

Engaging Stakeholders in Program Planning for an Online Master of GIS Degree Program

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Abstract

In 2003 Penn State's Department of Geography submitted a proposal to the University's Graduate School to create a new professional masters degree program in geographic information systems that enables students to participate at a distance. The proposed new degree program builds upon a successful certificate program offered entirely online since 1999, in response to frequent requests by its students and an evident need in the field. An advisory board consisting of industry experts as well as university faculty members guided the design of the expanded curriculum. This paper describes the curriculum, explains the process by which it was designed, as well as how continuous program improvement will be informed by regular feedback from stakeholders. The role of the GISCI certification framework as a vehicle for students' professional development planning is also discussed.

Introduction

The changing needs and expectations of a changing society pose challenges for Penn State and many other universities. One sign of change is the aging of the student body. Nationwide, between 1970 and 2000, the proportion of college students aged 18 to 21 years enrolled in college declined 24 percent, from 58.4 percent to 44.2 percent (U.S. Bureau of the Census 2001). Most college freshmen now aspire to a master's degree as their ultimate educational goal (LaPibus 2000). Today's "typical" graduate student "is female, in her thirties, married with dependents, and takes classes on a part-time basis while also holding a full-time job" (Kohl 2000, p. 18). Acknowledging the public's frustration with universities' perceived unresponsiveness to such changes, members of the Kellogg Commission on the Future of State and Land-Grant Universities has argued that

With a more diverse and older student population, we need a more diversified set of educational offerings. As people mature and move through successive careers, we need to be there to help them retool and retread, with special courses available at their convenience (Kellogg Commission, 1999, p. 8).

The Department of Geography at Penn State's University Park campus contributes to the University's engagement with communities and its responsiveness to stakeholders in many ways. In 2003 the Department proposed to the University's Graduate School an ambitious new contribution: a Master of Geographic Information Systems (MGIS) degree program to be offered through Penn State's World Campus. The proposed MGIS will be a professional degree that complements the Department's existing academic Master of Science degree. The MGIS will address the needs of adult professionals who aspire to leadership in the GIS profession, but whose commitments to family, career and community permit them to study only part-time and at a distance—needs not well met by the Department's existing residential masters

program. The MGIS will build upon the Department's successful World Campus Certificate Program in Geographic Information Systems, which has attracted over 2,000 enrollments by more than 800 students since 1999 from across the country and around the world. An Advisory Board composed of a diverse array of industry leaders as well as GIS educators from four different Penn State units has guided the design of the proposed MGIS curriculum.

The goals of the Penn State MGIS Program are to:

- Help graduates advance their careers by becoming not only knowledgeable and skillful users of geographic information technologies, but also leaders in their organizations with regard to the design, specification and management of geographic information infrastructures.
- Strengthen the geospatial workforce by nurturing not only technical competence but also the articulacy, analytical skills, and professionalism required for leadership in any organization.
- Expand and strengthen the Department of Geography's capacity to serve a national and international market of adult professionals who need to participate on a part-time basis and at a distance. The Department seeks to develop a professional curriculum that is comparable in effectiveness and reputation to the nationally-ranked academic programs it offers to students in residence at University Park.

Need for the Program

The geographic information systems industry is large and growing. Technology market research firm Daratech estimates that sales of GIS software totaled \$1.1 billion in 2001, up fourteen percent from the previous year. Worldwide spending on GIS software, hardware and services totaled \$7.7 billion in 2001. ESRI Inc., which accounts for the largest share of the GIS software market, licenses one million seats of its software products worldwide. ESRI estimates that 500,000 individuals in the U.S. use its software products as part of their jobs, and that some 50,000 individuals work as full-time GIS specialists. The proliferation of GIS usage is estimated to be about fifteen percent per year (Phoenix 2000).

Meanwhile, the emergence of GIS as a profession is evident in the recent establishment of a GIS Certification Institute (www.gisci.org) that since January 2004 has offered a certification process for GIS professionals. Additionally, a NASA-funded National Workforce Development Education and Training Initiative has identified twelve roles played by "geospatial technology professionals" along with 39 technical, business, analytical and interpersonal competencies, some subset of which professionals in any given role ought to possess. The NASA initiative followed from the realization that "there is a serious shortfall of professionals and trained specialists who can utilize geospatial technologies in their jobs" (Gaudet and others 2003, p. 21). Michael Phoenix (2000, p. 13) estimates that "the shortfall in producing individuals with an advanced level of GIS education is around 3,000 to 4,000 in the U.S. alone." In particular, he stresses that "the few graduate programs now in place cannot meet the needs of the marketplace ... the shortage outside the United States is even greater ... this demand is truly global and will continue to grow faster than the supply of qualified graduates."

Indeed, most academic institutions have only begun to recognize the need for specialized masters degree programs in GIS (Wikle and Finchum 2002). Only about eighteen specialized masters degree programs in GIS are currently in operation worldwide. Eight of these programs allow students to participate from a distance (City University London, Leeds University, Manchester Metropolitan University, the University of Colorado at Denver, the University of Denver, the University of London, and the University of Salzburg). Distance education programs are best suited to adult learners with full-time commitments to careers and

families—the kind of students who currently enroll in Penn State’s World Campus Certificate Program in GIS. Feedback from graduates of the Certificate confirms that Penn State should “seriously think about how to expand the program to a full Masters” (Outreach Office of Marketing Research and Planning 2002, p. 4).

Relationship to Existing Penn State Programs

The MGIS will complement the Department’s existing academic Master of Science degree in Geography. The MS program primarily serves young adults who have recently completed baccalaureate degrees and who are able to enroll as full-time students in residence at University Park. In contrast, the proposed MGIS is designed for older students whose full-time jobs permit them to participate only on a part-time basis and at a distance. The Department’s graduate program guide states that “the MS in Geography is awarded to students who demonstrate proficiency in the knowledge base of geography and the capacity to undertake independent, scholarly research.” The MGIS will be awarded to students who demonstrate mastery of the technical competencies and leadership skills required to successfully design, manage and use geographic information technologies within a wide range of professional fields.

The distinction between professional and academic orientations is reflected in the adoption of the term *geographic information systems* for the MGIS degree, as opposed to *geographic information science*, which is used to identify the related specialization within Penn State’s resident degree programs. Whereas geographic information science connotes a research enterprise, geographic information systems suggests an emphasis on applications of geographic information technologies. The Penn State MGIS is intended to enrich the geospatial workforce by helping personnel develop the knowledge, skills and attitudes they need to apply GIS effectively, wisely and ethically within their organizations.

Program Description

Students earn the MGIS degree by successfully completing 35 credits of graduate-level course work, including a supervised independent project. Students create and maintain personal e-portfolios that chronicle their achievements in the program, outline long-term professional development strategies, and foster meaningful interactions among students and faculty members. The independent project demonstrates the student’s ability to apply advanced knowledge and skills related to geographic information systems in a way that makes a substantial contribution to his or her professional work. The project culminates in a formal public presentation, attended by a member of the graduate faculty associated with the MGIS Program, which takes place at either an appropriate professional conference (such as annual conferences of the Urban and Regional Information Systems Association, the American Congress on Surveying and Mapping, or ESRI Users) or an annual meeting of MGIS students, faculty and Advisory Board members. International students who are unable to travel to a mutually agreeable conference location may fulfill this requirement through a presentation to a qualified proctor that is videotaped and subsequently delivered to the student’s advisor for review. The presentation will be preceded by a dress rehearsal that is open to all students in the program through Web and audio conferencing. As part of his or her individual studies, every student is expected to contribute a formal peer review of one other student’s rehearsal. Each graduate’s e-portfolio, including digital presentation materials, is delivered to the student on CD-ROM and archived at Penn State as a permanent record of his or her achievements.

MGIS Curriculum

An Advisory Board consisting of accomplished GIS professionals in government and industry, as well as Penn State faculty members in a variety of disciplines who specialize in geographic information science,

guided development of the initial MGIS curriculum. Mindful of the roles and competencies identified during the recent NASA-funded Geospatial Workforce Development initiative, the Advisory Board identified during its March 2003 meeting at University Park a list of over seventy specific competencies that MGIS graduates should be expected to have mastered. These competencies were subsequently clustered into a set of six new courses that, in combination with the six existing courses offered through the World Campus Certificate Program, will constitute the initial MGIS curriculum.

Consistent with the Certificate Program, MGIS courses will be offered in a compressed 10-week format, requiring eight to twelve hours of student activity per week. Most courses will be offered quarterly; others will be offered one or two times a year. The typical student course load is expected to be three to four courses per year. At a rate of four three-credit courses each year, most students will complete the MGIS in about three years of part-time study. Students who are able to manage heavier course loads may complete the program in a shorter period of time. Conversely, students whose commitments to career, family and community require them to suspend their studies for one or more quarters will be permitted to do so. By Graduate School rules, students remain eligible to earn the MGIS degree for eight years from the date of matriculation.

The recommended sequence of courses follows below. First-year courses are designed to help students develop the information literacy and technical competencies they need to become knowledgeable and skillful users of desktop geographic information technologies. Second-year courses prepare students for leadership in their organizations with regard to the design, specification and management of complex geographic information infrastructures. During the third year, students complete electives and an independent study project by which they demonstrate a substantive contribution to their organization as well as the ability to communicate their contribution to a professional audience. Students who successfully complete the Penn State MGIS satisfy the minimum educational achievement required for professional certification by the GIS Certification Institute.

Year 1 (11 credits)

Winter quarter (January-March): GEOG 482, The Nature of Geographic Information (2 cr.)

Spring quarter (April-June): GEOG 483, Problem Solving with GIS

Summer quarter (July-September): GEOG 484, Database Development for GIS

Fall quarter (October-December): GEOG 485, GIS Programming and Customization or GEOG 486, Cartography and Visualization or GEOG 487, Environmental Applications of GIS.

Year 2 (12 credits)

Winter quarter: GEOG 582, Acquiring and Integrating Geospatial Data

Spring quarter: GEOG 583, Geospatial System Analysis and Design

Summer quarter: GEOG 584, Geospatial Technology Project Management

Fall quarter: Elective: GEOG 585, GIS Application Development or GEOG 586, Geographic Information Analysis or MANGT 510 Project Management or ENGL 4xx, Technical Writing for GIS Professionals

Year 3 (12 credits)

Winter quarter: Elective: GEOG 585, GIS Application Development or GEOG 586, Geographic Information Analysis or MANGT 510 Project Management or ENGL 4xx, Technical Writing for GIS Professionals

Spring quarter: GEOG 596, Individual Studies or elective

Summer quarter: GEOG 596, Individual Studies (including peer review)

Fall quarter: GEOG 596, Individual Studies (including professional presentation)

The MGIS curriculum is expected to expand as enrollments and faculty participation increase. Additional courses to be proposed and developed include a seminar in Ethics for GIS Professionals, Enterprise GIS, Three-dimensional GIS and various specialized applications courses.

Quality Assurance Plan

Stakeholders in the MGIS program include students, employers, the emerging geospatial technology profession, as well as the faculty, administration, alumni and Board of Trustees of the Pennsylvania State University and the MGIS Advisory Board. The MGIS Advisory Board and faculty guided the initial curriculum design effort. The program will respond to students' and employers' concerns through a formal quality assurance plan that regularly invites, analyzes and reports their feedback from the time they apply for admission to the program through graduation and beyond. The plan outlined below addresses five sets of evaluative questions, including learning effectiveness, student satisfaction, faculty satisfaction, cost effectiveness and access—the “five pillars” of quality online education identified by participants in the Alfred P. Sloan Foundation's Asynchronous Learning Networks initiative (Lorenzo and Moore 2002). Evidence-based answers to the following research questions will inform the Department's annual reports to current and prospective students, faculty members, and the MGIS Advisory Board, as well as its triennial report to the Graduate School.

- **Learning Effectiveness** To what extent is the MGIS program successful in preparing students for leadership roles in their organizations? How responsive is it to the evolving requirements of the geographic information systems workforce? Beyond its existing curriculum, what knowledge, skills and attitudes should the MGIS program seek to help students develop? Does the program provide the frequency and character of interactions among students and faculty members that are needed to foster learning?
- **Student Satisfaction** How satisfied with the MGIS program are current and former students? Are their expectations met and exceeded with regard to attentiveness and knowledge of program faculty and timeliness of student support services? What are students' perceptions about the quality of course content? In what ways can student satisfaction be increased?
- **Faculty Satisfaction** How satisfied with the MGIS program are its participating faculty members? To what extent are they satisfied with their quantity and quality of their interactions with students? Do they perceive their workload to be sustainable? Is their participation adequately valued and rewarded? Do they receive adequate training and support from the appropriate support staff? How is the program perceived by non-participating faculty members? To what extent is the relationship between the MGIS program and the Department of Geography's resident programs synergistic?
- **Cost effectiveness** To what extent is the program financially viable and sustainable? Do the benefits of the program to stakeholders (including students, the GIS profession, and the University) outweigh its costs (including opportunity costs as well as real costs)?
- **Access** To whom and under what conditions is the MGIS program accessible to its intended audience? Whom does it exclude? What technological, socioeconomic, or other barriers prevent or discourage prospective students from participating in the program? Can barriers be removed? How?

Survey Instruments

A variety of instruments, some existing and some to be developed, will be used to produce the data needed to address the questions identified above. The data produced through these instruments will inform a process of continuous quality improvement, and (with appropriate human subjects clearance) will provide a rich dataset for formal research on instructional effectiveness in an online setting.

- **Marketing Research** Previous studies conducted by the Outreach Office of Marketing Research and Planning, including World Campus GIS Certificate Graduates Survey Report (OOMRP 2002) confirm that strong demand for a professional degree program in GIS exists. In 2003-04 the office will again contact the now 315 graduates of the existing Certificate Program. It will inform graduates of the proposed MGIS degree and will request feedback to gauge their interest in and expectations for the program and to identify potential barriers to participation.
- **Program Application Statement of Goals and Experience** A statement of goals and experience will be included among the application materials required by the Graduate School and the MGIS graduate program. In addition to articulating specific professional goals and explaining how his or her professional experience has prepared him or her for graduate study, the applicant will also be asked to reflect on his or her learning style and previous experience with distance learning (if any).
- **Entry Interview** The MGIS program Advising Coordinator will pair incoming students with academic advisors. The first advising session will consist of an entry interview that begins with discussion of the student's statement of goals and experience and proceeds to a reflection of the student's perceived strengths and weaknesses as an aspiring GIS professional and as a graduate student participating at a distance. The discussion will be guided by the criteria for GIS professional certification developed by the GIS Certificate Institute (www.gisci.org). The interview will be conducted by a mutually-agreeable medium or media including telephone, instant messaging, and/or Web/audio conferencing. In combination with the statement of goals and experience, the entry interview will result in a set of baseline data by which student progress may later be evaluated.
- **Semi-annual Advising Interview** Students and advisors will "meet" at least twice each year through some mutually-agreeable medium. An interview protocol that guides discussion about student performance (portfolio review and course grades), student satisfaction (with courses, instructors, and interactions with peers) will be developed.
- **Course Evaluation Surveys** In parallel with the feedback acquired during semi-annual advising sessions, student feedback will also be acquired during each quarterly course offering.
- **Exit Interviews** Students' and advisors' final advising interview will consist of a summative evaluation of students' experience in the MGIS program, a final review of the students' professional development strategy, and the collaborative development of a letter of recommendation that students may use to address future employment opportunities or further graduate study.
- **Graduate and Employer Surveys** Every five years the Outreach Office of Marketing Research and Planning will conduct a survey of MGIS graduates and a sample of their employers. The survey will ask graduates and employers to reflect on the downstream impact of graduates' MGIS experience on their professional careers, on the status of their professional development strategies. It will also solicit suggestions about how the program should adapt to changes in the field. It will inform graduates about changes in the program, and invite them to serve as ambassadors within their organizations.

- Faculty Interviews and Peer Reviews** An MGIS program evaluation team will conduct annual interviews to gauge the satisfaction of participating faculty members. It will also interview a sample of four non-participating Geography faculty members each year to elicit their impressions and concerns about the MGIS program. In addition, as part of its normal promotion and tenure procedures, the Department of Geography will assign senior faculty members to serve as peer reviewers of MGIS classes.

Conclusion

Nadler and Nadler (1998) identify a cycle of “critical events” that must take place in the design of an effective educational or training program, including:

1. Identifying the needs of an organization (or, in this case, a profession)
2. Specifying job performance
3. Identifying learner needs
4. Determining objectives
5. Building a curriculum
6. Selecting instructional strategies
7. Obtaining instructional resources
8. Conducting education

Effective program planning includes within each critical event formal, ongoing evaluation and feedback needed to assure the program’s quality. This paper has described the outcome of a series of critical events by which a subset of program stakeholders designed the Penn State Master of GIS degree program was designed. A key design objective is to institutionalize continuous improvement that is informed by regular feedback from all stakeholders. The Penn State Board of Trustees approval of the MGIS degree is expected in time to admit its first incoming class in the Fall quarter of 2004.

Penn State MGIS Advisory Board

Internal Members	
Mark Gahegan, Chair	Professor, Department of Geography
Barry Evans	Senior Research Assistant, Institutes for the Environment
Frederico Fonseca	Assistant Professor, School of Information Sciences and Technology
Stephen Matthews	Director, Geographic Information Analysis Core, Social Sciences Research Institute and Associate Professor, Department of Geography
Gary Miller (ex officio)	Associate Vice President for Outreach and Executive Director,

	World Campus
Tina Enderlein (ex officio)	GIS Officer, Office of the Vice President for Research
External Members	
Christopher Cappelli	Philadelphia Region Representative, ESRI Inc., King of Prussia PA
David Maguire	Director of Products, ESRI Inc., Redlands CA
Ingrid Ratsep	Principal, Ratsep Group, Malvern PA
Adena Schutzberg	Principal, ABS Consulting Group, Cambridge MA
Rebecca Somers	Principal, Somers St. Clair, Fairfax VA
James Query	Director, Enterprise GIS, City of Philadelphia PA
John Ross	GIS Director, PPL Electric Utilities Corporation, Allentown PA

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Biography

David DiBiase directs the John A. Dutton e-Education Institute within the College of Earth and Mineral Sciences at the Pennsylvania State University. He is also a senior instructor in Penn State's Department of Geography. David has led Penn State's World Campus Certificate Program in GIS since its inception 1999, and is principal author and Program Manager of the planned Master of GIS degree program. David came to Penn State in 1989 after earning BS and MS degrees in Cartography at the University of Wisconsin—Madison. He has earned Penn State's Wilson Award for Excellence in Teaching and Mitchell Award for Innovative Teaching, as well as the Association of American Geographers' Media Achievement Award "for exceptional creativity in applying multimedia technology to cartography and geographic education."