
Online Components	• 'www	• www • ESRI Virtual Campus
Guest speakers	• NCSU GIS Library resources w/ NCSU GIS Librarian • NCGS technicians (on GPS) • Graphic Design Prof.	• NCSU GIS Library resources w/ NCSU GIS Librarian • NCGS technicians (on GPS) • Possibly others
Field Experience	• On campus with GPS guest speaker	• On campus with GPS guest speaker • Establish community partner connection & visit a GIS office.
Products	• "Where are You?" Activity; layout with questions on line (In ArcVoyager) • Problem-Based Learning Activity • Original .apr project with imported data, maps and lessons	• "Where are You?" Activity; layout with questions on line (in ArcVoyager) • Power Point presentations • Problem-Based Learning Activity • Original **.apr** project with imported data, maps and lessons

be accessed on the World Wide Web at http://www.citejournal.org