

# Collaborative Inquiry at a Distance: Using the Internet in Geography Education

*James M. Hurley, James D. Proctor, and Robert E. Ford*

## ABSTRACT

This article describes how an experimental geography seminar utilized Internet communication tools in conjunction with constructivist strategies to actively engage geographically distant students in the process of collaborative inquiry and comparative analysis. Review of the evidence suggests that the application of constructivist-inspired teaching and learning strategies together with Internet communication tools served to facilitate geographically distant students in a dynamic process of collaborative inquiry and comparative analysis. However, both the application of constructivist-based strategies and the integration of Internet tools require considerable time, effort, and resources that may deter some geography educators from implementing similar Internet-based collaborative learning environments.

*Key Words: cooperative learning, constructivist pedagogy, distance learning, Internet*

*James M. Hurley is a Doctoral Candidate in the Graduate School of Education, University of California, Santa Barbara, Santa Barbara, California 93103 USA.*

*James D. Proctor is Professor in the Department of Geography, University of California, Santa Barbara, Santa Barbara, California 93107 USA.*

*Robert E. Ford is Professor in International Studies, Westminster College, Salt Lake City, Utah 84105 USA.*

As geography educators continue to expand their curriculum to incorporate Internet-based communications tools, it is appropriate to consider what pedagogical strategies may best complement the use of these tools for geography education. This article begins with a brief overview of the tenets of constructivist theory and a discussion of some of the various teaching and learning strategies that can be employed to apply constructivist theory to the practice of geography education. This is followed by examples of how the Internet has been employed in geography education. We then describe an experimental geography course and, through analysis of qualitative data, discuss the strengths and weaknesses of the course's design and implementation. Finally, we discuss the need for further research into the application of constructivist pedagogical strategies in Internet-based collaborative learning environments.

## CONSTRUCTIVISM, THE INTERNET, AND GEOGRAPHY EDUCATION

### Constructivist Theory

As a response to the difficulties seen in other learning theories (e.g., behaviorist, information processing) constructivist theories evolved from the field of cognitive science and the thinking of numerous educational psychologists and philosophers such as John Dewey, Lev Vygotsky, Jean Piaget, Jerome Bruner, and Seymour Papert. Constructivist theorists have found it difficult to settle on a single definition for constructivism given the many divergent branches and interpretations of constructivism. Molenda (1991,47) observed that, "constructivism comes in different strengths...from weak to moderate to extreme." However, some general pedagogical strategies seem to emerge consistently from most perspectives of constructivism.

John Dewey's notion that instruction should be centered around activities that are relevant and meaningful to a student's own experience has become a fundamental premise of constructivism. Similarly, seminal constructivist theorist Lev Vygotsky "emphasized the importance of social relations in all forms of complex mental activities" (Prawat 1993, 10). Gage and Berliner (1988, 126) interpreted that, "In the zone of proximal development, social knowledge-knowledge acquired through social interaction-becomes individual knowledge and individual knowledge grows and becomes more complex." Vygotsky's work

clearly influenced constructivist concepts emphasizing the importance of learning through collaborative, social activities as well as focusing instruction on each child's personal experiences, creativity, and differences.

Piaget, also a very influential constructivist thinker, "viewed the human mind as a dynamic set of cognitive structures that help us make sense of what we perceive" (Brooks and Brooks 1993,26). Papert's (1980, 7) work acknowledged Piaget's constructivist notion of looking at children as active "builders of their own intellectual structures." He emphasized that education could provide rich, motivational environments to foster cognitive growth, and that the microworlds of a computer, properly designed, could assist in providing such complex environments. Further support for constructivist theory is provided by the work of Bruner (1973), who felt that at each stage of intellectual development, education could be made more relevant to students' needs and that teacher intervention could promote active participation in the learning process. By providing discovery learning environments educators could encourage children to explore alternatives and recognize relationships between ideas (Bruner 1973). Constructivist educational researchers Brown et al. (1989) articulated that students should engage in problem solving in settings familiar and useful to the student. They emphasized that this notion of situated cognition could be achieved most effectively in collaborative, group-learning environments.

### **Theory into Practice: Constructivist-Inspired Strategies**

As various constructivist theories of learning have taken shape, educators have identified some common constructivist-based teaching and learning strategies that can be employed in constructivist-oriented learning environments. Roblyer et al. (1997,72) suggest that constructivist-based learning environments frequently:

- involve problem-solving activities,
- provide visual formats and mental models of the problems to be solved,
- provide rich learning environments,
- involve cooperative or collaborative group learning,
- promote learning through exploration, and
- utilize authentic assessment methods.

Similarly, Brooks and Brooks (1993, 17) discuss how constructivist-inspired classrooms tend to apply many of the following pedagogical strategies.

- Curriculum is presented whole to part with emphasis on big concepts.
- Pursuit of student questions is highly valued.
- Curricula activities rely heavily on primary sources of data and manipulative materials.
- Students are viewed as thinkers with emerging theories about the world.
- Teachers generally behave in an interactive manner, mediating the environment for students.
- Teachers seek the students' points of view in order to understand students' present conceptions for use in subsequent lessons.
- Assessment of student learning is interwoven with teaching and occurs through teacher observations of students at work and through student exhibitions and portfolios.
- Students primarily work in groups.

### **Applying Constructivist Theory to the Practice of Geography Education**

In light of emerging interest in constructivist thinking among educators, there are numerous examples of how geography educators have begun to apply some of these constructivist-based teaching and learning strategies into geography courses. A brief look at a few of these courses helps to illustrate how constructivist-inspired strategies can be applied effectively to geography education.

Healey (1996) contends that a team-based cooperative learning strategy produced higher achievement and more positive relationships among students than did competitive or individualistic experiences. Madge (1995) describes how the implementation of problem-solving exercises was effectively used to develop transferable skills in a human geography course. In a project comparing traditional lecture, half-lecture/half collaborative, and full cooperative course formats for an undergraduate applied shoreline management geography course, Nordstrom (1996) found that student evaluations indicated that students significantly supported the cooperative format over others. Haigh and Gold (1993) describes some of the problems with tradi-

tional field study in higher education geography and advocates a combination of field study that also includes students engaging in research projects and developing presentation skills. Burkill (1997) discusses a course which promoted deeper student empowerment by having students role-play the parts of consultants involved in group work on global issues. Lyman and Foyle (1991) argue that cooperative learning is a viable means for teaching geography, suggesting that the cooperative learning strategy helped create a positive classroom climate and that students were more involved in the subject and more motivated to learn content. Kneale (1996) discusses an undergraduate physical geography course that combined lecture with an integrated team project involving fieldwork, laboratory analysis, data analysis, group report writing, poster production, and presentations and asserts that the class encourages group interaction, student decision making, and the development of transferable skills. Hindle (1993) describes how a cooperative group project is the basis of the first two years of a three-year geography program that has been received favorably by students and faculty members. Harbeck (1997) describes a cooperative learning course in which students are guided through an exploration and analysis of a real human system (e.g., supermarket, hotel, etc.) with the goal of building skills that transfer.

We describe a geography course that employed the constructivist-oriented strategy of team-based collaborative inquiry to foster student cooperation, interaction, and comparative analysis of student-generated research data. Through the intentional application of teaching and learning strategies that reflect the tenets of constructivist theory, geography educators can design learning environments and experiences that are compelling and meaningful for their students.

The geography education examples suggest that employing constructivist-based strategies can generate beneficial student experiences and results; however, constructivist strategies have been criticized in areas such as prior knowledge, depth versus breadth of coverage, transfer, and assessment. Molenda (1991,44), concerned that a lack of prior knowledge of subject matter in some constructivist environments could be detrimental to the learner, stated, "He who can swim may bring up pearls from the depths of the sea; he who cannot swim will be drowned; therefore only such persons as have had proper instruction should expose themselves to risk." Tobias (1991) found little evidence to

support the constructivist notion that problem solving taught in authentic situations transferred easily to real life problems. Tobias (1991) also pointed out that constructivist approaches that advocate in-depth coverage of one topic in a field can come at the expense of students developing a broad understanding of many different topics in a field. Finally, Reigeluth (1991) argued that constructivists' qualitative, authentic-assessment strategies often conflicted with the quantitative, objective measurements that schools must currently use to certify that students have learned key skills.

### The Internet and Constructivism

In the 1990s, emergence of Internet-based telecommunications technologies such as e-mail, video conferencing, and the World Wide Web have dramatically enhanced opportunities for geographically distant students and educators to learn and teach collaboratively. Wagner (1993a, 29) defines distance education as the "transmission of interactive educational or instructional programming to geographically dispersed individuals and groups." The notion that interactive Internet-based tools have the potential to change education for the better has many proponents. Owston (1997, 27) asserts that "nothing before has captured the imagination and interest of educators simultaneously around the globe more than the World Wide Web. The Web is now causing educators, from preschool to graduate school, to rethink the very nature of teaching, learning, and schooling." According to Owston (1997,27), when it comes to "increasing access to education,...promoting improved learning [and] containing the costs of education, [a] promising case exists for the Web in all three areas." Such expectations run the risk of making Internet-based learning susceptible to the disappointment that characterized educational television after it failed to live up to its promise as a technology that would revolutionize education. However, as the Internet phenomenon continues to expand rapidly into more and more homes, businesses, and schools, educators are examining the potential that these tools for interactive communication can have in facilitating collaborative learning environments.

Some educational researchers are beginning to investigate how these collaborative Internet tools are being integrated into constructivist pedagogical designs. Sayers (1995, 6) writes that "the electronic classroom is not only bringing geographically dispersed students together, but it is introducing a

new pedagogy, one which stresses learning as a social and collaborative process." Garrison (1993, 201) suggests that this emerging social and collaborative process of learning reflects the theory of "cognitive constructivist learning" that assumes that the "learner takes responsibility to construct meaning actively, not in isolation, but through dialogue with onself as well as others." A number of other educational researchers (e.g., Crotty 1995, Dede 1995, Jonassen et al. 1995, Lebow 1995, Means and Olsen 1995, Yakimovicz and Murphy 1995) have explored this relationship between constructivist pedagogy and collaborative, distance-learning environments. As referred to earlier, constructivist theories and methods of teaching and learning generally assume that knowledge is constructed by the individual in context based upon interpretation of experience and previous knowledge structures (Resnick 1991). Garrison (1993, 201) writes that such collaborative, constructivist, distance-learning environments are in contrast to the "isolating" and "prepackaged self-instructional course materials" of most traditional correspondence courses that "inherently carry a behavioral orientation to learning." Stein et al. (1994, 1) writes that "the hallmark of constructivist learning is activity" and that in such environments "students are not passively absorbing information, but are actively involved in constructing meaning from their experiences and prior knowledge."

### The Internet and Geography Education

Geography researchers have recognized that Internet-based tools and resources have great potential for the advancement of geography education. Bishop et al. (1993) discuss how geographers can utilize the Internet's vast amount of climate and meteorological imagery and text (e.g., satellite images, radar summaries, air charts, meteorograms) for research, lectures, and student analysis. Svingen (1994, 180) describes how Internet tools such as e-mail and the Web can offer geography students "ways to communicate with other children around the globe and work with them on joint projects." Fitzpatrick (1993, 156) argues that "the geography teacher has to deal with vast libraries of textual information, numerical data, and graphic displays." He asserts that "geographers see the world as an intricately interconnected place" and that telecommunication "links with the world beyond the classroom can take on a productive and instructive role" (Fitzpatrick 1993, 156). Nellis (1994, 36) argues that

"through telecommunications, computer graphics, geography computer software, and simulations, as well as, GIS, GPS, and remote sensing, geography educators and students can address a broader range of spatial questions than was previously possible."

One example of the emergence of Internet-based geography education resources is the Virtual Geography Department Project (see Appendix A for URL), which promotes collaborative research efforts among geographers and offers high quality curriculum materials over the Internet for use by geography students and faculty at any university in the world with an Internet connection. Although many Web sites on the Internet provide geography-based resources that can be utilized for education (e.g., interactive maps, GIS data), little research has been done examining the use of Internet communication tools for geography learning environments that employ constructivist strategies to facilitate collaborative inquiry among teams of distant student researchers.

### COURSE DESCRIPTION

The Comparative Environmental Change Seminar, which took place in the spring of 1997, was designed to utilize Internet communication tools to facilitate collaborative inquiry and comparative analysis among teams of geography or environmental studies majors from the University of California at Santa Barbara (UCSB) and Westminster College in Utah (Westminster). At each school three teams of three or four students were given the task of collaboratively researching human-induced environmental change issues within an assigned regional mountain ecosystem and then comparing their findings with those of a similar team of remote students. Westminster students examined human influences of the Wasatch Front in the Rocky Mountains outside of Salt Lake City, while UCSB students examined comparable issues in the southern Sierra Nevada Mountains.

The research issues were defined according to elevation (lower, middle, or upper slopes), creating a remote counterpart research team for each team at each level. These geographically distinct, yet elevationally similar, teams of students could then collaboratively conduct research on related topics and compare their findings. This structure also allowed the authors to gather data on the collaboration experiences of each set of student research teams.

Major criteria for the selection of research topics included the significance of known human-induced

environmental change associated with that topic and potential comparability to other mountain ranges. Some topics were more narrowly defined than others. For example, the upper-slope UCSB team was asked to explore environmental change surrounding the threatened mountain yellow-legged frog (*Rhyacophila siskiyouensis*) in the alpine lakes of the Sequoia region. Their counterpart team was asked to research issues facing the endangered boreal toad (*Bufo dorsalis dorsalis*) in the lakes of the Wasatch Front. In contrast, the mid-slope teams were asked to research the much broader topic of environmental change caused by the growth of skiing and other winter recreational activities. The lower-slope teams were also given a relatively broad task of researching environmental change related to the growth of human development in the foothills.

### Course Instructional Design

The seminar intentionally employed numerous constructivist-based teaching and learning strategies such as collaborative research teams, role-playing, accessing primary data sources, student-centered curriculum, instructors as facilitators, qualitative assessment, and experiential use of technology. Such strategies were incorporated into the course design to facilitate students with the process of developing their own understanding of environmental change. By engaging students in the process of analyzing primary data (e.g., via case studies on the course Web site, Internet and library resources, interviewing experts) and then having them actively collaborate with their local and remote student researchers, course designers anticipated that students would construct a fuller understanding of the many aspects that influence human-induced environmental change at various elevations. Instructors facilitated and guided each team as they collaborated with their remote counterparts, investigated their research questions, and authored, posted, and compared their reports.

At both UCSB and Westminster, the course met twice a week for two hours for ten weeks in 1997. Almost all participants were geography or environmental studies majors who had previously taken an introductory course in human geography that focused on environmental change. Before enrolling, students were informed that the course was experimental and was investigating Internet-based distance learning. Students were also notified that all course e-mail, Web, and video-conference-based electronic interactions would be forwarded auto-

matically to special accounts for research purposes. Human subjects research approval was granted for this study by both UCSB and Westminster.

### Course Objectives

The goal of the course was to engage geography students from two different higher education institutions in an Internet-based course that facilitated team-based collaborative inquiry and comparative analysis. The primary educational objectives of the course were

- to facilitate collaboration between local and remote teams of student researchers;
- to provide a format for students to comparatively analyze environmental change over time within two geographically distinct mountain ecosystems;
- to promote student understanding of the nature and complexity of environmental change; and
- to promote the use of state-of-the-art computer-based telecommunications and research tools.!

### Student Assessment

Students were assessed primarily through qualitative measures. Course instructors assessed the quality of each student's research process as well as their team research product using the following criteria:

- student attendance at regularly scheduled meetings as well as active participation in and out of class;
- instructor observation and anecdotal notes of individual and team-based effort;
- quality of student team-based research, collaboration, and reports (posted to the course Web page);
- quality of e-mail and live video conference interactions with local and remote participants; and
- participation in regional research field trips (e.g., most of the UCSB students participated in a field trip to the Sequoia National Park region).

Constructivist approaches to assessment generally assume that by actively engaging in each of the

stages of the inquiry process, students will construct a meaningful understanding of the research experience. Stein et al. (1994, 17) emphasized that assessment of students within constructivist-based learning environments tends to focus on "the process of getting an answer rather than just the product." This focus on both process and product is often reflected in constructivist learning settings through the use of qualitative performance assessments such as "projects, portfolios, learning logs, journals, constructed responses, observation, student interviews, peer evaluation, self evaluation" (Stein et al. 1994,21). In our course, rather than evaluating students solely on the merits of the final team project, course instructors assessed the quality of each student's collaborative research efforts as well as the quality of that student's team product. The research process experienced by each student was assessed through the use of various qualitative instruments such as direct observation, analysis of anecdotal notes, student e-mails, student journal reflections, and post-course student interviews.

Each student and team was qualitatively assessed in light of the whole context and process of their research and collaboration experience. This constructivist-based emphasis on both the quality of the process and the quality of the product gave course instructors a rich array of qualitative data with which to assess each student's experiences within the collaborative distance learning environment. This is consistent with Stein et al. (1994,21) who write that "methods of assessment should allow students to demonstrate what they know and are able to do, not just what they don't know or are unable to do."

Constructivists emphasize that students can demonstrate individual competence by collaborating with others to learn how to solve problems that they could not previously solve by themselves. Webb (1995,242) points out that the process of "building on each other's ideas can also help the group to produce a higher quality product or solution to a problem." Webb notes that the group process or the final product will vary in quality depending on whether assessment procedures stress collaborative learning or whether they focus on the final group product. According to Webb, the assessment of an individual's learning from group collaboration can be achieved by stressing that individuals will be accountable through individual tests and/ or presentations on the procedures, reasoning, and conclusions reached by the group. This is consistent with Ramsden's (1984, 145) statement that,

"a student's perception of the learning context is an integral part of his or her experience." Such a perspective is in contrast to more traditional behaviorist forms of assessment which tend to emphasize quantitative measurement of student productivity and recall of specific course content.

## **Design Process and Technical Considerations**

The course Web page played a central role as a virtual home allowing students to access, for example, course-related news, team projects, links, and case studies. All students were given password access to the Web page and to a directory on the Web server so that each team could independently post files to their team Web page, which in turn was linked to the course Web page. Creation and maintenance of the course Web page was time consuming (approximately 30-40 hours) to design, update, and troubleshoot. The time spent troubleshooting technical issues such as posting files to the Web was considerable (approximately 2-3 hours per week) for instructors at both UCSB and Westminster. These time demands will be reduced as Internet tools become easier and more reliable to use.

In addition to using e-mail and the Web, student teams also collaborated using Internet-based video conferencing software and hardware. Using a free video conference software program called CUSEEME (see Appendix A for URL) and using several inexpensive (\$100) computer video cameras, teams of students were able to easily enter the Internet Protocol (IP) address of the remote computer and students they wanted to call. Once connected, students were able to video conference for as long as they wanted without concern for minute-by-minute phone charges. Although the video image was small and of poor quality (3-8 frames per second), the CUSEEME audio was very clear, enabling students over a thousand miles apart to see each other and communicate live.

## **Qualitative Research Design**

The analysis and discussion below reflect a qualitative research design intended to gather descriptive, contextually rich information and observations relating to student interactions within a collaborative Internet-based learning environment. Because researchers have had difficulty defining the qualitative data analysis process as a definitive set of steps, it is often referred to as an "organic whole that begins in the data-gathering stage and

does not end until the writing is completed" (Potter 1996, 120). Data analysis in qualitative research is frequently considered a rather "open, flexible, and creative analytical process" (Potter 1996, 121). This study has generated a significant body of data that represents the bulk of student interactions throughout the duration of the course. Data were analyzed using qualitative procedures defined by Marshall and Rossman (1989) as the process of organizing the data; generating categories, themes, and patterns; testing emergent hypotheses against the data; searching for alternative explanations of the data; and writing the report.

## ANALYSIS AND DISCUSSION

### Collaborative Research

One of the course's major objectives was to facilitate collaboration among teams of student researchers. As intended, collaboration took the form of research and communication as well as authoring and publishing team findings. The following excerpt is from a post-course interview with a UCSB upper-slope team member illustrating how students developed their own cooperative strategies for conducting their team research.

We all kind of helped each other out but at the same time we did retain our areas. My main focus through the whole quarter was looking at the causes, but Tina and Erin kind of branched out a bit. And we'd go to the library together sometimes, and we'd search the Internet together. So towards the end of the class when we were building our web page, we had to split it up even further.

From the very beginning of the course, students seemed quite taken with the idea of working together in a collaborative way with their team members. As reflected in the excerpt above, the course's use of cooperative learning seemed to help develop a sense of responsibility for their own learning.

The following e-mail exchange (which occurred between the counterpart upper-slope research teams) is typical of the hundreds of lively messages sent between counterpart research teams at UCSB and Westminster.

Hey Uppers!

We found an article in the "Copeia" journal series titled: "Toxicity of Mine Drainage to Embryonic and Larval Boreal Toads". Basically, the article's about the lethality of copper and zinc in the larvae of the toad. They found that it could be a factor accounting for the absence of amphibians from Clear Creek County, Colorado. The Wasatch mountain range contains thousands of mines in it, so it's definitely possible that our *Bufo boreas* has been affected by mine drainage as well. I have no idea about the mine situation in the Sequoia's, but the drainage may be an attribute of your frogs decline also.

This kind of collaborative sharing of research data, ideas, and speculations occurred via e-mail messages, telephone calls, or video conferencing sessions. The ability of student researchers to e-mail other course participants with a single message provided a powerful way to quickly communicate with numerous participants. Student researchers used e-mail not only to send messages but also to exchange research-related Web addresses, images, maps, and attachment files. The following excerpt from a post-course interview with a UCSB upper-slope student demonstrates the role that e-mail and team Web pages played in student communications and interactions.

In the beginning we emailed a lot. Maybe they had found a link on the Web that was important to our research and we did the same for them. And we would email them with questions, like, "Are you looking into this?" "No." "Well, we're looking into this, but this might help with your frog because it sounds like something that might be affecting your frog." You know, we found an article on acid rain, a deposition, and so, we told them about it.

Participants in all six teams actively engaged in a dynamic process of collaborative research, primarily within their own team but also with other teams locally and remotely.

### Comparative Analysis

A second course objective was to facilitate local and remote teams in the process of comparatively

analyzing the similarities and differences in their research findings. Comparative analysis is one of many phases in the process of scientific inquiry. The following e-mail quote demonstrates one of many instances in which the two upper-slope teams were actively engaged in comparative data analysis of their research findings.

Hello all upper-slope members. Thanks Adrian for bringing up the Bufo. We are having problems with our own frog, the yellow legged frog. This frog was once abundant in the high elevations of the Sierra region, but their numbers have dramatically decreased in recent years. The most suspect reason for their decline has been the introduction of trout in the alpine lakes and streams.

We are interested in any comments you might have concerning our studies. Do you notice any similarities with our case to your own? We notice that the decline of our frog is due mainly to the introduction of non native species yet in your case you did not mention any such scenario. We are also interested in the factors concerning amphibian decline which you mentioned in the case of the Bufo, such as ozone and water pollution. Please keep us updated on any general data which you receive on those subjects.

All of the counterpart teams found both many similarities and differences when comparing their research findings. For example, the upper-slope teams discovered that their two subject species were threatened for reasons that differed: the yellow legged frog is threatened primarily due to the history of stocking some Sierra alpine lakes with an assertive non-native trout species, whereas a main reason that the boreal toad IS threatened appears to be the introduction of human pollutants.

Comparative analysis between groups primarily occurred via e-mail exchanges and, to a lesser extent, via live video conference sessions. The e-mail platform allowed distant teams to compare their differences in text form and then respond. The frequency of student e-mail-based interactions with remote research partners had several high and low points throughout the 10-week course (see Figure 1). The highest frequency occurred in the opening weeks of the course when students mostly

exchanged introductory e-mail that often focussed on socialization rather than course research content. Although e-mailing continued to occur each week, the volume dropped off during weeks three, four, and five when students were concentrating on conducting research rather than collaborating or comparing their findings with remote partners. In the sixth and seventh weeks, the frequency of e-mail correspondence between grollps began to increase again, with the messages becoming both longer and more substantive. This correlates with a course deadline requiring students to engage in comparative analysis of both their preliminary findings and their final results. Review of course e-mail indicates that student research teams actively compared their own research findings with the findings of their remote counterpart team.

### Course Content Understanding

Another objective was for students to gain an understanding of the complexities of human-induced environmental change. Numerous post-course interviews suggest that this objective was met. The following excerpt is from the UCSB's upper-slope research team's final findings report.

Criticality: Criticality, defined by Regions at Risk [Kasperson et al. 1995] is the endangerment of the ability to sustain human life over the long term (Regions at Risk, 13). For our project, we have substituted the word human for *Rana muscosa*. The frog will remain in a critical state as long as the non-

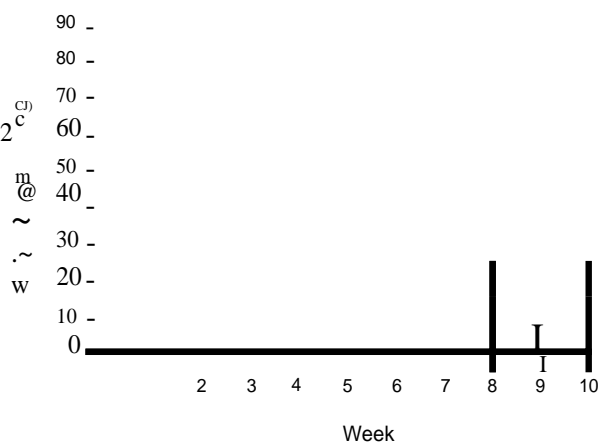


Figure 1. E-mail transactions during a 10-week course.

native trout species are present and prevent the frog from producing viable offspring. The population of *Rana muscosa* will continue to decline as long as trout eat the frog's eggs and tadpoles.

Regions at Risk also claims that a species is at a critical point when its "life supporting environment" is at risk due to human-induced change (Regions at Risk, 14). The life supporting environment of *Rana muscosa* has been placed under a great deal of stress from pollution, poor management practices, and population pressure (more people want to fish in the Sierras).

This sample was posted as part of the team's Web page. Each team's final report generally followed a similar inquiry rubric for human-induced environmental change (i.e., environmental change, human causes, consequences, criticality / trajectory, and comparison) as outlined in Appendix B. These reports demonstrate that students gained an understanding of the complexities and characteristics of human-induced environmental change issues.

### **Technical Familiarity with Internet Tools**

The following excerpt from a post-course interview with a student from the Westminster upper-slope research team is typical of the comments students made about having gained familiarity with computer and communications tools.

It was good because it was a course where you did both, you did both research and learned the technical side. And I wouldn't have learned the technical side as well without doing the research.

Throughout the course it was evident that some of the students demonstrated a stronger aptitude for computer-based technical skills than others. However, all of the students gained valuable knowledge and skills regarding how to use the Internet for research, communication, and authoring. Promoting student understanding of the use of state-of-the-art computer and telecommunications tools appears to have been attained.

### **Technical Issues**

Although considerable effort went into providing students with reliable and bug-free hardware

and software tools, analysis of student interviews and anecdotal notes indicates that student interactions were influenced, and sometimes significantly hampered, by technical difficulties. The most significant technical problem came several weeks into the course when the software program being used to support Web-based student forums began to uncontrollably erase student forum postings. By the time the problem was fixed five weeks later, students were very busy with their research and seemed leery of resuming use of the forum tool. Instead, most students felt that e-mail, Web pages, and video-conferencing tools were all they needed to conduct their collaborative research projects.

Another area in which technical reliability was an issue was in the use of Internet-based video conferencing. During the first two weeks, research teams were scheduled to engage in introductory video conference sessions with their remote counterpart teams, but had difficulties doing so because of technical problems. The video conferencing difficulties were resolved within a week and for the remainder of the course did not hamper student communication.

Other evidence suggests that some students needed additional training in using the Internet for communications, research, and especially Web-page authoring. Several participants said that they could have benefitted from more technical training in order to participate more effectively in the course.

The need to provide significant levels of technical training and support to some of the participants of Internet-based distance-learning courses may very well be one of the biggest stumbling blocks to widespread implementation of collaborative student research courses at a distance. Instructors spent considerable time both prior to and during the course setting up and training students to utilize the technical tools needed to communicate, research, and publish via the Internet. Most students did not possess significant technical abilities, and although many learned quickly, others seemed to have more difficulty learning and effectively using the technology needed to participate fully in the course.

### **Clarification of Research Guidelines and Accountability**

Determining how much structure and guidance the student researchers would need was not always readily apparent. The following quote is from a post-course interview with a student in the UCSB mid-slope team.

I think we needed probably more structured deadlines because a deadline...it just makes you do it. You think, "I gotta do it,"...because if you don't, then you know you're not going to get as good of a grade as YOU want.

Emphasizing a more constructivist-based approach, the course designers intentionally chose to avoid quantitative assessment for grading purposes. Some students felt that because there seemed to be few clearly defined consequences (such as adverse grade implications) of missing a research deadline, they could miss deadlines, even though deadlines were important for conducting comparative analysis and collaborating with their remote counterparts. For example, the course calendar called for all research teams to complete a draft research report by the end of the sixth week of the course. This important deadline was designed to motivate students to keep their research progressing, as well as to encourage lively discussion with their remote partners about their findings. Yet only three of the six research teams completed their draft research document on time, resulting in delayed remote discussion for over a week for some teams. Post-course interviews indicated that some students were accustomed to quantitative evaluation methods and that such methods may have motivated them to complete and e-mail their draft findings on time. The data suggest that the students and their research would have benefitted from more specific guidelines and consequences regarding deadlines as well as more detailed rules regarding Web publication.

The following is a post-course interview quote from a Westminster mid-slope team member illustrating how publishing final reports on the Web seemed to have a motivational influence on some students.

I think it's more motivating just because you feel like other people out there might be going through what you were, and so if they find this web page on the net it's going to be really helpful for them and probably really be appreciated and so it makes you want to do a pretty good job, especially if your name's going to be on there and everything. I think it's a lot more motivating because in the past you just turned in a paper to the teacher. They grade it and turn it back into you, but it is not like

anyone else sees it, where this is pretty open to the world.

A central part of the course involved student teams electronically posting their research findings as Web pages linked to the main course Web page. Students seemed to recognize that these team Web page reports were the culmination of their research and that they really were being published on the Internet for all the world to see. Though motivated by the opportunity to post their research findings on the Internet, some of the teams clearly needed more specific guidelines. In some cases it appeared that students assumed that the traditional rules of research writing and publication did not apply to the Web. This was most evident in the incomplete way that some students cited sources or the embellishment of their reports with unsophisticated animated images.

### Disparity among Research Topics

Defining team research topics more specifically and more comparably to their remote partner's topics, especially in light of the research limits that the 10-week quarter imposes, might have been helpful. The following is quoted from a post-course interview with a Westminster lower-slope team member and illustrates the difficulty the two lower-slope teams had in identifying reasonably similar research topics to compare.

The only thing that we could really compare, because of our "apples versus oranges" differences, was the loss of the natural vegetation and the loss of some of the species in the area. And that was the only thing that we could really even compare, because we [our region] left cattle ranching a long time ago.

When designing the course, the instructors assumed that a 10-week course would give each team sufficient time to select the most pertinent environmental change issue(s) in their assigned region and slope. However, data suggest that the teams whose research topic was more specifically defined by the instructors were able to make more consistent progress toward publication of their findings.

An example of this was the relatively high level of difficulty that the UCSB lower-slope team had moving through the inquiry process. This team was

asked to research the effects of human land use upon the foothill region just below Sequoia National Park in California. Given these broadly defined research parameters, the team clearly had difficulty choosing a more specific focus for their research.

Further, the significant environmental differences between the two lower-slope regions created disparity between how the two teams defined the focus of their research. Given the proximity of the Wasatch foothills to booming urban Salt Lake City, the Westminster team was able to quickly narrow their research focus to the most obvious land use influence of housing development upon the foothills. In contrast, in the semi-rural Sequoia foothills, rapid housing development was not an urgent issue. Thus, the UCSB lower-slope team spent well over half of the course trying to narrow their research topic while their Westminster counterparts were moving ahead with their research. For the lower-slope teams, these environmental differences were so dramatic (urban versus rural) that comparing the two regions was difficult.

Because of the constructivist approach, wide disparity in research topics did not significantly affect the assessment of individual students because assessment was based upon the quality of both the process and the product generated by the students individually and as a team. The final team reports for the lower- and mid-slope teams were generally inferior to the reports of the upper-slope teams, whose research topics were more narrowly defined. The lower- and mid-slope teams were forced to spend more time and effort engaging in the important scientific inquiry stage of topic identification. Had these students been evaluated solely on the quality of their final product, their process-based experience would not have been of much educational value.

#### **FUTURE DIRECTIONS: THE INTERNET, CONSTRUCTIVISM, AND GEOGRAPHY EDUCATION**

As opportunities increase for geography educators to develop Internet-based learning experiences, it is also important to consider the complementary role that constructivist-based teaching and learning strategies can play in facilitating engaging on-line learning experiences. Garrison (1993, 208) noted, "If the goal of distance learning is to facilitate learners in their construction of meaning then methods,

materials and evaluation must be congruent with that goal." Moore and Kearsley (1996, 7) note that "what makes any course good or poor is a consequence of how well it is designed, delivered, and conducted, not whether the students are face to face or at a distance." Sayers (1995, 6) reminds educators, "As with any educational medium, the methods of implementation rather than the technology itself will ultimately determine its degree of effectiveness and acceptance." By their very nature Internet communication tools such as e-mail, forums, and video conferencing tend to foster interaction and invite collaborative communication. As discussed earlier, constructivist-based student experiences such as team research, comparative data analysis, and active student-to-student collaborations are important pedagogical activities that foster student-centered learning.

The course described in this article actively utilized some common constructivist-based teaching and learning strategies (e.g., collaborative inquiry, authentic assessment) in conjunction with various Internet communication tools to provide students with an engaging collaborative learning experience in human geography. However, designing and implementing both constructivist-based strategies and Internet-based tools requires a considerable commitment of time, effort, and resources, as well as technical savvy, from potential instructors. Further qualitative studies and instructional examples are needed to increase understanding of the nature of student interactions and outcomes in geography courses that employ constructivist strategies within Internet-based learning environments. The challenge for geography educators that are interested in constructivism and the Internet will be to creatively and appropriately integrate constructivist-inspired strategies with rapidly changing Internet communication tools (i.e., e-mail, video conferencing, the Web). Innovative integration of these tools and strategies can provide geography students with engaging and interactive learning environments where students can individually and collaboratively construct meaningful interpretations of geography-related data and concepts.

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## NOTES

- 1 Students at both UCSE and Westminster participated in pre-course technology training sessions in which students learned how to utilize the Internet for research, communication, and authoring. This mini-technology course met just before the seminar began, once a week, for four consecutive weeks. At the end of these training sessions, all students were generally familiar with e-mail, Web-based video conferencing, and the basics of Web-page authoring.

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## Appendix A. URL sites.

Comparative Environmental Change Seminar  
<http://128.111.134.12/GDP/geogcourse/index.html>  
 Virtual Geography Department Project  
<http://www.utexas.edu/depts/grg/virtdept/main.html>  
 California Virtual University  
<http://www.california.edu/>  
 Western Governors University  
<http://www.wgu.edu/wgu/index.html>  
 Open University  
<http://www.open.ac.uk/>  
 Global Schoolnet Foundation  
<http://www.gsh.org/>  
 Intercultural Email Classroom Connection  
<http://www.stolaf.edu/network/iecc/>

## Appendix B. Questions derived from the environmental challenge research.

These questions were derived from a recent comparative analysis of regional environmental change (Kasperson et al. 1995) and modified slightly to consider some key questions of interest to participating students, such as impacts on biodiversity. The questions gave all students a similar rubric for inquiry to afford ready comparison with other group projects and provided students guidance on how to organize their data-gathering and analysis efforts over the duration of the term.

*1. Environmental Change*

What kinds of environmental change have occurred?  
 What components are probably anthropogenic vs. biophysical in origin?

*2. Human Causes*

What are the primary human proximate causes of this environmental change, and what human driving forces are associated with these proximate causes?

*3. Consequences*

What have been the major impacts of this environmental change on humans? On biodiversity? What has been the social response?

*4. Criticality and Trajectory*

Based on 1-3, is this a "critical" situation? A "sustainable" situation? Somewhere in between? (See Regions at Risk volume for definitions of criticality and sustainability.) What is the overall trajectory in terms of environmental and social well-being?

*5. Comparison*

How does this location compare to other locations (i.e., Wasatch Front or Sequoia region)?