Introducing the First Edition of *Geographic Information Science and Technology Body of Knowledge*

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ABSTRACT: A "Body of Knowledge" is a comprehensive inventory of the intellectual content that defines a field. Following the lead of such allied fields as Computer Science and Information Technology, a team of seven editors and over 70 contributors completed the first edition of *Geographic Information Science and Technology Body of Knowledge* (*BoK 1/e*) in 2006. Specifying 329 individual topics in terms of over 1,600 formal educational objectives, the *BoK 1/e* is designed for use by curriculum planners and evaluators, certification and accreditation bodies, current and prospective students, and geospatial professionals in government, industry, and academia.

KEYWORDS: GIS, curriculum, education, certification, accreditation, articulation, assessment, objectives

Introduction

Constant changes in courses and curricula seem to be a fact of life… (Turner 2001, p. 4)

So began Joe Turner's invited editorial in the June, 2001, edition of the Association for Computing Machinery's *SIGCSE Bulletin* (SIGSCE is ACM's Special Interest Group in Computer Science Education). ACM first endorsed a curriculum for baccalaureate degree programs in computer science in 1969, followed by a revision in 1978. In 1991, in cooperation with the Institute of Electrical and Electronics Engineers (IEEE), ACM published baccalaureate curricula for both computer science and computer engineering. By 2001, the joint effort yielded new and revised curricula for four related disciplines, including computer science, computer engineering, information systems, and software engineering. An information technology curriculum followed in 2006. Although Turner was reflecting on his years of involvement in the development of computer science curricula and accreditation programs, his observation pertains to GIS education as well.

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Though few were developed as methodically as the ACM/IEEE curricula there have been many local-scale and several national-scale curriculum development efforts in the U.S. related to cartography, geographic information systems, and remote sensing (e.g., Dahlberg and Jensen 1986; Nyerges and Chrisman 1989; Goodchild and Kemp 1992). Some 30 years after ACM published its first computing curriculum, the National Center for Geographic Information and Analysis (NCGIA) began work on its influential *Core Curriculum in GIS* (Goodchild and Kemp 1992). Work on a successor to the *Core Curriculum*, dubbed *Model Curricula in Geographic Information Science*, began in 1995. Plans to develop a complementary *Remote Sensing Core Curriculum* took shape at a 1992 NCGIA workshop and later gained support from the National Aeronautics and Space Administration (NASA). In 2001, NASA commissioned the University of Mississippi to develop a new and greatly expanded remote sensing curriculum in the form of digital courseware equivalent to 30 undergraduate courses (Luccio 2005). The courseware is available for licensing by educational institutions, government agencies, and private firms. Meanwhile, an even more ambitious effort began in 1998 under the auspices of the University Consortium for Geographic Information Science (UCGIS). Motivated in part by a concern that entry-level workers in the geospatial technology industry lacked adequate backgrounds in computer science (Marble 1998), UCGIS emulated the approach and format of the ACM/IEEE computing curricula.

The UCGIS Model Curricula initiative arose from a set of eight education challenges identified at the 1997 UCGIS Summer Assembly in Bar Harbor, Maine. One challenge concluded that "improving GIScience education requires the specification and assessment of curricula for a wide range of student constituencies" (Kemp and Wright 1997, p. 4). A Model Curricula Task Force, chaired by Duane Marble, was formed in 1998. In 2003, the Task Force issued a *Strawman Report* that presented an ambitious vision of how higher education should prepare students for success in the variety of professions that rely upon geospatial technologies (Marble et al. 2003).

A key distinguishing characteristic of the Model Curricula vision is its expansive and integrative conception of the "Geographic Information Science and Technology" (GIS&T) knowledge domain. As illustrated in Figure 1, GIS&T encompasses three subdomains, including:

- **Geographic Information Science,** the multidisciplinary research enterprise that addresses the nature of geographic information and the application of geospatial technologies to basic scientific questions;
- **Geospatial Technology,** the specialized set of information technologies that support data acquisition, data storage and manipulation, data analysis, and visualization of georeferenced data; and
- **Applications of GIS&T,** the increasingly diverse uses of geospatial technology in government, industry, and academia. The number and variety of fields that apply geospatial technologies is suggested in Figure 1 by the stack of "various application domains."

Other aspects that distinguish the UCGIS Model Curricula initiative from other related curriculum planning efforts are:

- **Top-down design:** As opposed to the typical practice in U.S. higher education of simply outlining the subject matter to which students should be exposed, top-down curriculum design "starts from a clear statement of broad educational aims, refines these into a series of explicit and testable objectives, and then devises teaching strategies, content

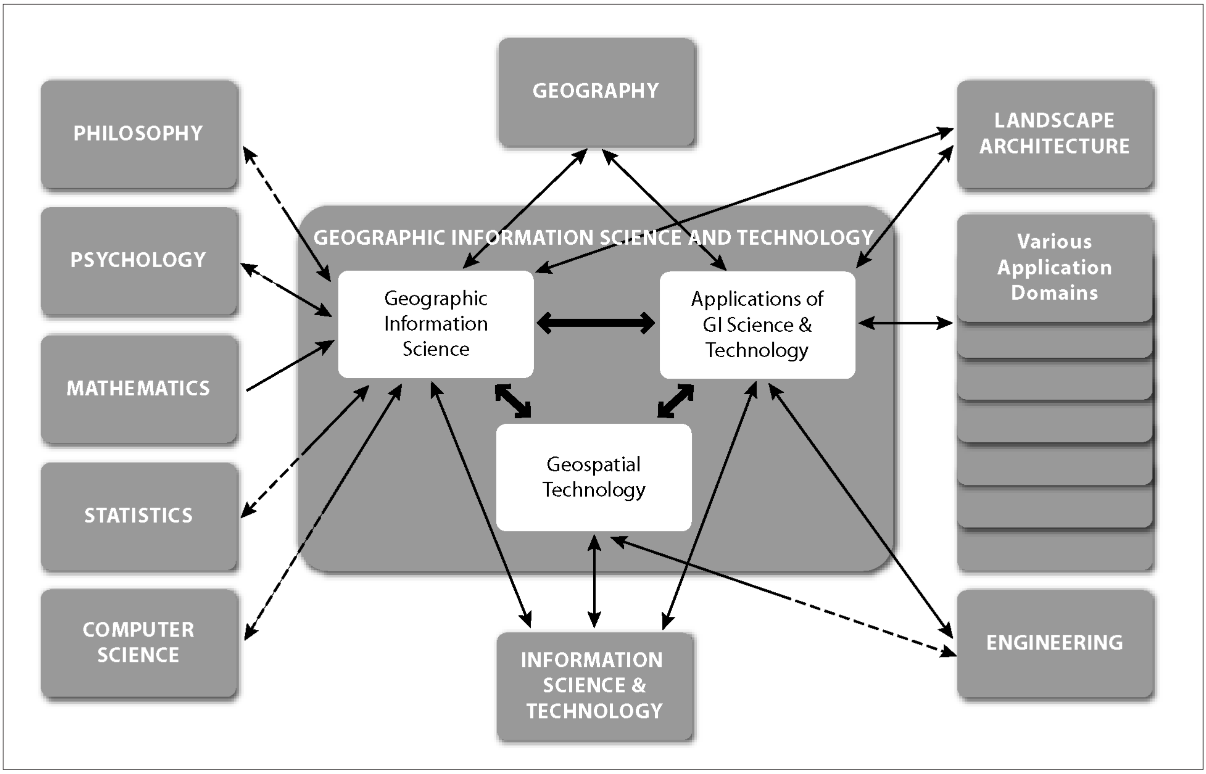

Figure 1. The three sub-domains comprising the GIS&T domain, in relation to allied fields. Two-way relations that are half-dashed represent asymmetrical contributions between allied fields. [© 2006 Association of American Geographers and University Consortium for Geographic Information Science. Used by permission. All rights reserved.]

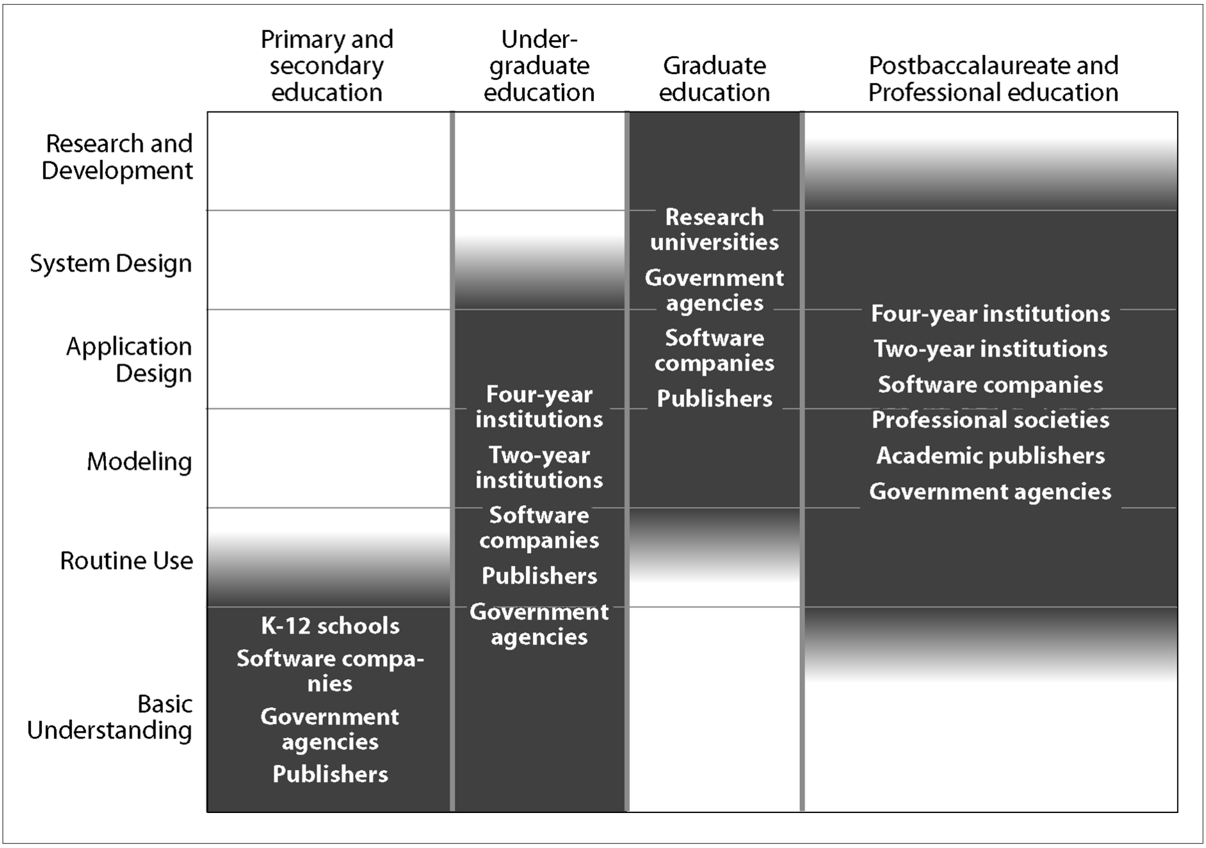

Figure 2. The GIS&T education infrastructure. Columns represent sectors of formal education that span a lifetime of learning. Rows correspond to levels of competency as described in Marble (1998). Informal education spans the learner's lifetime in parallel with formal education. [© 2006 Association of American Geographers and University Consortium for Geographic Information Science. Used by permission. All rights reserved.]

and assessment methods to meet these aims and objectives" (Unwin 1990, p. 4).

- **Multiple pathways to diverse outcomes**: Recognizing the multidisciplinary nature of the field, the Task Force envisioned an adaptive curriculum that students and advisors could tailor to suit individual aims. The Task Force adopted the plural "Curricula" to denote that multiple curricular pathways leading to diverse educational outcomes would be specified.
- **Adaptable to varied institutions:** From the outset the Task Force envisioned a curriculum that would be adaptable to the special circumstances of academic institutions and departments, as well as to learners and employers. The first edition of *GIS&T Body of Knowledge* describes a diverse "GIS&T education infrastructure" (Figure 2) that cultivates a range of competency levels (from basic awareness to research and development) through a lifetime of learning (from primary and secondary schools through post baccalaureate and professional education).

GIS&T Body of Knowledge (BoK 1/e)

In order to develop a curriculum, it is essential to develop a detailed understanding of the knowledge encompassed by [a] discipline (*ACM/IEEE* 2001, p. 14).

Central to the Model Curricula vision is a comprehensive "body of knowledge" that specifies what current and aspiring geospatial professionals need to know and be able to do. Following over seven years of deliberations involving more than 70 contributors and reviewers, the Association of American Geographers published the first edition of *GIS&T Body of Knowledge (BoK 1/e)* in 2006. Like the bodies of knowledge included in recent computing curricula, *BoK 1/e* represents the GIS&T knowledge domain as a hierarchical list of knowledge areas, units, topics, and educational objectives. The ten

Knowledge Area AM. Analytical Methods
Unit AM1 Academic and analytical origins
Unit AM2 Query operations and query languages
Unit AM3 Geometric measures
Unit AM4 Basic analytical operations
Unit AM5 Basic analytical methods
Unit AM6 Analysis of surfaces
Unit AM7 Spatial statistics
Unit AM8 Geostatistics
Unit AM9 Spatial regression and econometrics
Unit AM10 Data mining
Unit AM11 Network analysis
Unit AM12 Optimization and location-allocation modeling

Knowledge Area CF. Conceptual Foundations
Unit CF1 Philosophical foundations
Unit CF2 Cognitive and social foundations
Unit CF3 Domains of geographic information
Unit CF4 Elements of geographic information
Unit CF5 Relationships
Unit CF6 Imperfections in geographic information

Knowledge Area CV. Cartography and Visualization
Unit CV1 History and trends
Unit CV2 Data considerations
Unit CV3 Principles of map design
Unit CV4 Graphic representation techniques
Unit CV5 Map production
Unit CV6 Map use and evaluation

Knowledge Area DA. Design Aspects
Unit DA1 The scope of GI S&T system design
Unit DA2 Project definition
Unit DA3 Resource planning
Unit DA4 Database design
Unit DA5 Analysis design
Unit DA6 Application design
Unit DA7 System implementation

Knowledge Area DM. Data Modeling
Unit DM1 Basic storage and retrieval structures
Unit DM2 Database management systems
Unit DM3 Tessellation data models
Unit DM4 Vector and object data models
Unit DM5 Modeling 3D, temporal, and uncertain phenomena

Knowledge Area DN. Data Manipulation
Unit DN1 Representation transformation
Unit DN2 Generalization and aggregation
Unit DN3 Transaction management of geospatial data

Knowledge Area GC. Geocomputation
Unit GC1 Emergence of geocomputation
Unit GC2 Computational aspects and neurocomputing
Unit GC3 Cellular Automata (CA) models
Unit GC4 Heuristics
Unit GC5 Genetic algorithms (GA)
Unit GC6 Agent-based models
Unit GC7 Simulation modeling
Unit GC8 Uncertainty
Unit GC9 Fuzzy sets

Knowledge Area GD. Geospatial Data
Unit GD1 Earth geometry
Unit GD2 Land partitioning systems
Unit GD3 Georeferencing systems
Unit GD4 Datums
Unit GD5 Map projections
Unit GD6 Data quality
Unit GD7 Land surveying and GPS
Unit GD8 Digitizing
Unit GD9 Field data collection
Unit GD10 Aerial imaging and photogrammetry
Unit GD11 Satellite and shipboard remote sensing
Unit GD12 Metadata, standards, and infrastructures

Knowledge Area GS. GI S&T and Society
Unit GS1 Legal aspects
Unit GS2 Economic aspects
Unit GS3 Use of geospatial information in the public sector
Unit GS4 Geospatial information as property
Unit GS5 Dissemination of geospatial information

Unit GS6 Ethical aspects of geospatial information and technology
Unit GS7 Critical GIS
Knowledge Area OI. Organizational and Institutional Aspects
Unit OI1 Origins of GI S&T
Unit O2 Managing the GI system operations and infrastructure
Unit OI3 Organizational structures and procedures
Unit OI4 GI S&T workforce themes
Unit OI5 Institutional and inter-institutional aspects
Unit OI6 Coordinating organizations (national and international)

Table 1. Knowledge areas and units comprising *BoK 1/e.* Core units are indicated with bold type. [© 2006 Association of American Geographers and University Consortium for Geographic Information Science. Used by permission. All rights reserved.]

knowledge areas and 73 units that comprise *BoK 1/e* are shown in Table 1. Twenty-five "core" units (those in which all graduates of a degree or certificate program should be able to demonstrate some level of mastery) are shown in bold type. Not shown are the 329 topics that make up the units, or the 1,660 education objectives by which topics are defined.

Cartography in *BoK 1/e*

One of the ten knowledge areas represented in *BoK 1/e* is "Cartography and Visualization (CV)." Six units, three of which are core units, comprise knowledge area CV (see Table 1). Twenty-seven topics, defined in terms of 205 educational objectives, comprise the six units in CV. In many cases, objectives span the six "cognitive levels" and first three "knowledge types" identified in the *Taxonomy for Teaching, Learning, and Assessing* (Anderson and Krathwohl 2001). Also provided at the end of the knowledge area are references to 30 "key readings." An example core unit—CV2—appears in Table 2. Note that some topics are considered in more than one unit and knowledge area. Map projections, for example, are considered in the context of thematic mapping in knowledge area CV, but they also appear in knowledge area GD (Geospatial Data) in the context of their relationships to geospatial referencing systems (i.e., plane coordinate systems such as UTM) and geo-registration. Similarly, abstraction and generalization procedures are considered in both CV and knowledge area DN (Data Manipulation). Although the Index provides page references to the multiple occurrences of such "cross-cutting themes," *BoK 1/e's* hierarchical outline format makes it a challenge for users to keep track of topical relationships between knowledge areas. Alternative representation strategies that may do a better job in future editions of revealing such relationships are considered in the concluding section of this article.

Uses of *BoK 1/e*

Like their counterparts in Computer Science and other fields, the UCGIS Model Curricula Task Force originally conceived of *GIS&T Body of Knowledge* as a basis for curriculum planning. After the publication of the Task Force's *Strawman Report* (Marble et al. 2003), however, other needs became increasingly apparent. Expected uses of *BoK 1/e* include:

- **Curriculum planning**: Educators responsible for planning new GIS&T certificate or degree programs can use *BoK 1/e* to identify core topics. They can readily convert educational objectives into assessment instruments that gauge students' mastery. Most important, the granularity of units and topics in *BoK 1/e* is fine enough to be adaptable to the unique constraints and opportunities afforded by particular institutions.
- **Program evaluation and assessment**: Assessment instruments derived from *BoK 1/e* will help programs determine their standing relative to a comprehensive set of community-authored educational objectives. Such assessments may also help prospective students choose educational programs that align with their interests and career goals. Current students and recent graduates may use *BoK 1/e* to self-assess their mastery of the GIS&T domain, and to plan their continuing professional development strategies.
- **Program articulation**: The GIS&T education infrastructure spans a lifetime of learning. Educational institutions accommodate the mobility of GIS&T professionals through "articulation" agreements that ensure that credits earned in one institution will be counted toward relevant certificate and degree programs at another institution. Articulation agreements can be difficult to execute owing to differing academic calendars, incommensurate academic credit valuations, and especially differing course titles and objectives. Institutions that agree to specify course topics and objectives consistent with the *BoK 1/e* may find it easier to execute articulation agreements.
- **Curriculum revision**: As suggested at the outset of this article, curricula need to be reviewed and revised to reflect the evolution of the GIS&T field. *BoK 1/e* and its successors will be useful in helping faculties to identify the topics, objectives, and future staff specializations needed to ensure that their curricula reflect the breadth and depth of this evolving field.
- **Professional certification**: *BoK 1/e* is used by the Geographic Information Systems Certification Institute (GISCI) to adjudicate applicants' point claims associated with educational achievement.
- **Program accreditation**: Unlike the allied fields of Computer Science and Engineering, which are accredited by the Accreditation Board for Engineering and Technology (ABET), most GIS-related courses and programs are offered by academic departments that are not subject to disciplinary accreditation (DiBiase 2003). Recently, however, the U.S. Geospatial Intelligence Foundation (USGIF), an alliance of defense contractors whose major client is the National Geospatial-Intelligence Agency, announced the formation of a Geospatial Intelligence Academy that will "establish curriculum guidelines and accreditation standards and processes for geospatial intelligence aca-

Unit CV2 Data considerations *(core unit)*

This unit relates to data compilation and management for cartography and visualization. Certain data manipulations can and should be made prior to symbolization and labeling, although they are not made without consideration of the symbolization and labeling that will be applied. Symbolization and labeling requirements will shape the way the data used in the displays are selected, generalized, classified, projected, and otherwise manipulated. In this unit, the considerations for data selection, subsequent abstraction for cartographic and visualization purposes, and manipulations for display are considered. Related fundamental topics such as projections and datums are introduced in Knowledge Area GD: Geospatial Data rather than here. The procedures for implementing the tasks described in this unit are primarily covered in Unit DN2 Generalization and aggregation.

Topic CV2-1 Source materials for mapping

- List the data required to compile a map that conveys a specified message
- List the data required to explore a specified problem
- Discuss the extent, classification, and currency of government data sources and their influence on mapping
- Discuss the issue of conflation of data from different sources or for different uses as it relates to mapping
- Describe a situation in which it would be acceptable to use smaller-scale data sources for compilation to compile a larger scale map
- Describe the copyright issues involved in various cartographic source materials
- Explain how data acquired from primary sources, such as satellite imagery and GPS, differ from data compiled from maps, such as DLGs
- Explain how digital data compiled from map sources, influences how subsidiary maps are compiled and used
- Explain how geographic names databases (i.e., gazetteer) are used for mapping
- Explain how the inherent properties of digital data, such as Digital Elevation Models, influence how maps can be compiled from them
- Identify the types of attributes that will be required to map a particular distribution for selected geographic features
- Determine the standard scale of compilation of government data sources
- Assess the data quality of a source dataset for appropriateness for a given mapping task, including an evaluation of the data resolution, extent, currency or date of compilation, and level of generalization in the attribute classification
- Compile a map using at least three data sources

Topic CV2-2 Data abstraction: classification, selection, and generalization

- Discuss advantages and disadvantages of various data classification methods for choropleth mapping, including equal interval, quantiles, mean-standard deviation, natural breaks, and "optimal" methods
- Discuss the limitations of current technological approaches to generalization for mapping purposes
- Explain how generalization of one data theme can and must be reflected across multiple themes (e.g., if the river moves, the boundary, roads and towns also need to move)
- Explain how the decisions for selection and generalization are made with regard to symbolization in mapping
- Explain why the reduction of map scale sometimes results in the need for mapped features to be reduced in size and moved
- Identify mapping tasks that require each of the following: smoothing, aggregation, simplification, and displacement
- Illustrate specific examples of feature elimination and simplification suited to mapping at smaller scales
- Demonstrate how different classification schemes produce very different maps from a single set of interval- or ratio-level data
- Apply appropriate selection criteria to change the display of map data to a smaller scale
- Write algorithms to perform equal interval, quantiles, mean-standard deviation, natural breaks, and "optimal" classification for choropleth mapping

Topic CV2-3 Projections as a map design issue

- Identify the map projections commonly used for certain types of maps
- Identify the most salient projection property of various generic mapping goals (e.g., choropleth map, navigation chart, flow map)
- Explain why certain map projection properties have been associated with specific map types
- Select appropriate projections for world or regional scales that are suited to specific map purposes and phenomena with specific directional orientations or thematic areal aggregations
- Determine the parameters needed to optimize the pattern of scale distortion that is associated with a given map projection for a particular mapping goal and area of interest
- Diagnose an inappropriate projection choice for a given map and suggest an alternative
- Construct a map projection suited to a given purpose and geographic location

Table 2. Topics and educational objectives comprising core unit CV2: Data considerations, from the Cartography and Visualization knowledge area of *BoK 1/e*. [© 2006 Association of American Geographers and University Consortium for Geographic Information Science. Used by permission. All rights reserved.]

demic courses and certificate programs" (U.S. Geospatial Intelligence Foundation (2006). The USGIF panel charged with defining the Academy's guidelines and standards relies upon *BoK 1/e* to help specify its curriculum standards.

- **Employee screening**: The managers and human resource personnel who are responsible for recruiting and screening applicants to GIS&T positions in government and industry are not likely to possess relevant professional experience. In unprecedented breadth and detail, *BoK 1/e* defines the knowledge and skills that well educated professionals should possess. Job descriptions and interview protocols may be derived from these objectives.

Discussion and Conclusion

Although the definition of the body of knowledge represents a central task [in curriculum design], it is not sufficient on its own (ACM/IEEE 2001, p. 14).

The ambitious vision outlined in the Model Curricula Task Force's *Strawman Report* (Marble et al.2003) remains unfulfilled. Some of the challenges that remain include delineating a variety of educational pathways to help students and advisors to navigate the *BoK 1/e*—and the complementary bodies of knowledge of allied fields—in ways that ensure their preparation for the rigors and diversity of GIS&T careers. Self-assessment instruments for academic programs and students need to be developed, tested, and disseminated (Prager and Plewe, in review). And a diverse community of expert contributors to a second edition of the *BoK* needs to be impaneled.

The *BoK 1/e* itself does not fulfill entirely the vision of a comprehensive inventory that is "representative of the views of a majority of the broad GIS&T community" (Marble et al. 2003, p. 27). Educators and practitioners will justifiably criticize the first edition on various grounds, including which topics and objectives are included or left out, how included topics are parsed into knowledge areas, the extent to which the range of competency levels is supported, and how cross-cutting themes are distributed among knowledge areas. Some will question the motives of any attempt to define the content of the field, insofar as some knowledge, activities, and people are necessarily excluded from the geospatial enterprise. Ultimately, however, the impact of *BoK 1/e* will be reflected in how quickly it is replaced by a second edition, and by the number and diversity of contributors who are attracted to that effort.

Looking ahead, we believe that disruptive new technologies, innovative science, imaginative applications, and the dynamics of human and physical landscapes that give rise to the GIS&T field in the first place, will continue to drive changes in GIS&T curricula and courses. By 2010, we expect that a diverse set of educational pathways through the Body of Knowledge will have been published, along with a second edition. We hesitate to predict whether the second edition will consist of a single, comprehensive document like the *BoK 1/e*, or a family of related documents (like the current *Computing Curricula*) devoted to the specialized bodies of knowledge in GIS and Cartography, Remote Sensing, and perhaps Land Surveying. We hope that organizers of the second edition will consider adopting an alternative representation framework, as suggested in the knowledge domain visualization literature to which a number of cartographers and GIScientists have contributed (e.g., Skupin 2004; MacEachren et al. 2004). Finally, despite its inevitable shortcomings, we believe that the publication of the first edition of *BoK 1/e* will prove to have been a milestone not only in the history of GIS&T curriculum development, but also in the coalescence of GIS&T as a coherent professional field.

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REFERENCES

ACM/IEEE-CS Joint Task Force. 2001. *Computing Curricula 2001*. Association for Computing Machinery (ACM) and Institute for Electrical and Electronic Engineers (IEEE). [Retrieved September 6, 2006, from http://www.computer.org/portal/cms_docs_ieeecs/ieeecs/education/cc2001/cc2001.pdf.]

Anderson, L. W., and D. R. Krathwohl (eds), with contributions by P. W. Airasian., K. A. Cruikshank, R. E. Mayer, P. R. Pintrich, J. Raths, and M. C. Wittrock. 2001. *A Taxonomy for Learning, Teaching, and Assessing*. New York, New York: Longman.

Dahlberg, R. E., and J.R. Jensen. 1986. Education for cartography and remote sensing in the service of an information society: The U.S. case. *The American Cartogapher* 13(1): 51-71.

DiBiase, D. 2003. On accreditation and the peer review of geographic information science education. *Journal of the Urban and Regional Information Systems Association* 15(1): 7-14. [Retrieved June 29, 2004, from http://www.urisa.org/Journal/Vol15No1/Dibiase.pdf.]

Kemp, K., and R. Wright. 1997. UCGIS identifies GIScience education priorities. *Geo Info Systems* 7(9): 16-18, 20.

MacEachren, A. M., M. Gahegan, and W. Pike. 2004. Geovisualization for constructing and sharing concepts. In: *Proceedings of the National Academy of Science* 101 (Suppl. 1): 5279-86. [Retrieved February 25, 2006, from http://www.pnas.org/cgi/reprint/101/suppl_1/5279.]

Marble, D. F. 1998. Rebuilding the top of the pyramid. *ArcNews* 20(1): 1, 28-29.

Marble, D. F., and members of the Model Curricula Task Force. 2003. *Strawman report: Model curricula*. University Consortium for Geographic Information Science, Alexandria, Virginia.

Goodchild, M. F., and K. K. Kemp. 1992. NCGIA education activities: The core curriculum and beyond. *International Journal of Geographical Information Systems* 6(4): 309-20.

Luccio, M. 2005. Institute for Advanced Education in Geospatial Sciences. *GIS Monitor* (June). [Retrieved November 3, 2005, from http://www.gismonitor.com/news/newsletter/archive/060205.php.]

Nyerges, T., and N. R. Chrisman. 1989. A framework for model curricula development in cartography and geographic information systems. *Professional Geographer* 41(3): 283-93.

Prager, S.D., and Plewe, B. (In review). Assessment of GIScience curriculum using the *Geographic Information Science and Technology Body of Knowledge*. *Journal of Geography and Higher Education*.

Skupin, A. 2004. The world of geography: Visualizing a knowledge domain with cartographic means. In: *Proceedings of the National Academy of Sciences* 101 (Suppl. 1): 5274-8. [Retrieved February 25, 2005, from http://www.pnas.org/cgi/content/full/101/suppl_1/5274.]

Turner, J. 2001. Reflections on curriculum development in computing programs. *SIGCSE Bulletin* 33(2) (June): 4-6.

Unwin, D. J. 1990. A syllabus for teaching geographical information systems. *International Journal of Geographical Information Systems* 4(4): 457-65.

U.S. Geospatial Intelligence Foundation. 2006. USGIF Academy. [Retrieved September 19, 2006, from http://www.usgif.org/content.asp?pl=455&contentid=460.]