

Integrating GIS into Civil Engineering through Pedagogy and Scholarship

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Over the past five years, Bucknell has made a strategic investment in integrating Geographic Information Systems (GIS) across the undergraduate curriculum in teaching and research. Providing students with multiple opportunities to use GIS in different learning settings helps them develop critical spatial thinking skills that go deeper than mere technical proficiency. This presentation will give examples of how extending GIS integration beyond its traditional uses within the civil engineering major has enhanced student engagement and helped students cultivate a broader, interdisciplinary perspective. Two courses (Sustainable Transportation Planning and New Orleans in 12 Movements) are explored based on their connection to spatial analysis methods and use of GIS as a way to enhance student learning. In addition, two research projects (Sea level Rise Vulnerability Mapping and Transport of Hydraulic Fracturing Water and Wastes) are presented as examples of GIS integration into undergraduate research.

Pedagogy

Sustainable Transportation Planning (CENG432) is a senior level civil and environmental engineering elective that focuses on integrating social, economic and environmental perspectives into transportation engineering. Since the field of transportation requires spatial analysis and typically involves the use of mapping tools such as GIS in the field, students are taught basic skills in GIS through course projects such as the development of web-map applications for rail trail accessibility and connections, pedestrian and cycling mobility travel demand modeling, and daily campus commuting travel patterns for carbon footprint analysis.

In the course New Orleans in 12 Movements (UNIV200), three faculty came together from diverse disciplines (Music, History, and Civil & Environmental Engineering) to form an uncommon team, attempting to explore with students questions of how the ‘Crescent City’ of New Orleans came to be and how it is sustained in its precarious location at the nexus of the Mississippi River and the Gulf of Mexico. Lectures and activities rooted in GIS quickly became essential tools, providing location information for key events in history, musical development, and the key infrastructure sites that move water in and around the city.

Scholarship

Sea Level Rise Vulnerability Mapping- GIS is fundamental in the process for regional adaptation planning, specifically with regards to mapping impacts such as sea level rise vulnerability. Therefore, a faculty member and an undergraduate student focused on mapping sea level rise impacts on public transit facilities (bus and rail) in Philadelphia County as an example of how inundation modeling using GIS can be used by transportation agencies for adaptation planning.

Transport of Hydraulic Fracturing Water and Wastes- In the northeastern U.S., natural gas development is expanding at a rapid rate due to horizontal directional drilling and hydraulic fracturing. This increase in gas development has led to increased withdrawal of freshwater from local rivers as well as additional quantities of wastes, all of which are often transported over the road by truck. One faculty member worked closely with an undergraduate student to map these travel activities over Pennsylvania roads in the Susquehanna River watershed, using network analysis and geoprocessing to develop new estimates of transportation impacts.