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SYMPOSIUM

Distance Education in Geographic Information Science: Symposium and an Informal Survey

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Editorial Introduction

The US National Center for Education Statistics (NCES, 2002) defines distance education as "education or training courses delivered to remote (off-campus) location(s) via audio, video (live or prerecorded), or computer technologies, including both synchronous and asynchronous instruction" (NCES, 2000, p. 2). This definition excludes correspondence courses, by which colleges, universities and commercial enterprises have delivered educational opportunities via postal services to distant learners in many parts of the world for a century or more. While such a definition may seem too exclusive, it does highlight the technological innovations that, combined with unprecedented economic challenges faced by higher education institutions, have led to rapid growth in distance education over the past decade.

Educators are not of one mind about distance education, of course. Some celebrate the potential to expand access to higher education to lifelong learners not well served by traditional place-bound courses (e.g. Kellogg Commission, 1999). Others foresee revolutionary impact not only in expanding access to higher education but also in reforming it, by leveraging computers and networks potentially to create a new, more active more student-centered pedagogy (e.g. Benyon *et al.*, 1997; Browning & Williams, 1997). Still others view distance education as evidence of a regressive trend toward the automation of higher education and the commercialization of the academy (e.g. Gober, 1998; Noble, 1998). While a recent study has found that equivalent learning activities can be equally effective for both online and face-to-face courses (Neuhauser, 2002),

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there remains concern that distance education will never be able to fully engage the student in active, inquiry-based learning, or in the process of original, independent research (e.g. Hanson, 2001). Hopes and fears notwithstanding, distance education appears to be here to stay.

The potential benefits, costs and risks of distance education are certainly not lost on the geographic information science (GIScience) community. As the demand for training in geographic information system (GIS) software, as well as in GIScience education (the fundamental science behind GIS) grows, so too does the demand for effective modes of instructional delivery to students, regardless of time, place, or, in some cases, educational background. The community is already well aware of the challenges faced by GIScience educators in the classroom. The technological orientation of the subject, the head-spinning rate at which that technology is evolving, the need for collaboration—not only for creative innovation in the classroom but merely to keep up—and the realization that many institutions of higher education are not yet equipped to support these instructional requirements in classroom settings, all conspire to confound the efforts of even the most conscientious educators (Kemp *et al.*, 1999; Wright, 1999). But what about teaching GIScience at a distance?

Both generic and domain-specific challenges confront GIScience educators who plan to conduct classes involving geographically dispersed students. Whether it is conceived of as geographic information systems or science, the chief domain-specific challenge follows from the centrality of information technology in the domain. Although, as Unwin *et al.* (1990, p. 463) point out, "an introductory syllabus for GIS … is most certainly *not contingent on student access to a large, proprietary GIS*" (emphasis in the original), most educators, we believe, would agree that students deserve access to authentic GIS software in advanced courses at least. As is well known to readers of this Symposium, several vendors provide relatively inexpensive educational licenses of desktop software. Enterprise software, however, is typically not discounted for educational purposes, at least not at prices individual students can afford. Universities can provide remote students with secure access to enterprise versions of proprietary GIS software through 'terminal services' applications like Citrix Systems' Secure Access Manager, but such solutions are expensive. Even more challenging are Internet map server applications, which require providing students with administrative access to a Web server. Few universities are likely to be comfortable with the security issues raised by such access. Thus, ironically, it is particularly difficult for Web-based educational programs to offer technically challenging classes in Web GIS!

Ultimately, however, we believe that issues generic to the practice of distance teaching and learning are more challenging than the particular technical challenges posed by the geographic information technologies. Geographic information systems and science dictate no particular pedagogy. For instance, a GIScience class may be based largely on readings and discussions and not involve GIS technology at all. The challenge of fostering active learning and a supportive learning community is, we think, fundamentally no different than for other fields. Collaboration and group work are very hard to accomplish satisfactorily when learners are spread across many different time zones, especially when the learners are adult professionals with commitments to family, career and community. But this is true regardless of the subject domain. Of the 'five pillars' of quality distance learning (Lorenzo & Moore, 2002)—learning effectiveness, cost effectiveness, access, student satisfaction and faculty satisfaction—only access (and technical support of that access if software difficulties are encountered) is affected specifically by the nature of the field.

There is growing evidence that distance education does indeed hold great potential to deliver a rigorous GIScience education. One need only to look to the longstanding successes of the Open University in the UK or the International UniGIS Consortium (http://www.unigis.org/), through which courses are offered from institutions in Austria, Canada, the Czech Republic, Ecuador, Hungary, Italy, the Netherlands, Portugal, Russia, South Africa, Spain, the UK and the USA. Existing programs in GIScience may vary significantly. For example, at the University of Maine, lectures in some GIScience courses may be viewed either in real time at the student's desktop via one-way web streaming or at any time later from a web video archive. Students must begin activities in the courses at the beginning of the term while on-campus students are taking the exact same course. Courses are offered for university credit. In contrast, Penn State's online Certificate Program in GIS (http://www.worldcampus.psu.edu/pub/gis/index.shtml), is semi-asynchronous in that there is a schedule of weekly deliverables but students can work anytime they wish during the week, and they need not enroll at exactly the same time as on-campus students. One course is available for independent study credit all year round. And courses are offered for continuing education credit, not university credit. Courses at both Maine and Penn State are instructor-led, and/or cohort-based, whereas the Virtual Campus of the Environmental Systems Research Institute (ESRI; http://campus.esri.com) is largely an asynchronous, non-instructor-led learning environment in which students work independently.

An Informal Survey

As a backdrop to this symposium, the editors attempted an informal survey to uncover the diversity of existing programmes in GIScience. This survey was an activity of the Distance Education Working Group within the Education Committee of the University Consortium for Geographic Information Science (UCGIS), a consortium of 61 US research universities from 37 states whose mission is to serve as the academic voice of US geographic information science in both research and education (http://www.ucgis.org). It does this in part by training and educating students in GIScience in order to advance the discipline and to meet new employment demands. The survey was posted on the web and advertised broadly to the international GIScience community via various email listservs (the International Network for Learning and Teaching Geography in Higher Education listserv of ~90 members, the Association of American Geographers GIS Specialty Group listserv of ~1000 members, the ESRI Higher Education Special Interest Group listserv of ~1500 members, and the Urban Regional Information System Association listserv), an announcement in the trade journal *Geospatial Solutions*, and a call to the member institutions of the UCGIS, including their corporate, government, international and professional organization affiliates (~500 individuals). The survey instrument was available from August 2002 until responses trailed off approximately 6 months later. Questions in the survey included the following (and may still be viewed on the web at http://dusk.geo.orst.edu/disted/survey.html):

- Institution type (public/private doctoral, public/private master of science or arts, baccalaureate, etc., according to the Carnegie classification of institutions of

higher education in North America). As our survey was an activity of the US-based UCGIS, and aligned with the most recent and relevant surveys by the US NCES (NCES, 2002), its nomenclature was based on the US academic system. We appreciate the efforts of our international colleagues in filling it out despite the lack of a direct correspondence to their university system. Typical areas of confusion, as noted by N. Todd based on experiences within the international UniGIS network (N. Todd, personal communication, 2002), may include use of the terms 'undergraduate' (and within that 'freshman', 'sophomore', 'junior', 'senior'), 'graduate' and 'postgraduate'; differing credit schemes (e.g. 'credits' versus 'hours of study' versus other levels of achievement); 'university credit' versus 'continuing education' credit; and 'GI Systems' versus 'GI Science' versus 'GeoInformatics' versus 'Geomatics'. Future editions of a survey by the UCGIS or other entities should be sensitive to these differences and seek compromises in terminology wherever possible;
- Department or unit of the respondent;
- Length of time distance education courses have been offered, and in what form (asynchronous or synchronous)?
- Titles, topics, enrolments, level, college/university and/or continuing education credit of course offered;
- Course instructor (e.g. tenure-track, tenured, adjunct faculty, or graduate student);
- Study body (undergraduate, graduate, and/or adult professionals);
- Satisfaction of instructor and student relative to similar classroom courses;
- Degree, certificate or minor offered or planned in the future, and if so, URL;

Our survey will be greatly supplemented by final results of a similar, ongoing survey by Onsrud at the University of Maine, who is trying to find out what GIScience courses are offered at the graduate level only (see http://www.spatial.maine.edu/~ onsrud/PubCommonsOfGISci/DistEdGradCourses.htm), and the more formal work of Berdusco (2004), who has undertaken an extensive survey of diploma, certificate and degree programmes in GIScience around the world (as part of an MSc thesis at Manchester Metropolitan University). His survey also includes a count of which programmes include distance education course(s) (see preliminary results at http://www.institute.redlands.edu/users/kemp/Berdusco.htm). It is interesting to note, however, having just received the Berdusco data, that faculty on the same campuses apparently responded differently to the two surveys due to a lack of knowledge about what was happening elsewhere on their campus. For instance, a faculty member in one department on a campus indicated on our UCGIS survey that GIScience distance education courses were not offered at his/her university, while a faculty member from another department on the same campus responded to Berdusco that his/her unit did in fact offer a GIScience distance education course. This is definitely a source of error to be noted, but at least the lines of communication are being opened (see also Berdusco *et al.*, (2000) and the GeoCommunity site at http://spatialnews.geocomm.com/education/distance_edu for information on and web links to distance education offerings in GIScience at institutions around the world). In addition, Corrin, a graduate student in the UniGIS programme at Simon Fraser University in Canada, conducted a thorough examination, via surveys, of the opinions of both instructors and students as to what constitutes an effective online course in GIScience (D. Corrin, personal communication, September 2003).

Table 1. Numerical summary of results from informal survey conducted by authors on behalf of the UCGIS

No. of respondents	87 79 from US (51 of 61 or 84% of UCGIS campuses) 8 from outside US (including UniGIS, Curtin, Open University)
No. of respondents (institution type)	69 public doctoral (78%) 7 private doctoral (8%) 4 public master of science or arts (5%) 1 private master of science or arts (1%) 4 baccalaureate (undergraduate) (5%) 3 community college (3%)
Not offering courses	59 of 87 institutions (68%)
Offering courses	28 of 87 institutions (32%) 27 or 96% offering courses asynchronously 20 or 71% offering certificates or degrees in GISci (only 4 are completely online) courses at 20 in existence for 3 years or less
Student satisfaction	19 of 28 responded on this question (68%) 13 = equivalent to classroom experience (68%) 4 = more than classroom (21%) 2 = less than classroom (11%)
Instructor satisfaction	22 of 28 responded on this question (79%) 12 = equivalent to classroom experience (54%) 5 = more than classroom (23%) 5 = less than classroom (23%)
Typical enrolment	10–40 per course per year (university credit to undergrad, grad, adult) Ferris State at ~95 in a single course for university credit Penn State at 50–200 for continuing education credit only 4 of 28 institutions teach only to undergraduates

As to our informal UCGIS survey, it revealed the following (see also Table 1):

- 87 institutions responded, 79 from the US (including 51 of the 61 academic members of the UCGIS at that time) and 8 from outside the US (including the Open University, UniGIS and Curtin University of Technology). Berdusco's survey received responses from an additional 35 institutions, representing mostly smaller universities and community colleges in the USA, and a much broader sampling of international institutions. The 87 from our UCGIS survey included 69 public doctoral institutions, 7 private doctoral, 4 public master of science or arts, 1 private master science or arts, 4 baccalaureate (undergraduate), and 3 community colleges. Of these, 28 indicated that they are offering distance education courses in some area of GIScience. Twenty of the institutions are offering degrees or certificates in GIScience or GISystems, but most of these are not exclusively online except for Curtin University, UniGIS, Birkbeck-University of London (GISciOnline) and the University of Idaho (as reported by the respondents at the time of the survey);
- Of the remaining 59 who are *not* offering distance education courses in GIScience at this time, the survey did not require a response from them as to why this is so. However, a few indicated the following reasons: (1) budget problems within their university and/or their state precluded them from developing distance education courses or programmes; (2) an examination of the online education market indicated that the return on investment was not going to be as large as anticipated;

(3) the realization that without existing infrastructure, the development of GIScience distance education courses could be quite expensive, particularly with regard to providing content, as well as providing 'customer service' to students (e.g. answering both administrative and course content questions via phone or email, help with obtaining course materials, registration, transferring of credits, etc.); or (4) distance education courses in GIScience are already being offered by neighbouring institutions which their students may easily take and have credit transferred to the 'home' institution. However, 14 of these 59 are considering the future development of GIScience distance education courses. Of particular note is the Institute for Advanced Education in Geospatial Sciences at the University of Mississippi (http://geoworkforce.olemiss.edu/), which is currently developing several online courses as part of a completely web-based curriculum in remote sensing and other geospatial technologies (up to 50 courses to be developed within a period of 5 years; L. Usery, personal communication, September 2002);
- Of the 28, all but one are offering their courses in asynchronous mode, and the vast majority have offered their courses for only 1–3 years. Longstanding programmes in existence for 5 years or more include the Curtin University in Australia, Birkbeck-University of London, the Open University, Manchester Metropolitan University and the University of Salford, all in the UK, the University of Salzburg, Austria, and certificate programmes in the US at Ferris State and the University of Southern California;
- Of the 28, courses are most frequently offered by departments of geography and earth science. Other offerings include those in construction sciences, surveying engineering, computer and mathematical sciences, urban studies and planning, and Lakota studies.
- Enrolments are typically 10–40 per course per year for university credit only, except for programmes such as the Penn State World Campus (in which 50 to 200 students enrol per course per year) for continuing education credit, and Ferris State (95 enrolled in a single course) for university credit;
- The vast majority of courses are taught by tenured professors to combinations of undergraduate, graduate and adult students. Only four respondents (from Ferris State, Southwest Texas State, the Oregon Institute of Technology, and the Open University) indicated that they taught their GIScience education courses only to undergraduates.
- Student satisfaction compared with classroom courses was virtually equivalent (13 responses), with four responses indicating more, and only two responses indicating lesser satisfaction. We have no data on the details of what specifically was satisfactory or unsatisfactory. This was left up to respondents to elaborate on in the open comment boxes within our survey. One respondent did comment that he is planning exit interviews for future editions of his GIScience courses, particularly for those who do not complete it. The inclusion of data from such interviews, as well as general attrition rates for GIScience distance education courses, would be desirable for future studies.
- Instructor satisfaction as compared with classroom experiences was slightly more mixed, with 12 indicating the same level of satisfaction, five indicating more, and five indicating less.

The raw data and comment file from the UCGIS survey may be downloaded from http://dusk.geo.orst.edu/disted/disted_survey.zip.

An initial generalization that can be drawn from the survey results is that GIScience programmes, particularly in the US, are still hitting their stride, and still in early phases of development as evidenced by the majority of courses being offered by one or two ‘champions’ of GIScience on their campus. It remains to be seen how truly widespread distance education in GIScience will become (i.e. face-to-face versions of courses are not in danger of being replaced). There may be the perception of increased workload for GIScience distance education courses so that this mode of teaching is better left to the more senior faculty, perhaps paralleling the advice that junior faculty receive, whether accurate or not, to publish in well-established print journals first, rather than the newer journals that are solely electronic (see reference in next section below to DiBiase and Rademacher in this issue). And although many individual courses are offered completely online, most GIScience degree programmes worldwide are not offered exclusively at a distance. When ‘the stakes are raised’ from an individual course to an entire certificate or degree programme, there are issues of cost (for GIScience software and perhaps hardware), technical troubleshooting, widespread and effective support and assessment of collaborative learning, and the access associated with teaching more advanced GIS techniques and software (e.g. command-line functions in the enterprise Workstation ArcINFO versus the more readily available desktop ArcView).

Indeed access, particularly access to software, may be the challenge most unique to GIScience distance education. However, if access is a potential barrier, it does not appear to be insurmountable, as evidenced by the level of student and instructor satisfaction revealed in the survey (where provision of access to students is a critical part of satisfaction on both sides: Sener, 2003; Sener & Humbert, 2003; Thompson, 2003). This result does relate to other recent studies of student satisfaction in other disciplines, where there is a great deal of satisfaction with courses, levels of interaction and learning community involvement, (e.g. Shea *et al.*, 2003; Vignare, 2003) but, as student expectations continue to rise, additional studies will be needed on issues such as the efficiency of online student services, the value of automated interactivity, blended learning and multiple models of learning (Sener & Humbert, 2003; Vignare, 2003). More than many other distance education courses, GIScience requires students to use significant amounts of relatively sophisticated technology (e.g. GIS, cartography, and remote sensing software, geospatial data sets and imagery, and perhaps even GPS receivers in the field), as well as geospatial data sets and imagery (e.g. Purves *et al.*, 2005). Even with access, student success may be varied depending on whether they gain access in a campus computer lab that is staffed with technical support personnel (who may or may not be savvy in geospatial software), or if they are completely on their own at home trying to install and run the software or deal with the data sets on their home computer.

The survey results actually bring to bear some interesting questions, as well, such as how many courses focus on more than one technology, and what the implications of this are for all five pillars of distance education quality: learning effectiveness, cost effectiveness, access, student satisfaction and faculty satisfaction. Most responses to the survey pertained to distance learning focuses mainly on GIS software. There are few studies that examine more than one technology, or the synergistic effects of certain technologies in addressing specific education outcomes and student groups (e.g. Institute for Higher Education Policy, 1999). Perhaps research in GIScience distance education should be devoted to the interaction of multiple technologies (such as the interaction between GIS, remote sensing/image processing, location-based services and other mobile technologies). This may perhaps be unreasonable to expect on a broad scale given the current cost of GPS and other mobile technological hardware for large numbers of student, but perhaps not in 5–10 years' time. The survey also does not reveal enough about technologies used to *deliver* content and faculty satisfaction with such, i.e. how many courses used interactive graphics and technologies such as streaming video and virtual reality, as opposed to static web pages or PowerPoint files?

As the majority of institutions surveyed did not offer GIScience distance education courses at the time, another implication is that distance education materials continue to be costly to produce, as they are in other disciplines. What may be perhaps unique to GIScience is that these materials often include geospatial data sets, some of which may be proprietary or obtainable only on a single licence that will not transfer to other parties (e.g. the costs and licensing that Geographic Data Technology enforces for the use of its street network and address data products that are used in many GIScience college-level labs throughout the US). Given that materials are indeed costly to produce and that not all institutions can afford to follow MIT's lead in making all of their materials free (e.g. Heterick & Twigg, 2001), GIScience will not escape the general tension between recouping costs and sharing education resources and intellectual property.

The Symposium

There is an abundance of GIScience courses being offered, begging the question of what issues in distance education are specific to teaching GIScience. Or do all distance education offerings have the same challenges, regardless of subject? We have argued above that if there is an issue specific to GIScience it would be access (particularly at the advanced levels with regard to software, technical support and supporting data and hardware). The articles in this symposium explore what some others may. For instance, certainly an important issue for all disciplines is that of faculty workload (e.g. DiBiase, 2000). For many, distance education courses are tacked on to an already heavy classroom-teaching load. However, the study of DiBiase and Rademacher (2005), in which detailed records were kept of time spent teaching asynchronous GIScience courses via the web, found that, contrary to the conventional wisdom about faculty workloads in asynchronous education, regardless of subject, the online courses in *GIScience* required less instructor effort per student than a comparable classroom course. Harris (this issue) addresses the important topic of assessment and examination within a distance education GIScience course. What, if any, is the role of the traditional examination in the world of computer-based, asynchronous distance education, and again, what issues, if any, are unique to GIScience? Onsrud (this issue) focuses on *graduate* programme offerings in GIScience with a particular emphasis on the benefits of web streaming the class sessions of existing courses. On many university campuses there remains a dearth of excellent GIScience courses at the graduate level. Onsrud discusses how this may be remedied in part when students are allowed to take distance education courses across the globe for credit at their own universities. He addresses the legal implications of such arrangements, as well as various technical, financial and pedagogic issues. Johnson and Boyd (this issue) bring to bear the perspective of the GIS software vendor in distance education, in which they discuss approaches and lessons learned through the ESRI Virtual Campus and issues of hardware and software cost and access, and technical troubleshooting. Indeed there is much potential for fostering important cooperative links in distance education with GIS software vendors that may complement or support university efforts.

The UCGIS's original interest in distance education was motivated in part by concern about the quality of teaching and learning transacted asynchronously and at a distance within the US. In addition, however, interest sprang from the hope that distance education may extend access to learners (especially adult professionals) who are not well served by traditional place-bound, synchronous offerings in GIScience. We expect that many readers of the *Journal of Geography in Higher Education* are likely to share these concerns, at least in so far as they relate to the broader span of geographic inquiry. We hope that this JGHE Symposium addresses these concerns by illuminating the practices and reflections of experienced distance educators. Certainly no final conclusions can be drawn from these articles as to the potential of distance modalities to enrich GIScience education. At the very least, however, we do hope that the insights shared by these practitioners will lead to continued discussion of the best practices in distance learning that lead to fulfilling experiences for teachers and learners alike.

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