

BoK e-Tool Prototype

An ontological-based approach to the exploration of Geographic Information Science & Technology Body of Knowledge



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Abstract:

Using as a starting point the results attained in previous curricula development initiatives in the GIS&Science domain, a prototype tool for the visualization and exploration of Geographic Information Science & Technology Body of Knowledge (GIS&T BoK) contents is presented.

As suggested in the challenges launched for the second edition of the GIS&T BoK, the construction of this knowledge domain visualization tool, aims at stressing the advantages of using an ontological-based approach in the process of creating and exploring the *Model Curricula vision*.

Therefore, one of the objectives of this prototype was the conception of a semantic network allowing for the translation of the fundamentals of the GIS&T domain into a meaningful exploration environment and, from there, to evaluate the capacity to support the instructional sequences design for the creation of future *exemplar pathways*.

Key words: Curriculum Development, GIS&T Body of Knowledge, Concept maps, Semantic networks.

1 ISEGIUNL's previous initiatives in *curricula* exploration tools - The GIS&Science *Curricula* Development Model

The integration of new information and communication technologies in the process of curricular development may bring significant advantages for realizing a *European Area of Lifelong Learning* and to promote autonomous and self-oriented learning. However, these advantages can only be achieved if considered in the context of the new dimensions that characterize the current relations between learning and the curriculum.

In an age where learning, whether in a formal or informal context, uses as a privileged resource the Internet, the anonymous character of the information available there, inasmuch as it is disperse and absent from an ontological or contextual relationship, has contributed for the student's dispersion and the failure of many existing *curricula*. In fact, an hypertext or hypermedia curriculum suggested or constructed by the student, can hardly be grounded on an ontological base, since

the associations that facilitate its realization are frequently absent in the way information and contents are made available on the Internet (Banerjee, 2001).

This circumstance has led to demands for better systematization of *curricula* organization in order to improve its accessibility and efficiency. Those demands are related to the main objectives of the ISEGIUNL's previous initiatives in order to frame a GIS&Science curriculum development process in a context of epistemological, cognitive and educational paradigms change (Painho *et al*, 2006a, 2007a, 2007b). These initiatives tried to continue existing teaching strategies in this area, putting into practice the know-how acquired in several years of GIS teaching (Painho, 1999), which, according to new paradigms driven by scientific and technological advancement, demand the adoption of new approaches for the creation and dissemination of information, which are closer to the current ways knowledge is produced, explored and represented.

As a result of these initiatives, in these last years a first prototype of a curricular development model in GIS&Science (Painho, M. *et al*, 2006b) was conceived (Figure 1). This model, based on a curriculum conception as a process or praxis, assumed as a fundamental point in the implemented approach, the design of an ontology enabling the establishment of knowledge structures likely to be contemplated in a variety of *curricula* proposals in advanced studies in GIS&Science, able to answer the different academic, professional and/or personal necessities.

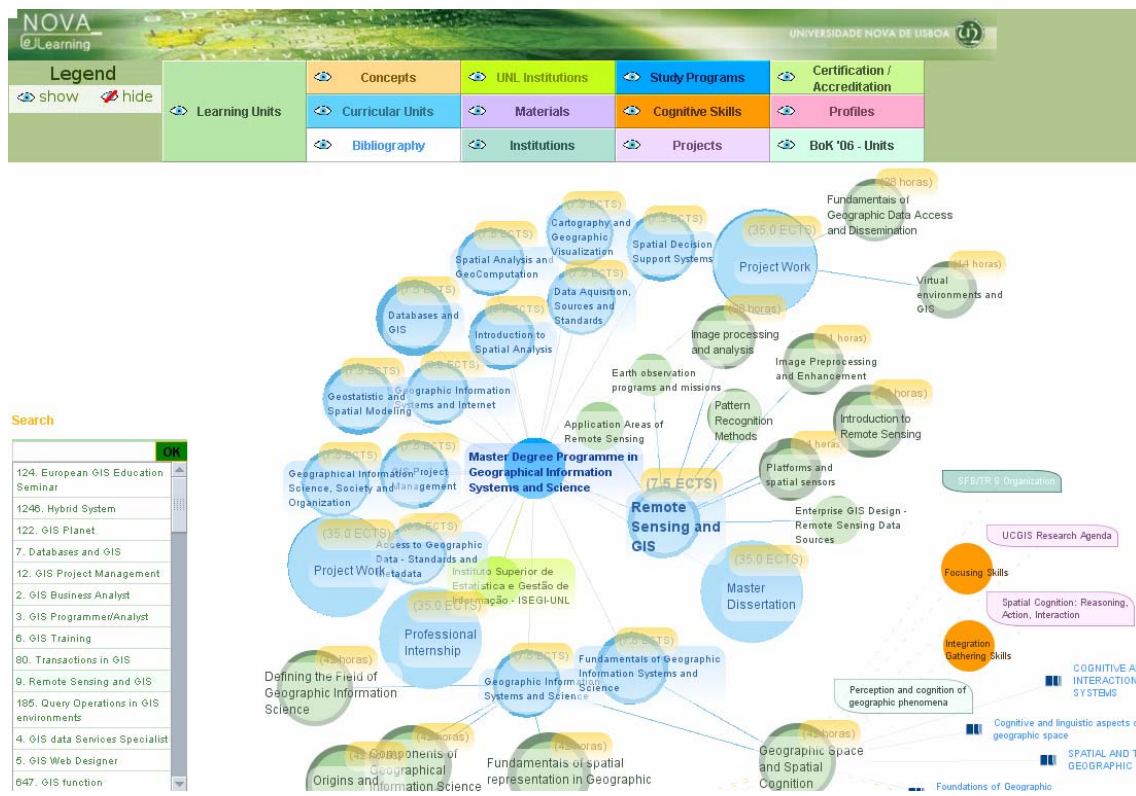


Figure 1- The GIS&Science *Curricula* Development Model Interface. Available at: http://193.136.119.12:8080/examples/MESTRADO_spider_en/webapp/

2 Challenges facing the second edition of the GIS&T Body of Knowledge

Published by the Association of American Geographers in 2006, the 1st edition of the **Geographic Information Science and Technology Body of Knowledge (GIS&T BoK)** includes ten knowledge areas, 73 units (26 of which are designated as “core” units), 329 topics, and over 1,600 formal educational objectives (UCGIS, 2006). The *Model Curricula* is designed for use by curriculum planners and evaluators, certification and accreditation bodies, current and prospective students, human resources personnel, and geospatial professionals in government, industry, and academia (DiBiase, D., 2007).

However, in order for these purposes to be effectively met, it is necessary to follow a series of “practicable activities”, as it was mentioned in its 1st edition (UCGIS, 2006, pp. 147-148). Of these activities, we highlight those programmed for the second edition of the GIS&T Body of Knowledge suggesting the pertinence and adequacy of the approaches adopted in the GIS&Science *curricula* development model:

«Editors of future editions of the Body of Knowledge may wish to reconsider the conventional hierarchical outline structure that the first edition adopted from allied field. One weakness of the hierarchical outline is that it tends to mask relationships and reoccurrences of topics in different knowledge areas. The “cross-cutting themes” idea presented in the “Strawman Draft” was one tactic for dealing with this short-coming. The field of information visualization offers an intriguing alternative. A more powerful approach may be to construct a formal knowledge domain visualization (Hook and Borner, 2005) that represents not only the topics that comprise the GIS&T domain, but also relationships among topics. Although “knowledge maps” are typically rendered from bibliometric data, it would seem that transformation of the community-developed inventory of the domain may be an insightful exercise» (UCGIS, 2006, p.148)

In fact, these presumptions suggest the necessity to frame the GIS&T BoK within the recent terminology research context, increasingly orientated towards facilitating information retrieval and knowledge engineering. The possibility of establishing multidimensional networks of concepts, through the construction of a repository of terms related to the problem in a given BoK Topic, increases a non compartmentalized and hierarchical idea of knowledge, by the establishment of semantic networks, that tend to bring closer the association process and the mechanisms of knowledge exploration, to the ways human memory and thinking structuring and organization occur.

As mentioned by Jonassen (Jonassen, D.H. *et al* 1998; Jonassen, D.H., 1999) semantic organization tools help students analyze and organize what they know or are learning, enveloping them inevitably in a process of critical reasoning regarding the subjects taught. As put forth by the author, the two most common approaches for semantic organization of knowledge are the databases and semantic network tools. These last-mentioned tools sanction the construction of concept maps which are meaningful methods for representing information visually, not only facilitating the exploration of contents, the gathering and the sharing of information, but also

helping the process of acquiring structural knowledge (Jonassen, D.H.; Beissner, K.; Yacci, M., 1993).

These two approaches are being explored systematically in the GIS&Science *Curricula Development Model* developed in ISEGIUNL. The possibility to extend these approaches to the GIS&Tt BoK second edition will fill a gap in this domain and stands as the main motivation for the development of a first GIS&T Body of Knowledge Exploration Tool prototype - **BoK e-Tool** (Painho, M. *et al*, 2007c).

3 BoK e-Tool - A Prototype for GIS&T Body of Knowledge Exploration Tool

Based on the conceptual approach and technological solution adopted by the ISEGIUNL's GIS&Science *Curricula Development Model*, the **BoK e-tool prototype** was intended for the creation of a web application allowing the management and exploration of the Geographic Information Science & Technology Body of Knowledge. This tool relies on the development of a relational database including all the components considered fundamental for the foreseen applications of the GIS&T Body of Knowledge and the future provision of the *Model Curricula* products and services (Figure 2).

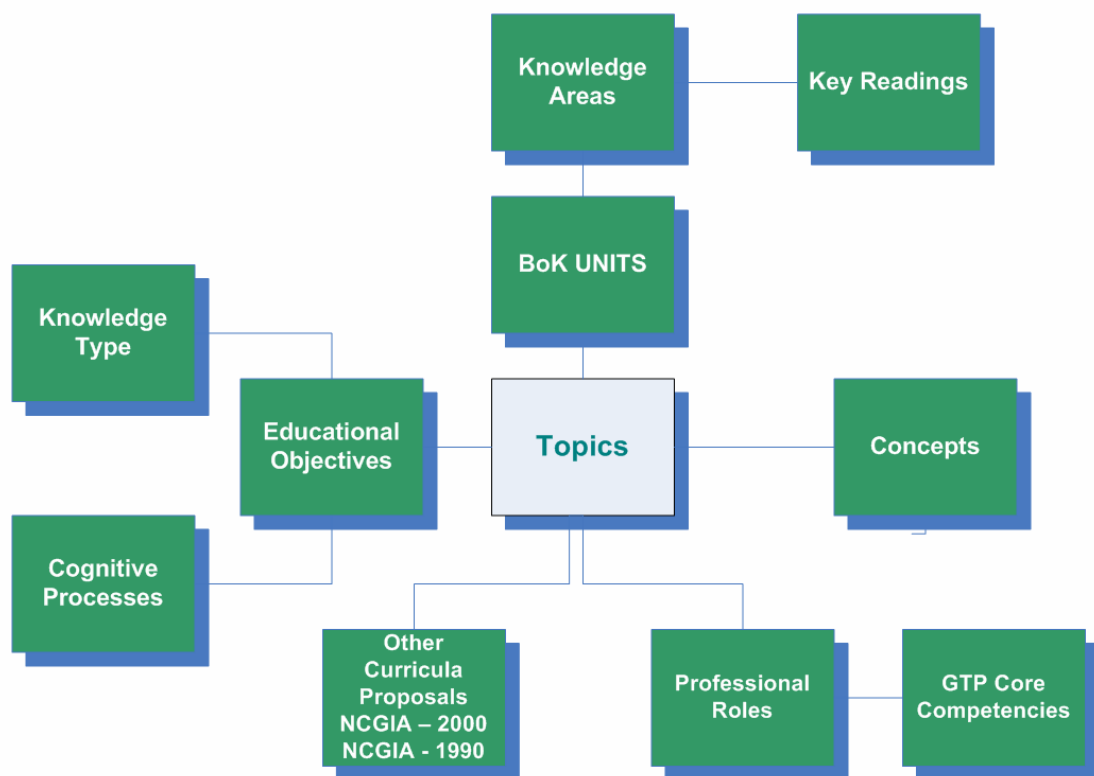


Figure 2 - A first approach to the GIS&T Body of Knowledge Database Model.

The content of this database, and the relations existing inside it, may be accessed using an information visualization tool that, in an intuitive and efficient manner, will promote the correct exploration and understanding of the GIS&T Body of Knowledge's first edition, but also prepares for the changes anticipated in its second edition (Figure 3).

In that sense, some of the potential offered by the new tools of information visualization were associated with the GIS&T Body of Knowledge Web Application in order to create a user-friendly interface, guiding users in a more interactive way with the GIS&T BoK contents, particularly by:

- (i) allowing the representation and visualization of the GIS&T *Model Curricula*;
- (ii) supporting the instructional sequences design and the compilation of a set of exemplar pathways;
- (iii) providing users (students and teachers) through the hierarchies of data and information search towards knowledge;
- (iv) creating concept maps or, in a broader sense, cognitive maps, to facilitate the acquisition of structural knowledge related to Geographic Information Science and Technology, as well as the understanding of curriculum development process and the *continuum* curriculum-teaching-learning.

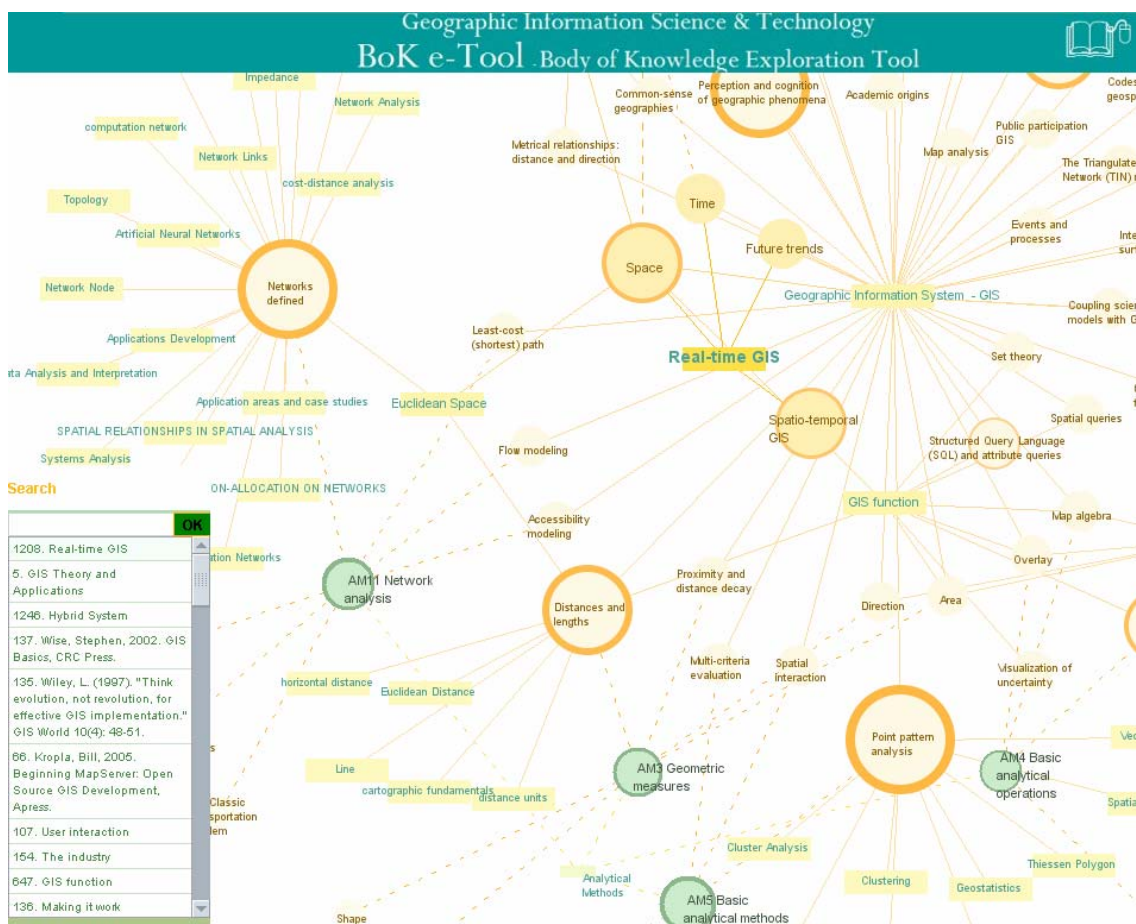


Figure 3- A first approach for GIS&T BoK Visual Exploration Tool. GIS&T BoK's Knowledge Areas, Units and Topics and its other model curricula resources associations. Available at:

http://193.136.119.12:8080/examples/BOK_spider_en/webapp/index.html

In fact, the overall purpose of this first prototype consisted on the establishment of a Web Exploration Tool for the GIS&T Body of Knowledge, in order to assist the continuous advancement of the Model Curricula vision (e.g. by way of constructing “Exemplar pathways”), to answer the expected applications of the GIS&T Body of Knowledge identified in its first edition, and also to anticipate some of the requirements that should be implemented during its second edition.

4 Final consideration on the Bok’s internationalization

Nonwithstanding the scientific and technical contributions for advancements and innovations connected with Geographic Information Science and Technology made by organizations, laboratories and research centres scattered around the world, the main stage for the development has been, with some exceptions, the USA, as the global weight of its GIS industry demonstrates.

This circumstance determined that, in academic and scientific terms, many of the study programmes offered by institutions around the world, took as a reference the results attained by American institutions in pioneering initiatives linked to the creation of curricula/material in this area, of which good examples are the *Core Curriculum in GIS* of NCGIA (Kemp, K; Goodchild, M.; 1990) and *The Geographer’s Craft Project* (Foote, K. E., 1997). In fact, these two projects, as well as some reference books (the two-volume compendium edit by David Maguire, Mike Goodchild and David Rhind and the two editions of the *Geographic Information Systems and Science* from the same author’s and Paul A. Longley), eventually settled, until recently, the nature and contents of GIS teaching. The visibility of these two projects, much higher than anticipated, led inevitably to (isolated) efforts to adequate materials and contents of these projects to the specific realities of the institutions and countries where the courses were given. The creation of an international curriculum in this area is a need that, at least from an European point of view, seems to be identified for a while now - for instance, the effort conducted by the Department of Geoinformation at the Technical University of Vienna (TUW) in 1993 for a European international post-graduate course on GIS.

Given these facts, the Bok’s internationalization, not only in Europe but in many other continents, seems not only desirable but also inevitable. In fact, in this globalized age, it doesn’t seem possible to conceive the GIS&T education infrastructure evolution without integrating this worldwide perspective.

However, for the Bok’s internationalization to take place, there is still a lot to do. In a first stage, and regarding the GIS&T Bok first edition, it is important to assess the need to introduce the alterations/extensions to topics that comprise the GIS&T for its use in the other countries. At a first glance some of the topics described, seem to indicate a need for reformulation so as to integrate an European perspective - e.g. topics connected to *GS1 Unit - Legal Aspects*; *GD12 Unit -Metadata, Standards, and Infrastructures*; *O14 Unit - GIS&T Workforces themes*, among others.

In a second stage, that internationalization may occur by way of contributions to the future model curricula products and services (program self-assessment, resources for professional certification and accreditation initiatives, creation and implementation of exemplary pathways, and contribution for a second edition of the GIS&T Body of Knowledge), as suggested in the prototype now being presented.

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