AUTHOR: A. David ***Hill***; Michael N. Solem

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ABSTRACT

Computer technology has a rich history in geography education. The Internet represents the latest in technological advancements that continue to have important effects on geography curriculum and instruction. Many geographers are involved with Internet-based instruction, which some educators believe has potential to facilitate changes in how we teach and even what we teach. This article describes how the Internet is being used by some geographers for instructional purposes and discusses opportunities for improving teaching and learning with the Internet.

Key Words: geography, constructivism, curriculum, Internet

Advancements in computer technology continue to create new frontiers in geography education (Nellis 1994). The most recent change comes in the form of teaching with the Internet, a telematic information system that links millions of computers worldwide. The Internet permits users to access and transmit textual, graphical, audio, and video files instantaneously via electronic networks. Given the importance of technology and graphics in modern geographical practice (Geber 1995), the Internet's potential to integrate computer-assisted learning in geography cannot be overlooked (Bishop et al. 1995). For example, the World Wide Web can be used to access on-line spatial databases (e.g., U.S. Census Bureau statistics), support geographical hypermedia (e.g., digital maps), and expand the spatial and temporal dimensions of our learning environments far beyond the traditional classroom.

It is difficult for some geographers to understand the broader curricular implications of the Internet because of an absence of systematic studies on its educational uses. This article begins to examine the use of the Internet in higher education and speculates on its potential to change the learning paradigm in geography. First, we briefly discuss pressures for change that are encouraging academic institutions to rethink traditional approaches to undergraduate instruction. Second, we identify some organizational issues that compound efforts to implement new instructional technologies in higher education. Third, we raise the question of whether the Internet has changed educational purpose and practice in geography. Fourth, we discuss opportunities for improving teaching and learning with the Internet. The article concludes with a description of a World Wide Web-based experiment with which the authors are involved.

PRESSURES FOR CHANGE

American colleges and universities are being forced to restructure their programs because public funding for higher education is either flat or in decline (Ernst et al. 1994) and because American businesses and workers face new opportunities and competitive pressures with globalization. These factors are challenging the knowledge and skills of students and workers in new ways, and, in turn, have increased state and public pressures for accountability and restructuring (***Hill*** 1995a). Under these circumstances, colleges and universities are struggling to cut costs while trying to serve the rapidly changing needs of society.

Ernst et al. (1994) argued that new information technologies such as the Internet can help academic institutions meet these new challenges. Indeed, many authors believe that information technology can enhance faculty productivity (Massey and Zemsky 1996), reduce operating costs (Heterick 1993), improve teaching (Menges 1994, Oblinger and Maruyama 1996), and enhance student learning (Hedberg et al. 1994). Recognizing that technological

change is inevitable, institutions are reallocating their resources to implement technology-based instruction and academic services.

How should geographers respond to these problems? What role will new information technologies play in geography curricula? Is it possible to achieve good educational practice with computer-based instruction? There are, of course, many possible answers to these questions, and our options will be conditioned by the realities of contemporary higher education.

INSTITUTIONAL ISSUES OF IMPLEMENTATION

Geographers work in different institutional contexts, which will likely influence how favorably Internet-based teaching is perceived and, in turn, how it is implemented. Overall, research universities may be in the best financial position to provide geographers with the means to adopt Internet-based instruction (Ernst et al. 1994). Darby (1994) argued that high costs associated with technology make it difficult for smaller academic institutions to provide sufficient access to computing, a factor that Kehr (1986) found to be responsible for negative perceptions of computer-based teaching at a liberal arts college. According to Katz (1993), research universities tend to have more funds to construct and maintain an extensive technological infrastructure (e.g., teaching laboratories and "smart" classrooms). As a result, adoption of Internet-based teaching (especially courses that feature a lot of Web-based materials) may be more readily accommodated at research institutions.

On the other hand, liberal arts colleges may be more inclined to reward faculty for efforts to improve teaching. Katz (1993) argued that research faculty have less time to devote to teaching because of institutional pressures to publish research (although this may be changing--some research universities are rewarding research associated with teaching). In contrast, research demands at liberal arts colleges are more lenient, and faculty may receive greater recognition for their teaching.

Incentive programs can provide dividends to faculty willing to experiment with computer-assisted learning. Because many faculty are unfamiliar with some of the more technical aspects of the Internet, training requirements can consume a considerable amount of time that faculty may not have (Howard-Vital 1995, Massey and Zemsky 1996). If, however, institutions provide incentives to mitigate these concerns, faculty may perceive Internet-based teaching more favorably than otherwise. Increasingly, instructional technology (IT) is being promoted with reallocated institutional resources. For example, Pennsylvania State University's IT Initiative provided faculty with free desktop computers, multimedia software, and technical support (Morrow and Boettcher 1994). In 1996 the University of Colorado encouraged faculty to develop IT with a grants-based program called The President's Initiative for Changing the Learning Paradigm Through the Use of Technology. The Alliance for Technology, Learning, and Society (ATLAS) at University of Colorado at Boulder was established in 1997 in order to develop and sustain teaching, research, and outreach related to information and communication technology. Examples such as these led Meyer and Berger (1996) to view incentives as influential agents in the diffusion of pedagogical innovations.

Perceptions of innovations may be affected by many interpersonal factors. For example, some faculty are intimidated by the perceived complexity of computer technology (Gerber 1995). This may be truer for older faculty than for younger faculty whose recent graduate training involved intensive use of computers. Other potentially important factors include tenure status and research specialization. Nontenured faculty may feel pressured to devote extra time to publishing research and, consequently, may perceive teaching with the Internet in unfavorable terms. Geographers with research interests that focus directly on computers and graphics (e.g., GIS) may perceive Internet-based teaching more positively than others.

Although it is clear that implementing computer-assisted teaching and learning involves many organizational issues, the precise relationships between perceptions of Internet-based teaching and its adoption in different institutional contexts remain unclear. Solem (1998) is examining this problem in the context of U.S. college geography. In any case, many voices are arguing that new information technology will inevitably change the ways faculty teach and students learn. Is a new learning and teaching paradigm emerging?

THE INTERNET AND EDUCATIONAL PURPOSE AND PRACTICE

Many authors believe that the Internet can facilitate major changes in the form and delivery of undergraduate education (Oblinger and Maruyama 1996). Currently, the lecture is the dominant method of college instruction, but increasingly, educators are using new technologies to place a greater degree of control over learning in the hands of students. This trend marks a shift toward constructivism, the theory that people, influenced by their values and cultures, learn through their own experience as they actively inquire into meaningful problems (Scheurman 1998). Constructivists believe that students interpret facts in subjective contexts and construct facts into context-specific meanings. In other words, knowledge is the product of the experience of the learner interacting with the

environment. Committed constructivist teachers view themselves as facilitators or even collaborators in the learning process.

A shift toward constructivism implies a shift away from behaviorism, which is the view that students learn by acquiring a previously established and accepted body of information. Behaviorists would take a structured, deductive approach for the efficient transfer to their students of facts, skills, and basic concepts. The behaviorist-oriented teacher tends to play the role of information transmitter and manager in the learning process (Scheurman 1998). In reality, one is likely to find many teachers practicing a mix of these and other approaches.

Just as certain teacher-practices may be associated with particular learning theories, so too do instructional materials tend to have certain identifiable characteristics. Behaviorist materials, according to Atkins (1993, 254), include:

* prior definition of objectives with explicit and measurable criteria for assessment of performance;
* material broken down into small, logically discrete instructional steps;
* material often presented in the form of a rule, category, principle, formula, or definition followed by examples and implications of the rule, category, etc., applied;
* learning activities sequenced for increasing difficulty or complexity;
* opportunity provided to observe, review, and copy the desired behavior;
* the sequence and pacing through the material is usually out of the learner's control;
* frequent review/revision with check tests at strategic points.

General characteristics of constructivist instructional materials include (Atkins 1993, 259-260):

* learner required to engage with the material;
* learner expected to analyze, synthesize, summarize, describe, and solve problems;
* learner interacts with "expert";
* learner invited to explore and discover an environment, sometimes with guidance;
* learner expected to build up own hypotheses, explanations, definitions, categories, rules, etc., through study of examples and reflection on own experiences;
* learner moved back and forth between symbolic representation of phenomena and the real-life referent.

Kafai and Resnick (1996) argued that the interactive, user-centered, and "open" structure of the Internet makes it an ideal technology with which to design constructivist learning environments. Many educational researchers believe that well-designed constructivist teaching materials enhance the learning and appreciation of a subject (Fosnot 1996). In addition to these advantages, the learning orientation of constructivism is quite pragmatic.

Constructivist learning environments are similar to the modern work place where the emphasis is on problem solving, collaboration, and application of skills (***Hill*** 1995a). Hence, many educational theorists have called for a change in educational practice to exploit the practical advantages of constructivist education (Oblinger and Maruyama 1996).

Menges (1994) argued that bringing groups of students together to hear information presented by professors can no longer be justified as the dominant method of instruction. Geographers can capitalize on the power of the new technologies to provide information to the student. This can change the role of the teacher, replacing the teacher as a source of information, and freeing up the teacher to work more as a facilitator of student learning (Scheurman 1998). Does the Internet offer any prospect of a learning facilitator/collaborator dividend? We think it does.

OPPORTUNITIES FOR IMPROVING TEACHING AND LEARNING?

As we contemplate the use of computer-based technologies in teaching, we face the recurring question: Do these technologies help us improve teaching and learning, and if so, how? (***Hill*** 1996). Unfortunately, as yet little systematic knowledge is available on this question, but we do know something about good educational practice in undergraduate education. A study supported by the American Association of Higher Education, the Education Commission of the States, and the Johnson Foundation looked at 50 years of research on educational practice. From that study, Chickering and Gamson (1987) summarized seven principles for good practice in undergraduate education, saying that good practice

1. encourages student-faculty contact,
2. encourages cooperation among students,
3. encourages active learning,
4. gives prompt feedback,
5. emphasizes time on task,
6. communicates high expectations, and
7. respects diverse talents and ways of learning.

These principles do not, of course, depend upon the use of computer-based technologies, but a high-tech

information environment is not only compatible with these principles, but can also facilitate them.

Menges' descriptors of shifts in the teaching/learning paradigm with computer technologies can be organized under the seven principles of good practice, as follows (***Hill*** 1996).

1. Student-faculty contact

a. teachers shift from lecture and recitation modes to coaching and facilitator modes

b. teachers shift from whole-class instruction to small group instruction

2. Cooperation among students

a. group projects take on new forms (e.g., exploring electronic datasets, searching video and audio archives, and electronic publication)

b. with access to extensive data bases and sharing through networked communications, collaboration can be encouraged

c. since electronic technology permits almost infinite variability in the tasks that group members pursue, a shift is encouraged from grading according to individual attainments to grading according to collaborative contributions

3. Active learning

a. with interactive technology, attention is assured

b. instruction comes to a halt when there are no responses from learners

c. shift toward more engaged students

d. shift from covering material to assisting students in sampling material

4. Prompt feedback

a. students can use e-mail to ask questions of the teacher and to submit assignments

b. students learn to navigate the information highway

c. shift from unilaterally declaring what is worth knowing to negotiating criteria that identify what is important

5. Time on task

a. the Web encourages exploration (surfing), which can absorb vast amounts of time, so students need help to allocate realistic amounts of time to well-defined projects

b. experience with open-ended assignments is also valuable, but these should also be constrained by realistic deadlines

6. High expectations

a. teacher time can shift from working with better students to working with weaker students

b. basis of assessment can shift from test performance to products and progress

c. shift from requiring students to reproduce knowledge to rewarding them for demonstrating originality (i.e., constructing discipline-based knowledge)

7. Respecting diverse talents and ways of learning

a. shift from students learning the same things to different students learning different things

b. shift from the primacy of verbal thinking to the integration of visual and verbal thinking

We believe that teaching with the Internet can enhance geography education, and that geographers teaching with the Internet evince the leading edge of a new teaching/learning paradigm. University of Texas at Austin geographer K. E. Foote is arguably the leader of this paradigm. He created the Virtual Geography Department (VGD)(FN1), which is fostering collaborations between geographers in the development of Web-based educational resources that will be available for use worldwide. For the three-year period, 1996-1998, the VGD had 144 participants from 117 colleges and universities in summer workshops and other meetings. Thirty-one participants were workshop repeaters. By mid-1998, VGD participants had developed Web materials for between 100 and 200 geography courses, which represented about one-third of the geography courses on-line worldwide. Each semester, some 50-100 new homepages for courses were appearing, and the rate of appearance was increasing (K. E. Foote, personal communication 1998).

Geographers have begun to explore synergies between the Internet, constructivism, and geography in their courses. Two examples of new Internet-based teaching approaches are the Geographer's Craft(FN2) and the University Consortium for Geographic Information Science (UCGIS) Virtual Seminar. Begun in 1991 by Foote, the Geographer's Craft is a two-semester Web-based course that introduces students to geographical research methods (Foote 1997). In this course students use the Internet to synthesize a variety of geographical techniques in order to solve problems. Rather than merely learning about the outcomes of scientific inquiry, students are taught how to inquire into problems from a geographic perspective. According to Foote (1997, 2),

> ...the principal difference lies in the way students gain experience with geographical information systems, spatial analysis, cartography, remote sensing, and field methods. Rather than teaching these methods separately, the Geographer's Craft employs a problem-solving approach in which students learn these techniques, sometimes concurrently, as they address realistic research topics. The idea is to use engaging topics to teach broader lessons

about how researchers and practitioners conceptualize theoretical and practical problems and approach them with appropriate methodological tools. The real goal of each project is to sharpen the student's analytical reasoning abilities while building their proficiency in a variety of technical skills.

Traditionally, course evaluations come from the students taking the course, but when a course is put on-line, its audience multiplies and course evaluation takes on entirely new dimensions. The Geographers Craft, valuable as it appears to be for University of Texas (UT) students(FN3), has also been a resource to anyone else with access to the Internet. All materials prepared for the course are maintained on-line and can be used by anyone studying or teaching GIS, and non-UT-student use has been extensive. Monitoring activity on the course's Web server revealed that UT students called 3,000-5,000 files per week from the materials, but the total number called was between 100,000 and 150,000 files per week by 1996 (Foote 1997). By mid-1998, the numbers had reached 150,000-200,000 per week (K. E. Foote, personal communication 1998).

In 1997 UCGIS experimented for the first time with a virtual seminar that was taught concurrently at State University of New York at Buffalo, Clark University, University of Colorado, University of Georgia, Hunter College, Ohio State University, San Diego State University, University of California-Santa Barbara, University of Washington, and West Virginia University (B. P. Buttenfield, personal communication 1998). The course introduced students to the theoretical foundations of geographic information science. Students enrolled in the semester-long course used the Internet to collaborate on course assignments, discuss issues related to the use of GIS, and conduct Web-based research.

Organizers of the virtual seminar gathered to assess their experiences in a session of the Association of American Geographers (AAG) conference in Ft. Worth in 1997 (The Virtual Seminar: Experiences from a Web-based Graduate Course in GIS), and instructors plan to write-up the experience for publication (B. P. Buttenfield, personal communication 1998). Discussion at the AAG session mentioned several valuable aspects of the virtual seminar. Participants found that interaction with others working in the same area introduced them to fresh perspectives and broader views than they found in the usual seminar. Communicating through postings allowed time to formulate more thoughtful responses than were typical of most face-to-face seminars. All students participated and contributed to discussions--the usual shyness was not a problem. The virtual seminar was not, however, an unadulterated success. One of the biggest problems was the lack of simultaneity in students' schedules. Because some were on the quarter system and some were on the semester system, coordinating time and topic schedules was difficult--those on the quarter system met more frequently and thus faced more intensive schedules. Despite such problems, most students said they would take another virtual seminar.

The Geographer's Craft is a fully developed Web-based course that has been taught since 1991, while the Virtual Graduate Seminar in GIS was a one-time, almost ad hoc experiment, yet both represent curricular developments that would have been impossible only a few years ago. It is unknown how extensive these kinds of practices are in geography. The full range of Internet-based instructional techniques and experiments in geography have not been documented, but it is clear that experimentation is increasing rapidly. We turn now to offer a detailed look at one local experiment for which the present authors are responsible.

COLORADO GEOGRAPHY-WEB PROJECT

Our multicampus Geography-Web(FN4) project at University of Colorado (CU) seeks to integrate the Internet with existing courses to improve the quality of the learning experience for a significant number and a special segment of the student population in large geography lecture sections. Introduction to Human Geography and World Regional Geography are two courses taught on all three campuses; these courses enroll about 250, 350, and 2,000 students annually at CU-Denver, Colorado Springs, and Boulder, respectively.

THE CU-BOULDER GEOGRAPHY REQUIREMENT

Since 1988 the College of Arts and Sciences on the Boulder campus has required entering students to meet Minimum Academic Preparation Standards (MAPS) in geography (Denver and Colorado Springs do not have a MAPS in geography). Because of inadequate high school preparation in geography, many entering students in Boulder are deemed deficient in this requirement. To make up this deficiency they must take one of four one-semester geography courses, typically in very large sections (150-500 students per section). The quality of the educational experience in large lecture courses is often less than optimum, but it is especially problematic for students who are taking the course to make up a deficiency. Under these circumstances students often view the course as a burden rather than as an opportunity, a factor that can militate against student retention. Therefore, it was decided to focus new resources on these geography MAPS courses and try to recast them in a new learning paradigm that would

capture the imagination of, motivate, and aid in the retention of class material for this very large group of students.

Since Boulder, Denver, and Colorado Springs teach equivalent courses, more students can be reached and, presumably, economies can be achieved by bringing all three departments under a multicampus effort to enhance these shared courses. That is the purpose of this project. We hope to pave the way for enhanced course materials, alternative and creative options for fulfilling specific course requirements, and greater communication between faculty, teaching assistants, and fellow students.

PRODUCTS PRODUCED

Thus far, the Geography-Web project has developed five on-line, interactive lessons (four virtual field studies and a lesson), homepages for six courses, and links to numerous other Web resources. Lessons developed are placed in a clearinghouse so they may be used in the targeted courses on all campuses. Currently no passwords are used, so the lessons may be accessed by anyone on the Web. The four virtual field studies are the Boulder Creek Virtual Field Study, a lesson on the flood hazards and land use in central Boulder; the Flood Hazards of Manitou Springs, a town near Colorado Springs that is periodically afflicted by flooding; Mt. Rainier, a lesson focusing on volcanic hazards; and Boulder's University ***Hill***, a study of socioeconomic conditions in a commercial/residential space adjacent to the University of Colorado-Boulder campus. In addition, a lesson on places and regions introduces the concept of regions and examines how definitions and perceptions of regions are affected by globalization.

Many of Geography-Web's lessons were designed to engage students in geographic practice as they acquire, map, and interpret real data to answer authentic questions. For example, the Boulder Creek and University ***Hill*** Virtual Field Studies involve a combination of work on the Web and in the field and give students an opportunity to study the local geography of Boulder. These lessons are modeled after ***Hill***'s (1990) issues-based geographic inquiry model, which served as the conceptual basis for an earlier University of Colorado-based materials project entitled Geographic Inquiry into Global Issues (GIGI) (***Hill*** 1995b). Research has shown that GIGI's constructivist approach can improve cognitive outcomes in secondary geography education and has potential to enhance affective outcomes (Klein 1995). We hope the Geography-Web lessons have similar results for college students.

An additional feature of the Geography-Web site is a collection of links to University of Colorado geography course homepages. The course homepages contain new interactive learning exercises, including cooperative learning projects; links to course resources available on the Web (e.g., databases from World Resources Institute, Population Reference Bureau, World Bank, and United Nations Development Program); course management tools, including syllabi, exams, and self-evaluation programs; and e-mail listservers for student discussion groups, faculty-student feedback, and instructions for using the enhanced course materials.

INCREMENTAL CHANGE

This project is not the first effort to improve these courses. In 1995 the Boulder department added recitations to its MAPS courses to offer some more personalized instruction in what otherwise was a large lecture format; most important has been the use of the recitations for hands-on activities and to cultivate critical thinking. Also, Boulder has recently spread the teaching of MAPS courses among more faculty, including more senior members. Nor is this project the first effort in applying computer-based technology to geography courses. Automated cartography and geographic information systems have of course been essential, computer-based elements of the curriculum for some time, and in 1997 Don Mitchell developed a Web-based version of Introduction to Human Geography for distance learning through continuing education at CU-Boulder. Beyond the current project, we want to build dedicated computer labs so that group work and discussion can be integrated with Web-based activities.

Thus, the present project should be seen as one of several steps toward the long-term goal of using technology to engage students thoughtfully and imaginatively in geography. We envision making progress toward this goal as we become increasingly able to

* enhance courses with substantial use of maps, satellite imagery, charts, and aerial photography in order to accommodate a wider range of learning styles than is typically addressed in large classes and to capitalize on student interest in visual, computer-based educational resources;

* make digital course materials available for student study, review, and self-evaluation outside the classroom;

* construct some course assignments with a computer option, especially those involving visualization and mapping, so that students have the opportunity to encounter the potential utility of computer graphics and geographic information systems;

* expose students to a wider range of information and expertise than is normally available in very large lecture courses; and

* engage collegial faculty groups in new pedagogy, including new lecture and recitation techniques utilizing smart

classrooms and facilitation of active learning through Web-based interactive learning exercises.

SUMMARY AND CONCLUSION

Computer-assisted learning has a rich tradition in geography education, and past diffusions of computer technology (e.g., GIS) greatly affected geographic curriculum and instruction. Clearly, teaching with the Internet represents another frontier for geography education. In practice, the Internet provides instructors with new options for course content and management, creating instructional materials, evaluating students, and delivering learning experiences. The examples described in this article illustrate the Internet's potential to introduce rich instructional techniques to the college geography classroom.

Geography education can make a paradigm shift from the didacticism of the traditional lecture hall to the technology-rich, constructivist environment partly by encouraging many local experiments in teaching practice with information technologies. At the same time, we must encourage research in order to help us make this shift as educationally efficient and effective as possible. Research is needed to collect and systematize the trial-and-error wisdom gained by many local experimenters imenters, and specifically to help us know whether geographers are considering what pedagogic methods are effective with the Internet, are carefully defining learning objectives for their instructional materials, are determining how learning can be enhanced with the Internet, and are deciding how student achievement in Internet-based courses can be assessed. Systematic answers to these and other questions will provide signposts for geographers using the information highway to help students learn about their world.

ADDED MATERIAL

A. David ***Hill*** is Professor Emeritus in the Department of Geography, University of Colorado at Boulder, Boulder, Colorado 80309-0260 USA.

Michael N. Solem is visiting Assistant Professor in the Department of Geography and Environmental Studies, University of Colorado at Colorado Springs, Colorado Springs, Colorado 80933-7150 USA.

FOOTNOTES

1 http://www.utexas.edu/depts/grg/virtdept/contents.html

2 http://www.utexas.edu/depts/grg/gcraft/contents.html

3 K. E. Foote kindly allowed us to inspect student course evaluations over a three-year period, 1994-1996.

4 http://www.colorado.edu/geography/COGA/geogweb/

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