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# Expanding Distance Education in the Spatial Sciences Through Virtual Learning Entities and a Virtual GIS Computer Laboratory

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## ABSTRACT

*In this article we describe the implementation of an emerging virtual learning environment to teach GIS and spatial sciences to distance education graduate students. We discuss the benefits and constraints of our mixed architecture with the main focus on the innovative hybrid architecture of the virtual GIS computer laboratory. Criteria that were used to develop the virtual learning environment included: (1) Facilitating student-instructor, student-computer, and student-student interactivity using a mix of synchronous and asynchronous communication tools; (2) Developing a liberal online learning environment in which students have access to a suite of passive and active multi-media tools; and (3) Allowing student access to a mixed Web-facilitated/hybrid architecture that stimulates their cognitive geographic skills and provides hands-on experience in using GIS.*

*Keywords: geographic information system; virtual learning; Web classroom*

## INTRODUCTION

Geographic information systems (GIS) are a rapidly evolving technology that is integrated in mainstream undergraduate and graduate curricula. Spatial sciences and GIS are multidisciplinary in nature and have important relevance beyond their traditional disciplinary homes. Currently, spatial sciences and GIS courses are offered

through geography, civil engineering, geomatics, soil, water and environmental science, and other programs. A GIS is a computer-based system for managing, storing, analyzing, and presenting spatial data. GIS have three important components: computer hardware, sets of application software modules, and a proper organizational context including skilled people (Burrough & McDonnell, 1998). As such, the GIS curriculum is particularly suited to the development of innovative learning models adaptable to students from different disciplinary backgrounds. GIS courses and programs are also ideally suited to use novel technologies as the discipline itself is technologically enabled, or even technologically driven. Zerger, Bishop, Escobar, and Hunter (2002) pointed out that it is important to infuse spatial science theory with practical examples/assignments and projects to optimize learning outcomes. Thus, transforming on-campus GIS courses into a virtual learning environment requires maintaining both lecture and lab components. Spatial sciences aim to stimulate cognitive geographic thinking skills that involve solving geospatial problems, to comprehend and integrate huge amounts of geospatial data, and to facilitate understanding of both large-scale and small-scale geographic features of ecosystems. These cognitive geographic skills are a prerequisite to understanding the underlying mechanisms for spatially explicit modeling using GIS software. Hands-on GIS assignments and projects facilitate student learning about GIS functionality and help them build their own spatial models.

Distance education courses and programs have adopted a variety of multimedia and Internet technologies. Recent changes in information technology have challenged instructors not only in terms of *what* they teach, but also *which* technology they use to teach. The proliferation of Web-based and interactive multimedia technologies that are used to teach spatial sciences has transformed numerous on-campus courses into Web-facilitated, hybrid (blended), and distance education courses. Hybrid courses mix traditional face-to-face instruction with a substantial portion that is delivered online. Virtual learning environments are diverse, ranging from simple Web pages to complex hard- and software solutions. A virtual learning environment is a set of teaching and learning tools designed to enhance a student's learning experience by including computers and the Internet in the learning process. Criteria to distinguish virtual learning environments include: (1) delivery type—audio, video-based systems (e.g., Power Point slides, videoclips, compressed interactive video, virtual reality worlds, and others); (2) delivery media (e.g., books, journal articles, CD, DVD, Internet); (3) communication type (synchronous and asynchronous) and student involvement (active and passive); (4) level of abstraction and content (e.g., text, maps, 3D models, 4D simulations, interactive virtual models);