Chapter 9
Using Geographic Information Systems in Educational Research: A Beginner’s Exercise

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ABSTRACT
The chapter introduces education researchers to geographic information systems (GIS) and the significant value of incorporating a geospatial perspective within research. The GIS approach to studying and presenting data incorporates geographic location and uses maps to visualize relationships for spatial and nonspatial variables, both of which enhance education research by visualizing local geographies. This chapter unfolds as a step-by-step guide that prepares researchers to identify the data needed for a GIS exercise, to collect or retrieve the data, clean and upload the data to ArcMap, georeferenced and symbolize the data, and interpret and present the results in a manuscript. After completing the exercise, researchers will have a basic understanding of ArcMap functionality and how integrating a geospatial perspective in educational research offers insights that may have otherwise been overlooked when using quantitative research methods alone.

INTRODUCTION
A geographic information system (GIS) is a database system that can assemble, store, manipulate, and display geographically-referenced data, linking this data to points, lines and areas on a map or in a table. Geographically referenced information is also known as geospatial information, data that references a
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place and includes location, distance and relative position. Types of geospatial information include features like the Mississippi River, the White House, hiking trails, school district boundaries and crosswalks. Each of these features has information associated with it and, in GIS terminology, that information is referred to as an attribute. For example, attributes of the Mississippi River include its length, the amount of water it discharges per second into the Gulf of Mexico and the average surface speed of the water. Attributes of a school district boundary may include the number of students who attend schools within the district, the racial characteristics of those students and the percentage of students who qualify for a free or reduced lunch.

What makes GIS a powerful tool is its ability to combine and display geospatial information on maps that uncover relationships, patterns and trends. Maps are collections of layers, each representing an attribute. For example, a road atlas may have layers for roads, landmarks and another for the trees along the roads. Together, these layers present a comprehensive illustration of the space through which a map-user would travel in real life. Similarly, within GIS, a user can link and merge layers with different attributes to produce a map that represents specific characteristics of geographic coordinates, which identify specific points or areas. Using a GIS, an education researcher can combine several layers to produce a map that visualizes school enrollment at each school within a school district to highlight enrollment patterns across the district. Another map might include the locations of both public and private elementary schools and the socioeconomic characteristics of the communities surrounding each school, a visualization that enables a comparative analysis of the locational positioning of each school type that may be difficult to do without using maps. Therefore, GIS mapping software provides an advantageous method to rapidly visualize information that exposes latent associations and reveals patterns of spatial phenomena that would be difficult to ascertain without the use of mapping technology.

In this chapter, GIS mapping software is presented as a fundamental component of education policy research and practical guidance is provided for the identification, collection and analysis of appropriate research data for analysis within a GIS context. The chapter unfolds as a guide, presenting users with step-by-step instructions for accessing publicly available data, entering the data into GIS and producing maps of the results. The chapter objectives are: 1. Understand how GIS supports education research, 2. Describe the identifying characteristics of Web-based GIS research, 3. Explore and retrieve Common Core Data (CCD) from the National Center for Education Statistics (NCES) and the American Community Survey (ACS) from the U.S. Census, 4. Prepare and upload data to GIS, 5. Conduct data analysis and visualize the data in a map and, 6. Evaluate and interpret the map in a research manuscript.

BACKGROUND

A GIS creates interactive and comprehensive visualizations that simplify understanding of the relationships, patterns and trends among georeferenced data, or data that is associated with a location in physical space, that helps users express multifaceted stories in a comprehensible way (Knowles & Hillier, 2008). GIS visualizes databases of spatial information stored in the GIS program and allows users to interact with and analyze the mapped data to investigate relationships based on spatial patterns. This technology allows education researchers to identify social, economic and educational patterns in a way that was previously impossible.
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