Spatial Thinking: Understanding the World Using GeoTechnologies

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Abstract

Over the past 15 years, a quiet revolution has occurred among a small but growing vocal group of educators worldwide. These educators are convinced that geotechnologies—Geographic Information Systems (GIS), Global Positioning Systems (GPS), Remote Sensing, and Virtual Globes—are the best technologies to use to prepare students to become the decision-makers of tomorrow. Will these students be those who will grapple with urban sprawl, biodiversity loss, and climate change?

There are two ways to think about educators who use geotechnologies. Some educators teach **about** geotechnologies—the theories and fundamentals behind Geographic Information Science (GISc), and the skills necessary to employ spatial analysis tools and GIS functions. Other educators teach **with** geotechnologies—using spatial thinking and technologies to teach topics in geography, mathematics, history, environmental studies, Earth Science, chemistry, biology, and in other disciplines. Both of these methods are growing in societies around the world.

Educators who teach **about** geotechnologies do so for many reasons. Issues in the community, region, and world might include traffic, population growth, urban sprawl, energy, water resources, crime and terrorism, epidemics, biodiversity loss, sustainable agriculture, or ecotourism. These issues are growing in complexity, exist at every scale, and affect our everyday lives. These and every other pressing concern of our time includes a spatial component. Geotechnologies are seen as the most effective technologies to equip people so that they can make wise decisions about the Earth. GIS courses, degree programs, and certificates are available at nearly all universities, colleges, and online. They are taken by students studying a broad array of disciplines including environmental studies, business, geography, GISc, biology, engineering and Earth Science. The number of students taking GIS courses each year worldwide may exceed 100,000 (Goodchild 2006).

Furthermore, the demand for geotechnology theory and skills has seen enormous gains and is expected to increase for quite some time, according to the U.S. Department of Labor. The President's Job Growth Training Initiative in the USA is an effort to prepare workers to take advantage of job opportunities in high growth, high demand, and economically vital sectors of the American economy, funding 14 job sectors, including geospatial technology.

Educators who teach **with** GIS do so because they see the value in incorporating spatial thinking and geotechnologies into instruction. Geotechnologies provide for active, student-centered, project-based learning that focus on geographic inquiry—asking geographic questions, gathering geographic data, analyzing geographic issues, and solving geographic problems. Geotechnologies provide opportunities for authentic practice—assessing students via presentations and portfolios. Because GIS and GPS-using students examine issues in the community and interact with community members, it is viewed as excellent citizenship education. Students use real-world data in real-world contexts to address real-world problems. Educators see the use of geotechnologies as being an excellent example of the use of constructivism, which holds that rather than being transferred from teacher to student, knowledge is constructed by the learner based on his or her own experiences. The school-to-career movement, content standards that focus on visualization, active learning, and processes; and the information and technical literacy that GIS provides are other incentives for teachers teaching with GIS. Lessons created by educators around the world illustrate community-based, open-ended projects that are interdisciplinary. These projects enhance motivation and learning, help students investigate the world, and provide real employment skills.

The use of geotechnologies in teaching and learning remains hindered by a number of factors, including the small size of supportive research, the difficulty of curricular fit, the fragmentation of the primary and secondary educational system in some countries, the segmentation of education into disciplines and class periods, and data licensing. Despite these challenges, geotechnologies in education have grown along several paths, including curriculum, research, data, hardware, and software into an international community. Curricular growth occurred after hardware and software had advanced to the point where educators could create lessons using easily-accessible, public-domain data. The impact of the geotechnology education community is rapidly moving from the domain of a few enthusiastic educators to impacts across whole countries, from Denmark to New Zealand. Indeed, the era of awareness and initial adoption in Rogers' Diffusion of Innovations model (1995) is giving way, with the help of web-based GIS and Virtual Globes, to widespread adoption.

Goodchild, Michael. 2006. The Fourth R? Rethinking GIS Education. *ArcNews.* Fall.

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