Submitted Title: Using GIS in Immersive Educational Experiences: An Example

Submitted Abstract:

Immersive educational experiences can engage students in ways that differ from traditional classroom lectures. These projects typically involve interdisciplinary teams of students. Developing projects that use GIS for real-world situations affords students the opportunity to experience the power of this technology. However, this also presents challenges, namely how to teach and train students unfamiliar with spatial concepts or technologies. In this paper, I discuss an example: a project in which a team of students (from six different majors) perform a market analysis and plan for a health-care practitioner interested in opening another office. Because GIS is the basic tool used, team members needed to become familiar with the software and spatial concepts in a short time without benefit of a formal class. I share the different strategies used, discussing which worked and which didn't.

Using GIS in Immersive Educational Experiences: An Example

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Introduction

Immersive education, a type of active learning which combines content, skills, and need into an intentional experience, offers students learning experiences that transcend that of a typical classroom environment (Ball State University, 2008). Often described as "transformative", these experiences engage students in ways that diverge from typical lecture or laboratory formats. Several characteristics are combined to create a true immersive educational experience: working with a community partner, working with an interdisciplinary group of students, creating some sort of tangible outcome, being student-driven yet faculty-mentored, and helping students define career paths (Ball State University, 2008). As such, students approach problems from a "real world" perspective. This paper describes an immersive project in which Geographic Information Systems (GIS) is used as a principle tool. Along with a general overview of the project, issues and challenges related to GIS and space are discussed.

A Sample Immersive Learning Experience

The use of GIS has exploded in the past decade, finding many applications in business and health administration. However, its use by small, private practices in health fields--including audiology--has been limited. The software costs and instructional time associated with a GIS may preclude these small firms from realizing any benefits. One such benefit is a spatial analysis of their patient databases. Knowing where patients are located could enable a health care practitioner to assess whether there exist underserved areas. Another potential benefit would be for a practice to determine whether outreach needs to be done in another language (e.g. Spanish). Marketing for health care practices would also be enhanced with the usage of GIS; this would prevent targeting areas that are already saturated with current patients.

For this project, a private audiology practice located in a small Midwestern city served as the community partner or client. The partner is establishing a second office to accommodate a growing audiology practice. An interdisciplinary group of students worked to examine the locations of the practice's clients, as well as to analyze the demographic characteristics of the region surrounding her proposed new location. Clearly, the utilization of GIS was warranted for such a project.

Challenges

According to Gehman (2006), spatial factors comprise at least some element of 80% of all data. Indeed, people exist in space. Businesses have locations, fixed positions in space. Human beings move about a spatial foundation. Spatial thinking, then, is fundamental and allows us to comprehend the world in terms of place, distance, and direction (National Research Council, 2005). This may be self-evident to geographers and other spatial professionals. However, spatial thinking among non-geographers is less commonplace; among students it may be even rarer. This presented challenges—and opportunities—for a project involving a multidisciplinary group. Concepts such as the relationship between the location of a business and the location of customers or clients or the desirability of address matching needed to be understood. The proposed client, too, needed to be persuaded to adopt a spatial approach. Being unfamiliar with GIS technology, the client had to be "sold" on the importance of space and location and what spatial technology could do for her.

The student team comprised ten students of seven different majors: audiology, geography (meteorology), business, advertising, public relations, urban planning, and fashion merchandising. A comprehension of spatial concepts, including an understanding of census data, among the team members varied, although no students considered themselves to have an expert level of knowledge. The geographers were conversant with basic geospatial technologies and the urban planning student had an understanding of GIS. However, given the dearth of spatial comprehension among the group and the client, it was inevitable that obstacles would exist.

Encountering Obstacles—Space and the Client

While GIS professionals and location analysts might be familiar with understanding the importance of “space”, this is not necessarily the case for other professionals. Indeed, for a health care practitioner like the project’s client, space may be an afterthought, something that may be thought of as not relevant to health professions. Such misgivings are certainly understandable, given that space (and by extension, GIS) is not used *directly* to provide health care services. Because a health care practice is also a business, it may have certain needs, including marketing. With GIS playing an ever larger role in business (including small business), it was the business perspective that was used to propose the project to the client.

The potential and power of GIS may be best demonstrated with a visual demonstration. A short presentation (using local pizza restaurants and census tract data) was developed to show the client the value of GIS with respect to marketing applications. Specifically, a hypothetical marketing problem was used: locating areas of high young adult concentrations in proximity to locations of a local pizza chain. This demonstration outlined the geocoding process. Additionally, it included an overview of census data and selection by attributes. The ability to locate and specifically target certain populations for a pizza chain could be extrapolated to that of an audiology practice. This potential was communicated to the client.

While the client was impressed with the technology, she did have some valid concerns regarding the privacy of medical data (which included patient addresses). This was anticipated and the client was shown how addresses could be aggregated by spatial units (e.g. census tracts) and the identifying information removed. The client also wondered whether concentrations of specific demographic groups could be identified (e.g. elderly and pediatric populations). She was assured that these could be determined. The GIS demonstration, then, "hooked" the client, who came on board with some specific needs: to locate areas with higher proportions of certain target groups, specifically the elderly and mid-to-upper income households.

Encountering Obstacles—Students and Spatial Analysis

Part of the immersive learning experience empowers students by having them learn new skills and technologies. For this project, then, students were introduced to GIS and spatial concepts. Two students, both geography majors, had GIS experience and were the GIS "leaders". Teaching all students to become fully versed in GIS was not the goal of this project, given time and other constraints. However, they needed to become somewhat conversant in spatial concepts. Although geography and urban planning students take the importance of space seemingly as a commonplace, those in other disciplines did not realize the vital role that space plays. Even students with some fundamental realization of the role that space plays (i.e. those students with business majors or minors) did not have much knowledge of the spatial technologies that would enhance this project, namely GIS. Fortunately, all had used spatial technology (e.g. Mapquest for driving directions, Google Earth); teaching them the importance of space and spatial technologies was initially done by discussing some similarities between the applications they had used and GIS. A general dialogue focusing on space ensued. Discussion topics ranged from the relationship between proximity and distance for businesses to the importance of knowing where one's market was located.

Unfortunately, time constraints precluded an in-depth introduction to spatial analysis and spatial statistics tools within the GIS. Most students did not have a sufficient mathematical or statistical background, so teaching the team members about nearest neighbor analysis or spatial autocorrelation, for example, was not feasible. This in turn prohibited the usage of these tools for the project.

Encountering Obstacles—Understanding Census Hierarchies

The project was predicated on the usage of census data to generate analyses of area demographics. However, save for the geography students, no team members were cognizant of census data hierarchies; even the geography students were poorly versed in the differences between blocks, block groups, tracts and counties. To rectify this, the project mentor organized a census data "mini-workshop": a short, hands-on exercise designed to explain the census units and how their relationships with one another.

Initially, the hierarchy of census units was illustrated by a flow chart. Then, student team members formed groups to observe the hierarchy with a visual demonstration using ArcGIS. Led by the mentor, the groups created a map of a single county (Delaware County, Indiana). They subsequently added layers for Delaware County census tracts, block groups, and blocks. Following this, the groups selected an arbitrary tract within the county, noting that the chosen tract comprised several block groups. Within that tract, an arbitrary block group was chosen. Students then saw that several blocks made up that particular block group.

Following the demonstration, the team discussed the relationships between population and census units. Several students were curious about the lack of specific data available at the block level, wondering why these much information was available at the block group, but not block, level. A discussion about privacy and space ensued, an especially important matter given the importance of privacy when working with patient data. The team members had already signed confidentiality agreements for the client, so they learned how information at refined spatial scales could be used to breach the privacy of citizens.

Encountering Obstacles—The "Each One Teach One" Pedagogical Approach

Peer instruction is a pedagogical technique involves the exchange of knowledge between student peers. Essentially, a student or students teaches peers some aspect or topic of knowledge. Peer instruction has been used in higher education in disciplines such as physics (Fagen, Crouch, and Mazur, 2002). A peer approach to foster an understanding of GIS was used in this project. Although the actual GIS work was to be done by a subset of the team, it was deemed important for the entire student team to understand spatial analysis and GIS. Therefore, the two geography majors, who had completed GIS coursework, were selected to present an overview of GIS capabilities to the team. They were charged with creating a presentation to show their fellow team members what GIS was and how it would enhance this project. Both students developed PowerPoint presentations and examples of techniques in ArcGIS.

Often, what seems good in theory becomes problematic when put into practice. This instance of GIS peer education did not work out as well as hoped. The overview presentation was somewhat disjointed; the student presenters, although they did have GIS experience, were less adept at conveying their knowledge to their fellow team members. No attempt was made by the mentor to vet their communications skills. The peer instruction was occasionally chaotic and without direction. The student presenters would have benefited from more structured and formal guidelines for the presentation.

Geocoding and Patient Analysis—Bringing the Team Together

Geocoding, the act of matching patient addresses to street locations, was the GIS-related part of the project that involved all team members. This necessitated teaching the team a conceptual grasp of geocoding. All students had used various web sites to find addresses, so a mentor-guided short lecture on geocoding in GIS began with locating addresses on the web. To introduce the geocoding segment of the project, team members searched for addresses of their choosing on Mapquest.com. Following this, the mentor detailed the basic steps involved in matching a textual address to a street location (i.e. explained the steps going on behind the scenes). This was done to give team members a basic understanding of the geocoding process in general. A discussion of why addresses might not match (e.g. new roads in a subdivision, spelling errors) also proceeded. Then, students were asked to think of ways to "fix" the unmatched addresses. They devised techniques to correct omitted addresses, including using external tools (such as Google Earth) and comparing the format of addresses in the dBASE file to the format of the streets file.

Four students, geography and audiology majors, created the address locator and performed the geocoding. However, approximately 35% of the 1200 addresses were not matched. This enabled the rest of the team to employ their correction methods. Breaking up into three groups, the students worked to match additional addresses. Ultimately, about 80% of the patient addresses were matched. Team members examined the remainder of the unmatched addresses to determine whether there were any spatial biases to the missing addresses. After concluding that the unmatched addresses were spatially random (i.e. not occurring in any one town or county), they proceeded to analyze the client's existing patient database.

Analysis of this database focused on the proximity of patients to the client's existing office. Here, students learned to use multiple buffers; rings, corresponding to different radii from the existing office (e.g. 3-mile, 10-mile) were drawn around the office and the number of patients within each buffer was calculated. Prior to the analysis, team members assumed that a fairly linear distance decay function would show the numbers of patients declining steadily with distance from the office. This was, in fact, not indicated by the buffers. Approximately 38% of the client's patients lived more than 10 miles from the office, which surprised the students, since the office is located in the middle of a county seat. Fully 26% of her current patients lived at least 15 miles from the office. These results were used to stimulate discussion on space and location. Because the client is opening a second office, an understanding of current patient locations would benefit marketing recommendations for the new office.

Conclusions

Engaging students in immersive learning can provide educational experiences that go beyond the classroom or laboratory. However, when a student or group of students lacks a comprehension of ideas and technologies fundamental to the immersive project, challenges emerge which need rectification. Spatial thinking, so familiar to geographers, may be less common among students from other disciplines. Thus, it becomes necessary to fill in the knowledge gaps.

In this project, a faculty mentor led a multidisciplinary team of students who were engaged in providing services for a client, a private health-care practitioner. Few students were versed in GIS, the primary tool used for the spatial patient analysis; the client, too, was unfamiliar with the technology. Therefore, some techniques were used to convey basic understanding of GIS to the student team. Additionally, the client was also familiarized with GIS.

Among the methods used was the simple demonstration of various techniques available within ArcGIS. Specifically, demonstrations were used to show the client how GIS could help her pinpoint concentrations of particular demographic groups. Demonstrations of buffering, distance measurement, and geocoding were also given; these were shown to the student team members. The demonstrations were successful, because they enabled observers to understand various GIS techniques in a short amount of time. This was particularly important, because the project had a definite ending time.

An unsuccessful method was the peer instruction overview of GIS. Several reasons point to the reason this method was ineffective. First, the student instructors were not gifted communicators. Second, the student instructors should have been given clearer guidance; they did not have enough experience in putting presentations together. Third, the topic—an overview of GIS—was overly broad. This led to a lack of focus.

Perhaps the most effective method was the "mini workshop" used to teach student team members the basics of census data and census hierarchies. This combination of short lecture and hands-on learning exercises greatly facilitated the comprehension of the students to the point where they felt very comfortable understanding census data. The workshop was short—only about an hour long—but it covered the essential components. It was not designed to be a comprehensive examination of census data.

Educating students (and clients) on the fundamentals of spatial analysis and GIS is possible, even with a highly varied group. The key is to keep the activities short and directed to the project at hand. Following these suggestions, this particular immersive project was deemed successful.

References

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