GIS Education in U.S. Public Administration Programs: Preparing the Next Generation of Public Servants

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ABSTRACT
Geographic information systems (GIS), data, and analysis are common and crucial resources for public agencies throughout the United States. Applications of GIS run the gamut from delivery of emergency services to monitoring the spread of infectious diseases and environmental contamination and more. Today’s public sector job descriptions often identify GIS knowledge as a must-have skill for new public administration graduates. Thus, public administration programs have a responsibility to their students, to the public agencies who hire their graduates—and to the citizenry—to provide adequate preparation in GIS skills. This article reports the results of a survey of public administration programs in the United States to determine how well such programs have integrated GIS instruction. Our results suggest that although there is interest in GIS among public administration programs, GIS is not yet well integrated into their curricula; however, there is momentum to enhance the role of GIS.

KEYWORDS
Public administration, geospatial, geographic information systems, GIS, education

Geographic information systems (GIS) along with geographic information science principles and analytical methods have become a common and crucial resource at all levels of government throughout the United States and beyond. Although GIS is often associated with software, it is an integrated system that includes hardware, software, data, and people. Effective GIS use requires the acquisition of specialized knowledge and skills. At the heart of GIS lies the “First Law of Geography,” which geographer Waldo Tobler (1970) described thus: “Everything is related to everything else, but near things are more related than distant things” (p. 236). Coincidentally, Tobler is also the geographer who figured out how to convert analog maps to digital format, thus paving the way for GIS. Location is the linchpin within and among many disparate functions of local, state, and federal governments; nonprofit organizations; and private businesses. Leveraging this location linchpin using GIS capabilities provides unpre-
Geographic information systems have been used since the 1960s. As noted, Tobler made it possible to digitize maps in 1959. The earliest broad-based public sector GIS, the Canadian GIS, was established in 1964; it integrated agriculture, forestry, wildlife, and recreation, as well as present land use and the boundaries of census subdivisions using a computer-based mapping system (Tomlinson, 2012). The U.S. federal government began use of geoprocessing during the 1960s in both the defense and civilian sectors; for example, in the U.S. Geological Survey and U.S. Census Bureau (Foresman, 1998). State governments in the United States did similarly at about the same time, often in combination with aerial photography and initially for land planning, as in Connecticut, Minnesota, and New York (Warnecke, 1998). About half the states had an automated natural resource information system by the end of the 1970s, some of which included GIS capabilities for singular or multiple purposes such as water resources, forestry, or wildlife management. By the end of the 1980s, “each of the 50 states had some GIS activity…which included not only natural resources and planning, but also transportation, public utility regulation, environmental protection, emergency management, economic development, and social service functions” (Warnecke, 1998, pp. 268–269). At the same time, more than 40 federal agencies were known to be using GIS (Federal Interagency Coordinating Committee on Digital Cartography [FICCDC], 1990).

While GIS use grew during these early decades, it was accompanied by much experimentation, and computer programming expertise was often needed to conduct geographical analysis.
Times have changed. GIS technology, data and storage, and analytical and user interface capabilities are now far more affordable and ubiquitous—and easier to use—than in the past. Commercial-off-the-shelf software can be expensive, although free and open-source GIS software is now readily available as well. Equally important, ready-to-use geographic data sets are now widely available and shared relatively freely across governmental jurisdictions. In fact, a great deal of basic data are gathered, maintained, and made available by governmental agencies. Federal agencies that provide digital maps and data that can be easily downloaded at no cost include the U.S. Census Bureau, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration. State and local digital maps and data are also available. Most of the 50 states and the federal government have data clearinghouses. For example, the Indiana Geographic Information Council, a nonprofit organization with members in both the public and private sector, has built a website from which anyone may download geographic data from any (or all) of the state’s 92 counties at no cost (www.indianamap.org).

In short, geographic information systems and science are well integrated in the public sector today. Moreover, position descriptions for public sector employment increasingly identify GIS as a must-have skill for newly minted public administration graduates. GIS-related jobs include positions at all levels, from analyst to GIS managers. Even for jobs that are not specifically GIS-oriented, knowledge of geographic information science is a plus. Significantly, the U.S. Department of Labor has identified the geospatial sciences as a “high growth industry,” specifically noting that “revenues from the public sector lead geospatial market growth and account for more than one-third of total revenue” (U.S. Department of Labor, Employment and Training Administration [ETA], 2015). While noting that federal agencies were among the early adopters of GIS, the Department of Labor also acknowledges the growing use of GIS among state and local governments and describes the technology’s uses as “widespread and diverse” (U.S. Department of Labor, ETA, 2015). Nonprofit organizations are also adopting GIS (Al-Kodmany, 2012; Eisman, 2011).

Thus, public administration programs have a growing responsibility, both to their students and to the public agencies for which they nurture their graduates, to provide adequate preparation in GIS skills as well as in understanding its scientific and technical underpinnings (Obermeyer, 1995). Moreover, given that governmental agencies are responsible to their client groups and to the citizenry at large, so too are the institutions that prepare the public leaders of tomorrow. This raises the question, are public administration programs up to the challenge?

This article reports the results of a survey of public administration programs in the United States to assess the degree to which they have integrated GIS training. Respondents completed the online survey during the summer of 2015. We begin the article with a discussion of the growing use of GIS in the public sector, establishing the importance of education in geographic information science for aspiring public administrators. We continue with a discussion of existing studies on the prevalence of GIS in public administration degree programs. We then describe and detail our survey findings and conclude by presenting recommendations for preparing the next generation of public administrators.

**GIS IN THE PUBLIC SECTOR**

As noted, GIS is now in use at all levels of government, from local to county, to state, to national, to international, and everything in between, having overcome early bureaucratic hurdles (Obermeyer, 1990, 2007). In this section, we discuss the diffusion of GIS into the public sector from its early days to the present, starting with local government implementations.

Implementation of GIS at the local level has been relatively difficult to track, given that there are more than 80,000 cities and counties in the United States. The International City/
County Management Association (ICMA) regularly conducts nationwide surveys of local governments. In 1995, ICMA’s nationwide computer technology survey of cities included a question about GIS. Over half of the responding cities with a population over 250,000 indicated use of GIS at the time (International City/County Management Association [ICMA], 1995). Warnecke, Beattie, Kollin, and Lyday (1998) used these and other data from the National Association of Counties and other organizations to design a survey about GIS implementation at the local level; the respondent sample consisted of 120 cities and 80 counties distributed over four regions of the United States. Their findings indicated that use of GIS among the surveyed cities and counties rose from 40% in 1992 to a predicted 87% by 1997. The greatest GIS use was indicated and expected in the West and South; the least such use, in the northeastern states. Concurrently, the number of staff members working with GIS rose from an average of 5 per jurisdiction in 1992 to 7 in 1996. The study concluded that GIS had not been used to its fullest potential (Warnecke, Beattie, Kollin, & Lyday, 1998).

Furthermore, survey respondents indicated that they were not sharing geographic data as broadly as technological advances allowed. Warnecke et al. (1998) explored the institutional infrastructure for GIS as a means to evaluate the capacity for sharing data and other GIS resources. Over 69% of responding jurisdictions indicated having a lead office for GIS, but less than half of respondents officially designated these roles (Warnecke et al., 1998, p. 59). Even fewer had data clearinghouses for GIS, and only 14% had official data clearinghouses (p. 61). Other studies from the late 1990s and early 2000s include work by Caron and Bédard (2002); Haithcoat, Warnecke, and Nedovic-Budic (2001); Kreizman (2002); the National Research Council (2003); Norris and Demeter (1999); and Walsham and Sahay (1999). These studies echo the conclusion that GIS is valuable in the public sector and note the need for further development and increased implementation.

Nedovic-Budic and Godschalk (1996) identified three reasons why GIS is attractive to local governments. First, as noted previously (Huxhold 1991), a large percentage (around 80%) of the data used in local agencies are geographically referenced. Second, information is considered to be a fundamental governmental resource. Third, GIS has the potential to improve the efficiency and effectiveness of public organizations (Nedovic-Budic & Godschalk, 1996, p. 554; Thomas, 2012).

A more recent study (Nedovic-Budic, Knaap, Budhathoki, & Cavric, 2009) focused on metropolitan areas in the United States, emphasizing the “provision and integration of spatial data at the metropolitan level” (p. 5). Note the emphasis on geographic data, a viable surrogate for GIS in the context of our current study. The authors focused on metropolitan agencies because of their sharing of geographic data across jurisdictional boundaries (usually city and county levels) and the broad range of their official duties. These duties include “transportation, economic development, air and water quality, social equity, growth, housing, and other urban and regional challenges,” including emergency management (Nedovic-Budic et al., 2009, p. 10). In fact, there is a long history of public access to cartographic information assembled by governmental agencies (Obermeyer, 2015).

Building on the value of geographic data to public agencies, Pirog (2014) identifies data as “key inputs to the production of public policy and management research,” noting that the federal Data.gov website lists “80,000 datasets, searchable by key words, and produced by governments at all levels, universities, nonprofits, commercial, and collaborative efforts” (p. 537). The author goes on to note the increasing availability of real-time spatially referenced data, suggesting that “geographically situated data will continue to push geospatial modeling to the forefront” and drive public policy and management research in the next decade (Pirog, 2014, pp. 537–540). Similarly, Ganapati (2011) identifies GIS as “one of the core technologies facilitating local e-government processes” in the United States (p. 426). The growth of public participation GIS (PPGIS) is
Research on GIS implementation at the state level began in the early 1980s (Caron & Stewart, 1984; Cornwell, 1982). A few years later, the Council of State Governments (CSG) sponsored an exhaustive investigation into GIS in all 50 states, known as the “50 States Compendium” (Warnecke, Johnson, Marshall, & Brown, 1992). In 1991, Georgia governor Zell Miller invited the leader of each state's compendium initiative to meet in Atlanta; 38 of them attended. Together, these leaders formed the National States Geographic Information Council (NSGIC) to learn from each other and to represent a unified voice about state government GIS issues and needs, particularly to the federal government. NSGIC has maintained a website and held at least one meeting each year since then. State-level organizations, like the Indiana Geographic Information Council are aligned with NSGIC. Several subsequent investigations into GIS in the 50 states have been systematically conducted since NSGIC was organized. However, after the mid-1990s, increasing GIS adoption made it essentially impossible to systematically investigate all state agencies with GIS activities across all 50 states (Warnecke, 1995). Research thereafter changed focus to primarily institutional GIS conditions in all 50 or a subset of the states, including authorizing directives; coordination of entities, groups, roles, and functionality; and resource mechanisms and levels, including those for financing and staffing GIS coordination efforts. For example, almost all states had at least one GIS coordinating group by 1995, and two thirds also had an authorized GIS coordinator position or office (Warnecke, 1995). Research thereafter changed focus to primarily institutional GIS conditions in all 50 or a subset of the states, including authorizing directives; coordination of entities, groups, roles, and functionality; and resource mechanisms and levels, including those for financing and staffing GIS coordination efforts. For example, almost all states had at least one GIS coordinating group by 1995, and two thirds also had an authorized GIS coordinator position or office (Warnecke, 1995). These findings are similar to those concerning large local government jurisdictions (Warnecke et al., 1998). All hard-copy documents provided by each of the 50 states to CSG and Warnecke for the compendium, as well as subsequent queries, are available for research use at the main library of the State University of New York College of Environmental Science and Forestry, located in Syracuse (SUNY-ESF).

While studies have documented early GIS developments in individual federal agencies (see, e.g., Foresman, 1998), there have been few systematic investigations across agencies. The most extensive research conducted to date was done by the National Academy of Public Administration (NAPA) in 1998. The study arose in response to congressional requests to investigate options for consolidating civilian federal surveying and mapping activities and to propose new organizational approaches to facilitate the expanding use of GIS and related technology at all levels of government. In 1994, President Bill Clinton signed Executive Order No. 12,906 to coordinate GIS-related activities at the federal level.

The NAPA panel made several recommendations based on extensive investigation, producing the organization's largest report to that time (National Academy of Public Administration [NAPA], 1998). Key recommendations were to draft a federal statute to define federal agency roles and responsibilities, establish a Geographic Data Service to unify data development and management efforts, and create an advisory committee including state, local, and other representatives. As a result, the National Geospatial Advisory Committee (NGAC) was formed to provide input to the Federal Geographic Data Committee (FGDC), the latter created in 1990 from a previous interagency federal committee focused on coordinating digital cartography. The other two recommendations have not been followed to date, but FGDC and NGAC continue to conduct coordinating and data disseminating efforts. Two congressional offices have also conducted investigations about federal GIS-related activities, including the U.S. Government Accountability Office (and its predecessor, the General Accounting Office) and the Congressional Research Service, though these investigations have been much shorter in duration and produced fewer results than the NAPA study. In addition, the National Academy of Sciences has conducted studies related to GIS for various federal agencies and topics over the years.
As cited previously, the Federal Interagency Coordinating Committee on Digital Cartography (FICCDC), identified over 40 federal agencies with GIS activities in 1990, and this number has since grown. Federal agencies, like state and local governments, develop and disseminate vast amounts of geographically referenced data and imagery. For example, the U.S. Geological Survey provides downloadable satellite imagery and digital data that has traditionally been used for mapping, and the U.S. Census Bureau makes demographic and socioeconomic information available for download. The federal Data.gov website provides access to more than 163,000 data sets at all levels of government available for download (catalog.data.gov/dataset).

GIS IN THE JOB MARKET

All of this leads to questions about the importance of GIS training as a means to qualify for jobs in public administration. In an August 2015 search of USAJobs.gov, a federal website, we identified 58 federal job openings that required GIS expertise. The opportunities included positions in crime analysis, wildlife biology, archeology, community planning, forestry, hydrology, and soil conservation. On the same day, a search of the GIS Jobs Clearinghouse (www.gjc.org) identified 174 jobs in GIS in the United States, in both the public and private sectors. These search results did not include positions that did not focus exclusively on GIS but for which knowledge about it would be valuable.

We do know, however, that GIS has been identified as an increasingly valuable knowledge and skill set. In 2004, the U.S. Department of Labor identified the geospatial industry as a high-growth field (U.S. Department of Labor, ETA, 2015). In particular, the Department of Labor identified the diffusion of GIS to state and local governments as a critical development that has increased the value of geospatial knowledge and expertise, opening positions across the country. Quoting the Geospatial Information and Technology Association, the Department of Labor noted that “because the uses for geospatial technology are so widespread and diverse, the market is growing at an annual rate of almost 35%, with the commercial subsection of the market expanding at the rate of 100% each year” (U.S. Department of Labor, ETA, 2015). The Department of Labor went on to suggest that apprenticeship programs may play a role in putting more GIS professionals in the pipeline. Public administration programs can play a key role in this trend.

Similarly, the National Geospatial Advisory Committee (NGAC, 2012) suggests that there is “a shortage of qualified and skilled workers” in the field. “Solving these workforce issues requires new methods, practices, partnerships, and outreach for this high growth, high technology industry among industry, academia, and government” (p. 3). NGAC (2012) goes on to suggest that the Federal Geographic Data Committee should work with academic partners to “facilitate development of appropriate training and curricula to address emerging geospatial workforce needs” (p. 16).

GIS IN PUBLIC ADMINISTRATION EDUCATION

Academic discussions in public administration have long recognized the value of GIS for public administration graduates. Mergel’s (2012) research suggests that “most information management syllabi in the top 50 public affairs schools provide programming skills for database management, website programming skills, or applied exercises of…GIS applications” (p. 472). Note that GIS is one of three IT applications taught. Mergel goes on to suggest a growing role for social media as an important element in the increasingly networked workplace and the need to integrate this into public administration programs. Several authors have specifically identified emergency services as a rapidly evolving public sector GIS application (Comfort & Wukich, 2013; Crosby, 2010; McGuire & Schneck, 2010). The past president of the Network of Schools of Public Policy, Affairs, and Administration (NASPAA), Jack Knott, identified GIS as a relevant factor that is transforming public service education by using spatial analysis and visualization technologies to analyze and address public policy issues (Knott, 2013).
At Austin Peay University, public administration faculty and GIS technicians implemented a pilot program designed to integrate GIS into their research methods and urban planning courses. Their approach emphasized online resources and selected topics to “prepare public service professionals who understand, and can make advantageous use of GIS as an administrative tool” rather than preparing students to become GIS technicians (Starnes, 2008, p. 6). This pilot program did not evolve into a permanent element of the curriculum (B. J. Starnes, personal communication, July 8, 2015).

Significantly, 10 years ago, Akhlaque Haque (2005), under the auspices of NASPAA, took a “60-second survey” of 135 NASPAA-accredited public administration programs to gauge the integration of GIS into their curricula. At that time, only 2 of the 135 programs surveyed (1.5%) required that their students complete a GIS course. Just over half of the programs (72, or 52%) allowed their students to take GIS as an elective course. Thirty-five programs (26%) offered GIS courses occasionally, while 42 programs (31%) had GIS resources within their departments. Most of the respondents (112, or 83%) did not recommend that NASPAA make GIS instruction an accreditation requirement. Only 16 (12%) did recommend adding such instruction.

The above summary suggests that GIS and geospatial data and analysis are well integrated into the public sector. Furthermore, the public administration community is well aware of these topics’ significance, and education in GIS is gaining ground. This brings us to our current study.

THE CURRENT STUDY

Three separate national organizations provided support for our survey efforts: NASPAA, the American Society for Public Administration (ASPA), and the University Consortium for Geographic Information Science (UCGIS). The groundwork for this study was laid at ASPA’s annual conference in March 2015 in Chicago, at a special session discussing the integration of GIS into the curricula of public administration programs. Less than three months later, at the beginning of June 2015, we launched the survey via an ASPA webinar. The target audience for our survey was directors (or other authorized faculty) of public administration programs in the United States. While our original intent was to focus only on NASPAA-accredited programs, of which there are just over 170 (NASPAA, 2014), we quickly recognized that not all public administration programs are accredited, and we broadened our outreach. Ultimately, our target survey population was drawn from U.S. News and World Report’s “Best Public Affairs Schools” rankings. Using this list, we created an Excel file that included the name of the university where each public administration program is located, along with its score and ranking according to U.S. News and World Report’s 2012 assessment (the most recent available). This list included 265 schools. We used the links embedded in the U.S. News and World Report rankings to find the public administration program! admission websites.

Recognizing that this information still had limitations, we then searched the websites of the public administration programs and identified a contact person—usually the program director—for each of the programs listed (some of the programs were listed but not ranked; we included all programs listed). Using this contact information, we e-mailed each public administration program director, asking for his or her help in completing the survey. We received 27 and 34 responses in each of the 2 following weeks, respectively. We kept track of which schools responded, thanking the administrators who completed the survey. At 2-week intervals, we sent e-mail reminders to directors who had not yet completed the survey. In addition, NASPAA and ASPA sent out e-mail reminders about our survey. In all, we received 189 responses to our survey, although this number included duplicates and otherwise unusable responses. After reviewing the surveys, we had 141 that were usable, for a response rate of 54.2%. One minor, yet unexpected factor that affected our sample size is that we learned that several public administration programs...
that had existed when the *U.S. News and World Report* rankings were published in 2012 have since closed or significantly changed their programmatic focus.

We developed the survey using SurveyMonkey, a standard tool for managing online surveys. The survey began with five demographic questions. Depending on the respondent’s answer to a required yes/no question—“Does your program offer any courses in GIS?”—the respondent was directed to one of two different sets of questions.

**RESULTS**

Our first key question was, “How would you rate the importance of education in geographic information systems (GIS) for your students?” The vast majority of respondents (88.57%) rated GIS as either important (21.43%), somewhat important (43.57%), or very important (23.57%). Only 11.43% rated GIS education for public administration as not important (Figure 1 shows rounded percentages).

We then asked, “Does your program offer any courses in geographic information systems (GIS)?” Just over 38% (54, or 38.30%) of respondents said that their programs do offer GIS, while 61.7% said they do not. Haque’s 2005 survey suggested that 26% of NASPAA-accredited programs offered GIS courses occasionally. While our questions are not identical to that earlier survey, there does seem to be an increase in the number of programs offering GIS courses in the decade since. Depending on the accounting systems at the specific university, there may be an advantage to offering GIS courses in-house. Doing so keeps such enrollments and credit hours in-house as well, rather than allowing other campus departments to count them toward their enrollment totals. Keeping GIS instruction in-house may also increase costs for hardware, software, and maintenance.

Of the 54 public administration programs that allowed students to take GIS courses, about two thirds (66.67%) allowed students to take a
GIS course from any campus department, as an elective; about one quarter (25.93%) included at least one in-house course with a GIS module; and nearly half (48.15%) offered at least one dedicated GIS course in-house. These options were not mutually exclusive. Seven of the programs’ (12.96%) curricula included a GIS certificate or concentration. It is clear that public administration programs are enhancing the opportunities for their students to gain expertise in GIS (Figure 2).

We attempted to learn about how many public administration students take at least one GIS course. Our results suggest that our choice options could have been better. First we asked, “What percentage of undergraduate students in your program take at least one course in GIS?” The options were 0% to 20%, 21% to 40%, 41% to 60%, 61% to 80%, and 81% to 100%. About 40% (40.43%) of the schools responded that a small proportion (0% to 20%) of their undergraduates take GIS courses; about 4% (4.26%) responded that 41% to 60% take GIS courses; and about 4% (4.26%) responded that 81% to 100% take GIS courses (Figure 3).

We asked the same question about graduate students. In about 60% (60.38%) of the programs, 20% or fewer graduate students take at least one GIS course. In about 19% (18.87%) of the programs, 21% to 40% of graduate students take at least one GIS course. In about 6% (5.66%) of the programs, 41% to 60% of graduate students take at least one GIS course. In one program (1.89%), 61% to 80% of graduate students take at least one GIS class, and in about 6% (5.66%) of the programs, 81% to 100% of graduate students take at least one GIS course (Figure 4).

We then asked, “Are students in your program able to take GIS courses elsewhere on your campus?” Nearly 80% (79.63%) of the programs said yes and 16.67% said no. Respondents for two of the programs (3.70%) were unsure.

Given the growing awareness of the value of GIS in the public sector and in public administration programs, we attempted to gauge the degree to which survey respondents plan to modify GIS course offerings in the near future. Seventy-five percent of the graduate programs...
plan to modify their GIS course offerings in the next academic year, while another 40% plan modifications in the next 2 to 3 years. There is some overlap in these percentages, suggesting that modifications are likely to be made over multiple years. Twenty percent of the undergraduate programs plan to modify their GIS course offerings in the next 2 to 3 years.

Twenty-five percent of all survey respondents said that they plan to modify GIS course offerings in both their graduate and undergraduate programs in the next academic year, while 40% suggested that they would make such modifications in the next 2 to 3 years. Overall, it appears that of the 52 respondents who answered this question, about 65% plan to modify...
We were also interested in learning about the status of the faculty who teach the GIS classes in programs where these courses are offered. Are the instructors tenured or tenure-track? Are they adjuncts or visiting? Respondents were permitted to choose all options that applied. Our results indicate that 37.74% of the programs hire adjunct (part-time) faculty to teach GIS; 7.55% hire visiting faculty (full-time, limited-term contract). Other programs hire permanent faculty: 9.43% hire a lecturer or equivalent (permanent, full-time); 37.74% have a tenure-track faculty member; and 41.51% have a tenured faculty member.

We asked the above questions only of programs that offered at least one GIS course. For programs that did not offer at least one GIS course, we asked, “Do you plan to create GIS course offerings in the near future?” One third of respondents indicated that they intend to both their graduate and undergraduate programs either in the next academic year or in the next 2 to 3 years (Figure 5).

Public administration students are able to access GIS software on their campuses in multiple ways. Free software is sometimes made available through site licenses with GIS vendors (33.33% of programs). GIS software downloads are sometimes available for home computers (27.08%). Remote login to campus computers is sometimes available (25.00%), and laptop loans are another option (4.17%). Of the public administration programs with GIS course offerings, 27.08% have a dedicated GIS lab in-house, and 50.00% share a computer lab with another program or department. In 22.92% of the programs, GIS is available on all campus computers. Note that these responses are not mutually exclusive and that programs may use more than one of these options (Figure 6).
FIGURE 6.
Access to GIS Software On- and Off-Campus

Different ways of accessing GIS software

- All of the above: 24
- Shared computer lab with another program/department on campus: 11
- GIS software is available on all campus computers available to students: 13
- Dedicated GIS lab within our program: 12
- Laptop loan program (with GIS software loaded) for on-campus users: 16
- Remote login to campus computers to access GIS software: 13
- GIS software available for download for home computers: 16
- Free software available through arrangements with vendors: 2

Number of respondents: 0 5 10 15 20 25 30

Note. N = 48.

FIGURE 7.
Future Plans of Programs That Do Not Offer GIS

Timeline: 0 to 3 years

- Yes, in the next 2 to 3 years: 28% Both, 61% Grad, 11% Undergrad
- Yes, in the next academic year: 50% Both, 17% Grad, 33% Undergrad
- No, not at this time: 54% Both, 41% Grad, 4% Undergrad

Number of respondents: 0% 10% 20% 30% 40% 50% 60% 70% 80%

Note. N = 82.
create a GIS course offering at the undergraduate level in the next academic year; about 11% (11.11%) said they will do so in the next 2 to 3 years. Nearly 17% (16.67%) of respondents said they plan to create a graduate-level GIS course in the next academic year; about 61% (61.11%) said they will do so in the next 2 to 3 years. Half of respondents said that they will create both an undergraduate and graduate-level GIS course in the next academic year; almost 28% (27.78%) said they will do so in the next 2 to 3 years. Again, the answers were not mutually exclusive (Figure 7).

RESPONDENTS’ COMMENTS

Our survey allowed respondents to make free-form comments, which we found very informative. For example, one respondent said there is a strong need for public administration scholars and instructors to better understand the kinds of GIS skills that would be of value to their students. The value of geographical analysis is high, and yet relatively few public administration faculty have the necessary foundation in geographical concepts and techniques (e.g., geostatistics) to teach GIS. Several respondents noted that they outsource their GIS course offerings to other programs and departments on their campuses. Geography, landscape architecture, planning, forest resources, earth and space sciences, and oceanography were all mentioned as departments from which students gained GIS instruction. As previously noted, students who take classes in these other programs and departments may represent lost full-time-equivalent enrollments and class credits, which in turn may reduce allocation of funds to the public administration program.

Several respondents suggested that GIS is “a tool,” one of many that public administration students may need to become successful in their field. Other respondents said that, based on feedback from regional employees, alumni, and students, they anticipate continued and expanded use of GIS across organizations. One survey respondent who teaches budgeting courses said that “GIS is useful in pointing out impacts of financial decisions” and would be valuable to students. Another respondent said that “understanding GIS tools is a must these days for academics, non-profits, public administrators.” Still another said that GIS “needs to become mandatory.”

This raises significant questions about how GIS should be integrated into public administration curricula. There is no “one size fits all” solution, because each public administration program is unique. As we have seen, there are many approaches to integrating GIS into curricula.

One way to introduce GIS instruction would be to develop modules that could be embedded in another course. For example, a case study could illustrate how a public organization (with a jurisdiction and mission relevant to the course) has used GIS in performing its duties. A visit from a full-time public servant—or a visit to a specific agency—may be of value. This “infusion” approach to adding GIS to curricula has been suggested for business schools (Sarkar and Pick, 2012).

A variant of this infusion approach could be a short course on GIS that uses data from the jurisdiction in which the public administration is located to demonstrate how to undertake geographical analysis. This course could be 1 week (5 workdays) in length, meeting both morning and afternoon, perhaps during a school break. The idea would be to help students understand how GIS is used by the organizations for which they may one day work as a non-GIS specialist. Even in positions that do not actively require GIS expertise, there is a good chance that the public organization does spatial analysis using GIS.

For universities that pay a site license for commercial-off-the-shelf GIS software, students may be eligible to take online courses from the software vendor at no additional cost. For example, an undergraduate student in a fall of 2014 GIS class at Indiana University’s School of Public and Environmental Affairs became an undergraduate teaching assistant during the spring semester, and he took online courses available from the school’s GIS software vendor. He graduated in the spring of 2015 and is now
working full-time as a resource specialist, using GIS, with the Indiana State Department of Agriculture’s Division of Soil Conservation.

Stand-alone GIS courses are another alternative. These courses may be taught either in the public administration program or through another department on campus. An introductory course would provide a sound basis of GIS knowledge to any aspiring public servant, particularly if this aspirant does not plan to become a GIS specialist.

For public administration programs that seek to prepare GIS specialists, a certificate or specialization would be appropriate. This specialization would logically begin with an introductory course, then move to an applications course, and then to a management course. The introductory course could (and should) require that each student complete a GIS project of his or her choice. This is the beauty of geography: everything has a location and thus each student will be able to find a project that matches his or her interests and/or specialization within the public administration program. The applications course would require that students take on a larger project, perhaps a service-learning project undertaken in conjunction with a public or nonprofit organization in the area. The GIS management course would cover a variety of GIS topics, including assessing an agency’s needs; considering its mission, budget, and personnel; and preparing the aspiring public servant to supervise the implementation of a GIS project, program, or enterprise. (A GIS project is a one-off study; a program is an ongoing GIS implementation within a specific organization; enterprise GIS occurs when multiple public agencies within a jurisdiction share GIS hardware, software, and data and an institutionalized approach has been established to coordinate and manage GIS throughout the jurisdiction.) Given the growth of GIS within public agencies, there is also great potential for developing internship programs focusing on GIS, yet another means for students to learn more and gain credits toward their public administration degrees.

CONCLUSION

It is clear that GIS is becoming more ubiquitous and institutionalized in the public sector with each passing year. Many public servants, whether or not they have GIS expertise, are being exposed to geographic analysis and either contribute or use geographic data (sometimes without even knowing they are doing so). Exposure to GIS in academia is valuable for aspiring public servants in order for them to objectively understand the inputs, utility, and potential limitations of GIS analysis.

Academic units on university campuses may operate as separate silos or, worse yet, find themselves competing against one another for full-time-equivalent student enrollments and college credits. For public administration programs without GIS capabilities, working across disciplinary boundaries can be beneficial. Geography programs and departments are an obvious potential partner. Given the broad nature of public administration programs, it may also be of some value to consider hiring a geographer as a member of the program faculty.

Today, many GIS resources are readily available. It would be useful for public administration faculty to learn more about these resources. For example, the University Consortium for Geographic Information Science (ucgis.org) has been instrumental in developing a body of knowledge for GIS. If a university is a member of UCGIS, public administration faculty and staff should make a point of talking with their school’s representative. In addition, UCGIS has recently added a membership option that enables a single university department to become a member.

Learning about on-campus or nearby GIS faculty, facilities, and resources as well as relevant resources at state and local governments can be very useful. The Federal Geographic Data Committee (www.fgdc.gov) and the National States Geographic Information Council (www.nsgic.org), for example, are two groups that provide information about expertise, activities,
and resources within specific states. Many universities and state governments have an annual “GIS Day” (usually in November) and/or GIS conferences that can be very informative and helpful for identifying potential collaborators. GIS organizations may be able to help develop internship programs for public administration students. Affiliated state organizations often have reduced membership rates for students, providing valuable learning and networking opportunities.

The GIS Certification Institute (GISCI; www.gisci.org), a national organization created in 2003, certifies individuals as “GIS Professionals” (GISPs) based on education, work experience, and contribution to the profession. The organization will soon add an examination to its evaluation process. To date, more than 9,300 individuals have been certified as GISPs. An Excel file listing all certified GISPs is available from the institute, including each GISP’s position title, location, and place of employment (www.gisci.org/Recertification/GISPRegistry.aspx). This could be a valuable resource for identifying guest lecturers, developing service-learning courses, or building internship opportunities for public administration students. The institute has played an important role in establishing and promoting ethical standards for GIS professionals (Craig, 1993; Obermeyer, 1998b).

The Urban and Regional Information Systems Association (URISA; www.urisa.org) is another useful resource. A current URISA initiative is the GIS Management Institute which is completing work on a capability maturity model for GIS implementations in public organizations. URISA members are individuals and most work in the public sector, again a resource for possible visiting lecturers, site visits, service-learning projects, and internships. The organization offers a reduced membership rate for students.

The Association of American Geographers (www.aag.org) is yet another organization that has helped shape the evolution of GIS and is a resource for many aspects of the field, including education. As well, the National Center for Geographic Information and Analysis (www.ncgia.ucsb.edu) has played a key role in shaping research in GIS as well as developing a core curriculum for GIS.

Another avenue for discussion involves the public administration community itself, both ASPA and NASPAA. As noted, we developed and participated in a session about GIS public administration at ASPA’s annual conference in 2015. The October 2015 NASPAA conference offered a similar session, which included a presentation of our survey results. We hope that this article stimulates further investigations and dialogue about the growing role of GIS in public organizations and helps the public administration community prepare the next generation of public servants.

**REFERENCES**


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**ABOUT THE AUTHORS**

**Nancy Obermeyer** earned her Master of Public Administration from Indiana University’s School of Public and Environmental Affairs and her PhD in geography from the University of Chicago. She has worked in public transit and energy planning in Chicago and Springfield, Illinois. She is a co-founder of the GIS Certification Institute (GISCI) and served as board member of the Urban and Regional Information Systems Association (URISA) and as GISCI’s ethics officer. She was certified as a GIS Professional (GISP) in 2004, one of the first to earn this title. She is lead author of *Managing Geographic Information Systems* (2nd ed.; Guilford, 2008).

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**Lisa Warnecke** began her career as a town administrator in Colorado after receiving a Bachelor of Science in public administration from Virginia Tech. Her research about nationwide public sector GIS started in 1982 through her professional (MBA) and academic (PhD) work, including with clients such as the U.S. Government Accountability Office, the National Academy of Public Administration, the National Academy of Sciences, over 10 federal agencies, various national organizations, and others.