
GIS in Business School Curricula: Trends and a Case Study

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Abstract

Geographical information systems are being increasingly used by organizations in business and government to derive spatial intelligence and make better decisions. GIS proliferation has increased employment opportunities for business school graduates – future managers and knowledge workers. However efforts so far to infuse spatial thinking and GIS into the curricula of business schools across the country have been somewhat tepid. We examine limited instances of GIS infusion in business school curricula reported in the literature and attempt to identify some trends of such infusion. Based upon those trends, we propose a model of maturity of GIS infusion. The model is comprised of sequential steps that improve the breadth and depth of GIS coverage in business school courses. We then present a detailed case study of GIS infusion in a business school. Several aspects of the case study such as historical evolution of GIS infusion in the school's curricula, current practices to infuse GIS at both graduate and undergraduate levels, GIS software and technology, training and support, and assessment are discussed in depth. The case study has the potential to act as a model for future efforts by business school educators to infuse GIS into their course curricula.

Keywords: geographical information system, GIS, business schools, curriculum, infusion, business GIS

1. INTRODUCTION

Key decisions made by businesses, governments, and non-governmental organizations worldwide include consideration of historical, cultural, ethical, legal, political, and various other perspectives, and are often impacted by the economic, global, technological, geographical, and other environmental factors. Key geographical factors and considerations include facility, asset, and infrastructure locations, boundaries of territories, locations of natural resources, customer demographics, etc. Understanding such factors and considerations is

often facilitated by geographical information systems (GIS).

A GIS can integrate business and socio-economic data with other forms of geographically referenced information to provide integrated data management, visualization, and analysis capabilities. Over the past two decades, organizational use of GIS has increased rapidly – especially among businesses. More recently, this has been fueled by the move from a mainframe to a desktop application, improvements in ease of use, availability across enterprise level platforms, (King and Arnette, 2011), declining

costs of hardware and software (King and Arnette, 2011; Wu and Kohun, 2008), widespread availability and access to geospatial data (Wu, 2007) especially through the internet, and finally migration of GIS software and data into the cloud – all of which arguably create business value. According to Pick (2008), approximately eighty percent of all business data has a spatial component. As geospatial orientation of business data becomes pervasive in the mobile and cloud environments and as GIS becomes available in the form of software-as-a-service (SaaS), use of GIS will grow much more rapidly.

A GIS enables visualization and analysis of geospatial information to derive insights, gather knowledge, and use that knowledge for the purpose of decision-making. Three common areas of GIS application are site selection, routing optimization, and business process redesign (King and Arnette, 2011). GIS usage cuts across organizations in many business sectors such as retail, insurance, real estate, transportation and logistics etc. (Blakeley et al., 2003; Camm et al., 1997; Weigel and Cao, 1999) and government (Bucciarelli, and Brown, 1995, Jang et al, 2006). Benefits of GIS usage, documented by Ramakrishna, Sarkar, and Vijayaraman (2010) include reducing costs (Blakeley et al., 2003), improved process efficiencies (Weigel and Cao, 1999), improved capacity utilization (Bektas and Elmastas, 2007), customer service (Murray, O'Kelly, and Church, 2008), and analytics (Camm et al., 1997).

Due to the rapid evolution and subsequent adoption of GIS by businesses, demand for business professionals with knowledge of mapping and GIS skills is also increasing especially in IS/IT functions of organizations (Wu and Kohun, 2005). Miller, Mangold, and Holmes (2006) provide evidence of a remarkable growth in employment opportunities for business school students trained in business GIS. Geotechnology was identified by the US Department of Labor as one of three most critical emerging technology domains around 2004 (Gewin, 2004). It is thus imperative that business schools around the country expose students to spatial thinking and the fact that geography often plays a crucial role in business decision-making.

The objective of this paper is to study historical efforts of business schools in the United States to infuse spatial thinking, possibly using GIS in

their curricula. We examine instances of such infusion reported in the literature to identify catalysts of GIS infusion and attempt to discover any trends in terms of disciplinary infusion and the extent and maturity of infusion. As a result, we propose a maturity model for GIS infusion in business school curricula. We then present a case study that thoroughly discusses various aspects of GIS infusion in the curricula of the School of Business at the University of Redlands – a private liberal arts university located in southern California. The case study intends to provide insights to business school educators regarding challenges and best practices of infusion of GIS in their curricula.

The remainder of this paper is organized as follows. In Section 2, we study various instances of GIS infusion in business schools. In Section 3, we outline our maturity model of GIS infusion. Section 4 discusses the case study mentioned previously. Concluding remarks are presented in Section 5.

2. GIS IN BUSINESS SCHOOL CURRICULA

Before proceeding further, it is important to define "infusion". In a recent paper, Ramakrishna, Sarkar, and Vijayaraman (2010) have defined that "infusion" may consist of GIS applications that constitute a part of a course, or a dedicated course which focuses on the theory and applications of GIS in business. The authors further mention that the degree of infusion may vary along a continuum. Our usage of the term "infusion" is consistent with the definition of Ramakrishna, Sarkar, and Vijayaraman (2010).

Instances of GIS infusion in business school curricula date back to the mid-late 1990's. As discussed later in Section 4, one of the earliest instances of infusion was an elective course in GIS at the University of Redlands School of Business (Pick, Baty, and Phoenix, 1994). Subsequently the first required course in GIS was offered by the University of Redlands in 1995. Locational proximity to one of the largest GIS software vendors in the world (ESRI) was one of the early catalysts for infusion of GIS at the University of Redlands.

In the late 1990's, evidence of infusion can be found at East Carolina University (Mennecke, 1998) and University of Tennessee (Smith, Langley, and Mundy, 1998). While GIS infusion at East Carolina University was initiated by an IS

faculty member interested in GIS due to a GIS software grant, the catalyst at the University of Tennessee was interest expressed by second year MBA students who had been exposed to GIS as part of an internship at a logistics solutions provider. As a result, GIS was infused into an advanced special topics course in logistics analysis.

In recent years, a handful of studies have examined the status of GIS infusion in business school curricula in the US. Via an internet search of curricula in 140 business schools, Estaville (2007) determined that only 5 business schools at Baylor University, California State University – Fresno, University of Cincinnati, University of Massachusetts at Amherst, and West Chester University have incorporated GIS in varying degrees in graduate and undergraduate business school courses in disciplines such as IS, Marketing, and Supply Chain Management (SCM). Li, Wynned, and Babb (2009) found evidence that less than 7% of 460 AACSB-accredited business schools offer GIS-related courses. However none of the courses was part of core curriculum requirement. In a similar survey of online course catalogs of 30 Management Information Systems (MIS) or equivalent departments in business schools, Arnette and King (2008) found that only North Carolina State University offered a single course in MIS which incorporated GIS to some extent. While several other schools in the study sample offered courses in decision support systems and other areas in business such as logistics and SCM – all of which lend themselves naturally for some level of GIS infusion, none of the schools' curricula infused GIS. In addition to the previously mentioned reports of GIS infusion, Ramakrishna, Sarkar, and Vijayaraman (2010) reported 12 more instances of GIS infusion in business schools – either reported in previous literature (Boasson, Boasson, and Tastle, 2006; Gadish, 2007; Miller, Mangold, and Holmes, 2006; Reames, 2006) or obtained by a preliminary internet search. Overall, it is clearly evident that GIS infusion in business school curricula in the United States is relatively uncommon in spite of the large number of business schools in the country. This indicates that business schools are indeed missing an opportunity to educate and train their students for a rapidly emerging area of employment.

Investigation of all instances of GIS infusion reported in the literature from 2006 to 2010 reveals some trends. (1) Instances of GIS

infusion are split almost equally between graduate and undergraduate level courses. (2) Slightly more standalone courses in business GIS (for example, Business Geographics, Geomapping Fundamentals, etc) have been offered in this period compared to GIS infusion as part of another course (such as Decision Support Systems, Tools and Techniques for Logistics Analysis, etc). This hints towards the possibility of a reversal of the 1990's trend when almost all instances (a very limited number reported in the literature) of GIS infusion took place as part of a different course. (3) Information Systems and Marketing are two key business disciplines that seem to have embraced GIS the most followed by Real Estate and Logistics/SCM. This seems intuitive given the organic fit of GIS with marketing and information systems. (4) Elective course offerings during this period have slightly outnumbered core courses that have infused GIS. The fact that core courses in business schools have not lagged far behind electives in terms of GIS infusion may be considered to be encouraging. One can argue that core course enrollments far outnumber enrollments for electives thereby impacting a larger number of potential graduates. (5) Finally, instances of infusion in AACSB-accredited schools/colleges outnumber those in non-AACSB accredited institutions by almost 4:1 (Ramakrishna, Sarkar, and Vijayaraman, 2010).

3. MATURITY MODEL OF GIS INFUSION

Several accounts of GIS infusion discussed in the previous section vary by the extent of GIS infusion. As reported earlier, during the period 2006-2010, a gradual shift in emphasis seems to have happened – from introducing GIS in the context of discussing major topics in standard business disciplines to more stand-alone courses that focus exclusively on business GIS.

Early instances of GIS infusion such as Mennecke (1998) and Smith, Langley, and Mundy (1998) introduced GIS in courses that focused on Decision Support Systems and Tools and Techniques for Logistics Analysis respectively. In Mennecke (1998), GIS is introduced as one part of the course and is presented as a tool that facilitates database management, decision analysis, and decision support in one software platform. In Smith, Langley, and Mundy (1998), GIS is presented as a tool for network optimization in logistics.

Hands-on training using GIS software is an integral part of both courses. On the other end of the spectrum, standalone courses such as Business GIS (found in Estaville, 2007; Reames, 2006) focus on the application of GIS and spatial analysis to solve business problems. Such courses sometimes provide a conceptual overview of database management systems from MIS perspective to geodatabases and their integration with a GIS. There is evidence in Estaville (2007) that software applications, methods, and data issues in GIS are often covered. Depending often upon the background of the faculty member teaching the course, emphasis is placed on problem solving in marketing (such as site selection, market segmentation, etc), real estate, and business strategy. Case studies are often used to illustrate fundamental to more advanced business principles in such courses. Hands-on exposure to GIS is facilitated by tutorials and lab exercises.

The difference between fairly distinct paradigms of GIS infusion witnessed so far in business schools can be explained by Kerski's (2008) dimensions of GIS education. Standalone courses embody teaching and learning *about* GIS whose goal is to "become familiar with the theories concerning geographic information science and the acquisition of skills to manage GIS and operate GIS software (Kerski, 2008, pp 541)". Courses emphasize topics such as data structures, database management, map scale and projections, data quality, and generalization. On the other hand, GIS infusion on an as-needed basis to develop and further understand key topics within specific business disciplines are illustrations of teaching and learning *with* GIS. The scope is smaller than teaching and learning *about* GIS and the focus is "not on GIS but on the disciplines that are home to the issues being addressed, using GIS (Kerski, 2008, pp 541)."

Regarding the maturation of student learning of GIS, the present model incorporates levels of learning behavior pioneered by Bloom (1956) and further elaborated over the past 50 years by many others including contributors to Anderson and Krathwohl (2001). These levels, which consist of remembering, understanding, applying, analyzing, and synthesizing/evaluating, are relevant during the GIS curricular maturation stages. As the curriculum matures, we posit that the student levels of learning become weighted more towards the higher levels of learning.

Based upon insights derived from accounts of GIS infusion in business schools and Bloom's Taxonomy (Bloom 1956; Anderson and Krathwohl, 2001), we now present a maturation model of GIS infusion in business school curricula. The model is somewhat adapted from Erevelles, Viswanathan, and Huntley's (1998) model to use GIS to teach various courses in marketing.

Level of curricular maturation advances from GIS content in a single course to its inclusion in several courses; to a standalone GIS course and finally to GIS inclusion in all courses in a curriculum including the capstone. The maturity of curriculum is a function both of the hierarchy of *student approach to learning*, based on Bloom's taxonomy, and on *teaching methods* employed, which progress from lectures to exercises and exams; then to GIS lab exercises; and finally to Integrative Case Studies, Capstone Projects, and GIS Technology Projects.

In the model (Figure 1 in Appendix), curricular maturation stages are shown on the vertical Y-axis, while student approach of learning and teaching methods are on the X- and Z-axis respectively. We posit that as curriculum matures (Y-axis), educational indicators on the other two axes tend to progress positively. For example, with increasing curricular maturity, instructors progress from traditional teaching methods such as lectures in specific disciplinary courses to using creative methods such as multidisciplinary integrative case studies. As a result student learning also progresses positively from remembering basic principles of business GIS to being able to understand concepts, apply concepts and technology to solve problems, and synthesize and evaluate solutions and their tradeoffs.

This maturation model of GIS infusion is a guide for business schools that recognize the importance of geography in business decision-making and hence aspire to foster development and implementation of curricula in business GIS. It intends to provide insights on correlates of curricular maturity and the connection to student learning. To illustrate the maturation model, we now present a case study of GIS infusion in the School of Business at the University of Redlands.

4. CASE STUDY: GIS IN UNIVERSITY OF REDLANDS, SCHOOL OF BUSINESS

The University of Redlands School of Business (URSB) constitutes a case study of incorporating GIS into a business school. This section discusses this case by first considering the background context over the past two decades, followed by the current spatial curricula and courses, GIS software and technology issues, training of business school faculty, assessment of GIS progress in the school, and summary.

Background

URSB taught its first elective course in GIS in 1992 and introduced its first required GIS course in its B.S. in Information Systems curriculum in 1995. The early development was helped by the proximity to the campus of the global headquarters of ESRI, the world's dominant GIS software company. This locational advantage provided expertise and some teaching and curricular support, for example, some GIS courses could be taught by part-time faculty from the company; ESRI experts could be consulted on course content or research. The close relationship with ESRI had continued to be a stimulus for introducing GIS in the business school.

At the University of Redlands (UofR) in the 1990s, there was slow growth in GIS. The university did not have a geography department and did not start a Master of Science in GIS Program until 2000. University-wide in the 1990s the group of full-time faculty who taught GIS could be counted on one hand. However, that number grew in the 2000s and today numbers about ten full-time faculty. In addition, today there are about 30 adjunct faculty who teach GIS, about 20 of whom are in the business school.

A GIS Emphasis in the MBA was first offered in 2004. Later the school realized that it had introduced the first such emphasis worldwide. The emphasis included courses on GIS and public policy, GIS and marketing, spatial analysis of global business, and GIS capstone. It was developed by a committee of business school faculty and several ESRI experts. From initial annual cohorts of ten students, today there are 35 MBA students annually who enroll in the emphasis. As detailed later, this emphasis mixes the management and technical sides of GIS. Its success is partly the "job pull" of

employment needs for people who combine business skills and capabilities with GIS knowledge and skills.

Deficits in URSB's early initiatives in GIS were missing pieces of GIS research, case studies, training, and contact with actual businesses. Fortunately, the next step for URSB in 2006 was to achieve funding from the U.S. Small Business Association (SBA) of a US one million dollar grant for three years. The grant included intensive "interventional" case studies of selected local small businesses, training workshops for small business owners and managers in GIS, and building a website that provided useful information to small businesses, academics, and the general public, including case studies and local socioeconomic mapping. Among the secondary benefits were to increase number of full-time URSB faculty actively involved in GIS, develop useful case studies in small business GIS, map social and economic trends in the local area, and post a compendium of academic reference information and contacts on business GIS.

Another indirect offshoot was the establishment in 2008 of a required course, GIS in Business, for undergraduates in the B.S. in Business (BSB) degree. About 350 students enroll in this required course annually, so it has led to about a fifty percent infusion of GIS knowledge in the URSB student body. The grant also set the stage for the university to establish two URSB centers for GIS in 2011, Center for Business GIS and Spatial Analysis and Institute for Spatial Economic Analysis. Together, they have active involvement by about half the full-time URSB faculty and by about 25 part-time faculty. Among the offshoots of the centers for business GIS are the regular annual GIS speaker series, research brown bags, enhanced website for business GIS, case studies, curricular and speaker videos, teaching workshops, posting of current map analyses, curricular development, and some technical support for faculty business research. The centers provide impetus to go beyond just offering repetitive courses, and to innovate in business knowledge creation and pedagogy. Support from the University's and School's academic administration was crucial to the development of these centers.

In summary, the School of Business steadily increased the scope and scale of its GIS themes, yet it still has more opportunities to go significantly further.

Curricula and courses

Although URSB has five degree programs, GIS so far has been infused only in the two largest ones, the BSB and MBA. This section discusses briefly the GIS curricular and course design in those two programs.

Bachelor of Science in Business (BSB)

Table 1. Sequence of Courses in the BSB Curriculum

Course Sequence	Course Title
BUSB 300	Ethical and Legal Environment of Business
BUSB 230	Economics for Business
BUSB 301	Critical Analysis: Written and Oral Communication
BUSB 145	Mathematical Foundations for Business
BUSB 330	Managing and Leading Organizations
BUSB 232	Business Statistics
BUSB 333	Business Information Systems
BUSB 433	GIS for Business
BUSB 260	Financial and Managerial Accounting
BUSB 370	Managing Quality and Operations
BUSB 361	Financial Management
BUSB 340	Principles of Marketing
BUSB 342	International Business
BUSB 481	Strategic Management
BUSB 485	Management Capstone

As seen in Table 1, the GIS for Business course (BUSB 433) occurs at the half-way point of a two-year curriculum. This has the advantage that students will already have a basic business and economics, quantitative, and information systems (IS) background prior to taking the GIS course. Since IS and GIS are closely related, placing them sequentially next to each other enables student learning of databases, systems development, and decision making to be leveraged directly into similar concepts in the GIS course. Another advantage of this sequencing is that a student can potentially utilize GIS knowledge and skills in the specialized business courses to follow and in the Management Capstone course. For example, the geo-segmentation concept, studied in the GIS

course, can be applied in the Marketing course. Geo-segmentation refers to specialized software which characterizes a neighborhood into one of dozens of typologies that can identify each neighborhood in the U.S. In the Capstone, students can do integrative projects that include GIS software and knowledge concepts.

The GIS in Business course provides an overview of GIS and Spatial analysis applied to organizations, including geographic information, locational decision-making, spatial data, costs and benefits of GIS, ethical aspects, and spatial strategies. Students analyze case studies and utilize GIS software and web services to solve problems. The objectives are for students to learn key concepts and skills in these areas, and to be able to apply the concepts hands-on at the lower intermediate level, as well as through decision-making insights.

MBA Emphasis

The MBA Emphasis was revised in 2012. Its three courses are GIS for Marketing (GISB 691w), Spatial Analysis for Global Business (GISB 692w), and GIS Strategy: Concepts and Implementation (GISB 693w). GISB 691w blends basic marketing principles with elementary GIS concepts. Students practice these concepts with five hands-on exercises. GISB 692w emphasizes the global economy; its locations and flows; industry sectors and their geographic arrangement; and how global economic and environmental trends spatially influence business operations and decision making. Students gain a working knowledge of ArcGIS, the mainstay full-featured software from ESRI, as well as a variety of web services. In 693w, student teams are sent to one or more organizations; they interview leaders and provide to the organization a strategic plan and some portion of prototype technical implementation of the plan. This course gives students experience in teamwork; developing spatial strategies for an organization; and customizing solutions to derive the most benefit to a particular organization. At the end of the emphasis, students are expected to gain at the minimum intermediate level of GIS hands-on skill and a higher level of understanding of business GIS concepts. The recent upgrade of the emphasis also examined very closely the mix of management and technical content, and adjusted the emphasis to have about an even balance between these elements.

Graduates of the GIS Emphasis have pursued both GIS specialty and general management careers. About half go into GIS-related jobs, including middle management, senior management, consulting, doctoral studies in GIS-related fields, and entrepreneurial ventures.

GIS Software and Technology

GIS software and technology have changed rapidly over the past two decades. URSB currently emphasizes ArcGIS software, Business Analyst Online (BAO) web service from ESRI, and several minor spatial web services. The ESRI software and services are provided free, as the result of the university's ESRI site-license.

BAO – This is a user-friendly web-based tool that has a rich set of business variables for the U.S. Due to its user friendliness, students learn quickly and gain access to very sophisticated data. On the other hand, the current BAO is limited in its spatial functionality to only about 25 functions compared to ArcGIS.

ArcGIS – It is the world standard for professional GIS, with over 500 features, web access, and powerful analytic capabilities. Although students have a harder time learning ArcGIS, it gives them insight into the vast analytic and spatial power of world-class software. The trick in teaching ArcGIS in the MBA Emphasis is to constrain its uses to pre-set exercises, since there is not sufficient time to learn and use it at an advanced level (unless a student enters with a strong GIS background).

World Mapper, Gapminder, Google Earth – They are free web-based services that are utilized as secondary spatial tools somewhat in the undergraduate GIS course and more fully in the GIS emphasis in the MBA. They are useful for specific problem solving in the courses, and they also communicate to students the variety of public domain and commercial spatial tools that are available.

Technical and GIS Software Support

An essential challenge faced in the entire progression of building GIS utilization in the School of Business is technical and GIS support. With 24 full-time faculty, URSB has been too small to hire a full-time technical/software support staff person. Hence, it has relied on several staff members of the university's central Information Technology Services for GIS

technical/software support, including management of licensing, lab set-ups and maintenance, GIS software and spatial services set-up in faculty offices. Deeper software issues have been assisted since the late 1990s by an applied research unit, the Redlands Institute (RI). However, since the RI is grant-funded so far its services have been expensive and constrained in time for technical support and consulting on URSB projects. Both ITS and RI have benefited by the close relationship of the campus with ESRI. Nevertheless, for over a decade URSB has been able to take sufficient advantage of this centralized support, as well as some faculty technical expertise, to achieve its growth steps in business school GIS.

Training of Business School Faculty

A critical factor in achieving widespread GIS curriculum and teaching in URSB has been training of faculty. The GIS teaching faculty has grown over the past decade to a level of 3 qualified full-time professors and 15 qualified adjunct faculty. Since the late 1990s, there have been annual training workshops on GIS teaching and pedagogy. The workshops emphasize hands-on use of GIS software and services. Faculty have been oriented to the software, briefed on common mistakes and pitfalls, and put in the students' place to take part in student exercises under training supervision.

For example, BAO was introduced for widespread faculty use in winter of 2011. An all day workshop, attended by 20 faculty included a talk by an ESRI developer of BAO, orientation to teaching with BAO, demo of BAO features, and practice session of taking a student exercise involving supply chain and customer proximity to Starbucks' outlets in San Francisco. Following the workshop, all faculty teaching GIS courses received that session's complete training materials electronically, so that faculty not able to attend can maintain up-to-date currency. We have learned that training sessions imparted over ten years to a fairly stable core of faculty teaching business GIS courses has raised teaching effectiveness from good to excellent levels as evident from student evaluations. It is pertinent to mention that the School administration supports such workshops through faculty professional development funds.

Assessment

In the innovative and challenging steps of introducing GIS, there is an urgent need to assess the impacts of steps taken and adjust initiatives accordingly. In fall of 2011, a study of student evaluations in the GIS courses in the BSB and MBA curricula was performed. The rating scale ranged from 1 to 4, with 4 indicating "strongly approve" and a 3 indicating "approve" of teaching measurements. The average of results for six key evaluation metrics was 3.57 for the MBA GIS Emphasis courses and 3.27 for the BSB required course. Hence, overall at 3.42, the effectiveness of GIS teaching is in between "strongly approve" and "approve" and at a level somewhat higher than the school's average MBA or undergraduate teaching effectiveness levels.

No formal assessment of GIS faculty research has yet been conducted, which points to a future need. However, over the past four years, six business school faculty have published books, journal articles, and in conference proceedings on GIS research.

Summary

There has been progress on bringing GIS fully into URSB. In over a decade of growth, barriers have included faculty and staff unfamiliarity with GIS and spatial analysis, secrecy and proprietary policies in the business world that restricts teaching cases and knowledge, resistance to change in URSB, and in the beginning lack of a critical mass of skilled faculty and support staff. However, more than offsetting these constraints were the proximity and strong relationship with ESRI, concordance with university strategy in GIS, hiring of business faculty who knew some GIS or had strong motivation to learn it, grant funding, and the 2000s groundswell of web-based mass consumer adoption of spatially oriented technologies. Beyond its current features, anticipated initiatives in GIS in School of Business in the coming two years include:

- posting of more case studies based on interviews with high-end user organizations, done cooperatively with ESRI,
- expanding GIS content coverage gradually across more of the business curricula, outside of GIS courses,
- inviting an annual national keynote speaker for 2-3 day visits involving a seminar and meetings with full-time faculty, adjunct faculty, and students,
- seed grant funding in business GIS,

- student awards for best papers in business GIS, and,
- external grant funding to expand the activities of the centers.

From URSB's steady progress in incorporating the GIS sub-discipline, it is today a unique strategic feature of the school. With the strong support of the school's Dean for GIS, two centers, active business faculty scholarship, and growing enthusiasm across its student body, URSB continues to build and emphasize GIS by undertaking the next steps and challenges. An overall lesson is that the critical factor is not just having deployment of up-to-date spatial technology, but developing "mindset" across the school, motivation, and sense of "payoff" to the students, faculty, administration, and staff.

Returning to the paper's theoretical model, in the URSB case, over time, the curricular maturation progressed from an initial standalone elective course to the present stage in between standalone required courses having full and partial GIS content and curriculum-wide infusion. Student learning approach has moved in the GIS Emphasis in the MBA to greater weighting towards application, analysis and synthesis, but falls short of evaluation. In the BSB program, the learning is more centered at the steps of understanding and applying. In teaching methods, both the BSB and MBA GIS Emphasis have added more lab content and some more case studies, although the availability of GIS business cases is severely limited. Although the GIS Emphasis has progressed to capstone and GIS technology projects, the BSB remains far short of this, and points to necessity of more effort in infusing GIS across the undergraduate curriculum and into its capstone course.

5. CONCLUSIONS

Businesses and government agencies are increasingly using GIS to harness the power of spatial analytics and make better decisions quickly and efficiently and evaluate the impact of those decisions. However existing, limited evidence from the literature suggests that the response among business schools educators to infuse GIS in their curricula has been lukewarm. Before business school academia fall too far behind practice, it is therefore imperative for business schools to respond so that graduates are well prepared for rapidly emerging geotechnology needs of organizations. In this

paper, we examine previous instances of GIS infusion in business school curricula and report on current trends. It seems that faculty are somewhat more interested in standalone business GIS courses in recent years, possibly indicating a shift compared to the 1990's. We propose a maturity model of GIS infusion in B-schools. Maturity of GIS infusion varies along a continuum and is a function of student approach to learning GIS and of teaching methods adopted in business school courses. The maturity model is illustrated by a case study that thoroughly discusses various aspects of GIS infusion in the curricula of the School of Business at the University of Redlands.

6. REFERENCES

- Anderson, L., and Krathwohl, D. (eds.). (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York, NY: Longman.
- Arnette, A., & King, M. (2008). The business value of geographical information systems in business school curriculum, in *The 2008 Southeast Decision Sciences Institute Conference Proceedings*, Orlando, FL, 413-420.
- Bektas, T., & Elmastas, S. (2007). Solving school bus routing problems through integer programming, *Journal of the Operational Research Society*, 58(12), 1599-1604.
- Blakeley, F., et al. (2003). Optimizing periodic maintenance for Schindler Elevator Corporation, *Interfaces*, 33(1), 67-79.
- Bloom, B. (1956). *Taxonomy of Educational Objectives*. Boston, MA: Allyn and Bacon.
- Bucciarelli, M. & Brown, K. (1995). A desktop-OR success: Modeling coast guard buoy tender operations, *Interfaces*, 25(4), 1-11.
- Boasson, E., Boasson, V., & Tastle, W. (2006). A New Tool in IS Management: Geographic Information Systems. *Information Systems Education Journal*, 4, 3-9.
- Camm, J. D. et al. (1997). Blending OR/MS, judgment, and GIS: Restructuring P&G's supply chain, *Interfaces*, 27(1), 128-142.
- Erevelles, S. Viswanathan, N. & Huntley, C. (1998). The use of GIS in Marketing. In J. Hair, C. Lamb, & C. McDaniel, (Eds.), *Great Ideas for Teaching Marketing* Cincinnati, OH: South-Western College Publishing.
- Estaville, L. (2007). GIS and colleges of business: A curricular exploration. *Journal of Real Estate Literature*, 15(3), 443-448.
- Gadish, D. (2007). Incorporating geographic information systems into an MBA program. *Journal of Education and Human Development*, 1(2), 1-8.
- Gewin, V. (2004). Mapping opportunities. *Nature*, 427(6972), 376-377.
- Jang, W. et al. (2006). The Missouri lottery optimizes its scheduling and routing to improve efficiency and balance, *Interfaces*, 36(4), 302-313.
- Kerski, J. J. (2008). Geographic Information Systems in Education. In J. Wilson, & A. S. Fotheringham (Eds.), *The Handbook of Geographic Information Science* (pp. 540-556). Victoria, Australia: Blackwell Publishing Ltd.
- King, M. & Arnette, A. (2011). Integrating Geographic Information Systems in Business School Curriculum: An Initial Example, *Decision Sciences Journal of Innovative Education*, 9(3), 325-347.
- Li, Y., Wynn, A., & Babb, J. (2009). Preparing tomorrow's global decision-makers: A case for geographic information systems in business curriculum, in *Proceedings of the 40th Annual Meeting of the Decision Sciences Institute*, New Orleans, LA, 3741-3746.
- Mennecke, B. (1998). Teaching spatial analysis in business: The case of geographic information systems in a decision support systems course. *Proceedings of the 13th Annual Conference of the International Academy of Management Annual Conference*, Helsinki, Finland, 181-189.
- Miller, F., Mangold, W., & Holmes, T. (2006). Integrating geographic information systems (GIS) applications into business courses using online business geographics modules. *Journal of Education for Business*, 82, 74-79.

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- Murray, A., O'Kelly, M. & Church, R. (2008). Regional service coverage modeling, *Computers and Operations Research*, 35(2), 339-355.
- Pick, J. (2008). *Geo-Business: GIS in the digital organization*. Hoboken, NJ: John Wiley and Sons.
- Pick, J., Baty, R. and Phoenix, M. (1994). Teaching Geographical Information Systems. *Proceedings of ISECON 1994*, Louisville, KY, 35-42.
- Ramakrishna, H., Sarkar, A., & Vijayaraman, B. (2010). Infusion of GIS and spatial analysis in business school curricula: A status report. *Journal of Informatics Education Research*, Spring/Fall 2010. Retrieved July 15, 2012 from http://www.sig-ed.org/jier/2010/JIER2010_ramakrishna.pdf.
- Reames, S. (2006). Business geographic information systems - A course in business geomapping. *Information Systems Education Journal*, 4(52), 3-15.
- Smith, C., Langley, C., & Mundy, R. (1998). Removing the barriers between education and practice: Tools and techniques for logistics management. *Journal of Business Logistics*, 19(2), 173-195.
- Weigel, D. & Cao, B. (1999). Applying GIS and OR techniques to solve Sears technician dispatching and home-delivery problems, *Interfaces*, 29(1), 112-130.
- Wu, P. (2007). Introducing Geographic Information Systems into the IS Curriculum: GIS Tutorial and Preparation Workshop. *Proceedings of ISECON 2007 v.24* (Pittsburgh PA): § 3732.
- Wu, P., & Kohun, F. (2008). Spatial Analysis and Information Visualization: using Geographic Information System for Competitive Intelligence. *Proceedings of ISECON 2008 v.25* (Phoenix AZ): § 3512.
- Wu, P., & Kohun, F. (2005). Designing Geographic Information System Courses in the IS Curriculum, *Proceedings of ISECON 2005 v.22* (Columbus OH): § 2564.

7. APPENDIX

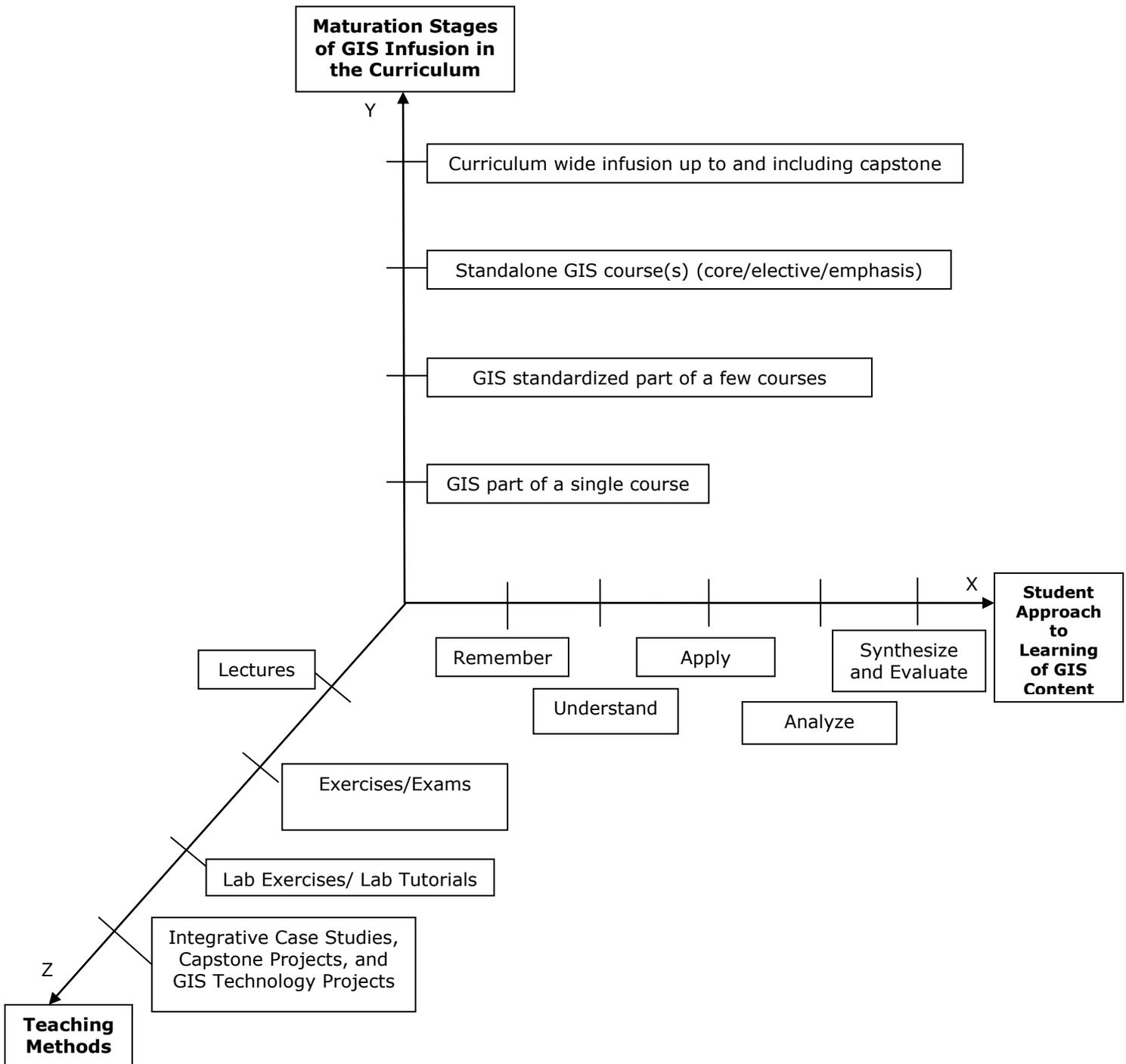


Figure 1. *Maturation model of GIS infusion in business schools*

(source for student approach: Bloom, 1956; Anderson and Krathwohl, 2001)