Chapter 55
Coupling Geospatial and Computer Modeling Technologies to Engage High School Students in Learning Urban Ecology

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ABSTRACT

This chapter is a description of the Urban Tree Project where high school students were engaged in the use of Geographic Information System (GIS) technologies to determine the economic and ecological value of trees in their neighborhood. Students collected data on tree locations and conditions and then used CITYgreen to evaluate the economic and ecological value of their trees. Urban high school youth had the opportunity to explore urban ecology in their neighborhoods. Pre–post interview and written assessments were conducted across a wide sample of school contexts. The goal of these assessments was to explore the students' beliefs and understanding regarding the ecosystem services that trees and greenspace provide to a city. The results were mixed as students' understanding measured by the written assessments increased significantly. However, upon further probing, students often showed difficulty in drawing coherent concepts and ideas that depicted a robust understanding of urban ecological principles regarding green space and the services that trees provide.

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INTRODUCTION

Recently the President's Council of Advisors on Science and Technology noted that information and computation technology can be a powerful driving force for innovation in education by improving the quality of instructional materials available to teachers and students (National Science Board, 2014). Yet, research has consistently found that information technology is underutilized in classrooms, particularly in high poverty urban areas (National Telecommunications and Information Administration, 2000). For years, researchers have documented that students in low income areas often use technologies for repetitive activities whereas students in higher-income areas often use technologies for higher-order thinking, problem solving, and other intellectually challenging activities (National Telecommunications and Information Administration, 2000). Further, information technology in such classrooms is often used independently of content, which limits the understanding that students can develop regarding the use of information technologies (Presidents Council of Advisors on Science and Technology, 2012). Nevertheless, educators have recognized the potential of geospatial technologies to motivate students to learn because geospatial technologies can provide opportunities for authentic scientific inquiry using the very tools that scientists use to analyze and manipulate data (National Research Council, 2006). This recognition is supported by improvements in technology that mean using geospatial technologies to explore and analyze our world is no longer isolated to a few very skilled scientists and researchers. Rather, such technologies are now available to nearly everyone (Barnett, MaKinster, Trautmann, Houle, & Mark, 2012). Over the past decade, consumer demand for the opportunity to manipulate and display geospatial information using Global Positioning Systems (GPS) and GIS has skyrocketed (Folger, 2008). For example, the integration of GPS data with digital maps has led to handheld and dashboard navigation devices used daily by millions of people worldwide. The release of Google Earth in 2005 made it possible for people from all walks of life to manipulate digital maps and geospatial data (Folger, 2008). The ability to swiftly and dynamically represent Earth's geography and scientific, social, political, economic, and environmental issues from a variety of perspectives creates powerful opportunities for teachers and students. In fact, geospatial tools expand the scope of topics that students can explore, promote interdisciplinary learning, and change the way that students learn to reason about and interpret data (Ramamurthy, 2006).

Building on these perspectives, geospatial technologies have significant potential to engage students in locally relevant, interdisciplinary study of phenomena with direct impact in the classroom (Barnett et al., 2013). For example, students can use geospatial technologies not only to map data and explore digital representations of Earth's surface, but also to visually explore relationships between various types of environmental and social data. By overlaying different data layers, students can identify areas of environmental concern in their own communities, such as steep slopes vulnerable to erosion, or areas of greatest benefit, such as habitat for a threatened or endangered species. Students also can examine relationships between biological and social variables. For example, in urban areas, students can consider comparing the health of trees, shrubs, and other vegetation with neighborhood income levels. Such relationships can be explored not only visually, but also by using the analytic capabilities of GIS. "Queries" enable a user to filter a specific data set or create a new data layer based on the intersection of two or more layers. Such queries enable students to identify hidden patterns or difficult-to-see correlations in their data. In essence, geospatial technologies provide an ideal tool for students to use when visualizing data, posing their investigation, and addressing specific questions. Coupled with this increased use of geospatial technologies, new technologies have enabled students to gain access to a wide array of in-

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