

A Project-Based Approach to Incorporating Geographic Information Systems into the Education Curriculum

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Abstract: This paper focuses on the incorporation of GIS projects into the educational curriculum by the use of a campus-based GIS facility. It discusses the opportunities for students to advance their skills, knowledge and experience in GIS software and hardware in a variety of areas as a result of participating in real-world applications. By taking an active role in projects, students become aware of the responsibilities and expectations of the various GIS occupations commonly found in today's GIS businesses. Students participate in these projects by student employment, internship, or graduate assistantship while under the supervision of a GIS Manager/Instructor.

Western Kentucky University (WKU) offers a Geographic Information Systems (GIS) Certificate through the Department of Geography and Geology. Students completing the courses in the GIS Certificate Program will have a solid foundation of the GIS concepts as well as hands-on experience with GIS software by completing projects that utilize sophisticated GIS functions. The GIS Certificate Program consists of four courses for a total of 12 credit hours. For graduate students, two of the courses in the certificate program can be earned for graduate credit. While in the program, students can advance their skill, knowledge and experience in GIS by participating in projects carried out by the GIS facility.

Students entering the GIS Certificate Program will begin with an introductory course that examines the basic concepts and applications of GIS. After completing this course, students can take the GIS Analysis and Modeling course for undergraduate or graduate credit. This course introduces them to a variety of spatial analysis functions and modeling techniques as well as address issues (e.g., such as data preparation and coordinate systems) that they will encounter during analysis and modeling. The last course in this three-course series is the GIS Application Development course, which can be taken for undergraduate or graduate credit. It covers the planning and implementation of GIS in an organization as well as customizing the GIS user interface and developing applications to aid in the decision-making process or to expedite GIS tasks. Furthermore, the student must take the Cartographic Design for GIS course without any prerequisites. This course introduces the student to the basic cartographic design principles in GIS.

Prior to the certificate program, the Department of Geography and Geology offered one course in GIS. As a result, the department suffered from the lack of resources in GIS. Realizing the need for expansion, the department created a committee to study the opportunities in GIS education with the aid of an external advisory committee that included GIS professionals in the region. They reviewed other universities' GIS programs and also the possibility of a GIS Certificate Program at WKU. After the review, the committee then developed a proposal for a new certificate program in GIS as well as additional GIS courses. On January 18th, 2001, the departmental committee approved the proposal on the GIS Certificate Program. However, other committees would have to approve of it as well before the GIS certificate could be offered. Soon after the approval by the department, the Ogden College Curriculum Committee, Ogden College Graduate Curriculum Committee, Graduate Council, and University Curriculum Committee would give their approval. In the late summer of 2001, the University Senate was the last committee to approve of the GIS Certificate Program.

After the final approval, the departmental committee began developing the GIS facility. Currently, the GIS facility includes a GIS Research and Development lab for carrying out projects and a GIS classroom lab for instruction. The GIS Research and Development Lab consists of a laptop computer and computer desktop workstations that are equipped with a suite of ESRI products as well as other software to aid in GIS. It also includes additional hardware such as a large-format printer (i.e., plotter), GPS units, digitizing tablets and a large-format scanner. The GIS classroom lab consists of twenty-one computer workstations with a suite of ESRI products as well as other software to aid in GIS. It also contains digitizing tablets, a flatbed scanner, printer and a digital overhead projector.

Since the completion of the GIS facility, the President and Vice President of WKU and the Dean of Ogden College of Science and Engineering have taken a tour of the Research and Development Lab and classroom lab. Each were shown a GIS demonstration and given the details on using the GIS facility to carry out GIS based projects, in particular, the campus-digitizing project. It was explained to them that students could gain real-world experience on these projects while under the supervision of the GIS Manager who is also a GIS Instructor in the Department of Geography and Geology. They gave their support in utilizing the facility in projects to give real-world experience to students.

The GIS facility's current project is to digitize WKU (Figure 1) and to use that data in a GIS, which will be used by the Information Technology (IT) Division and Facilities Management (FM) as well as the GIS facility. Digitizing WKU's campus will be conducted under two stages. The first stage of this project, funded by IT, will involve digitizing subsurface features with a priority emphasized on fiber optics, cable, and telephone wires. The second stage will involve digitizing surface features (e.g., light poles, sidewalks, parking lots, utility lines, etc.), which will be funded by FM.

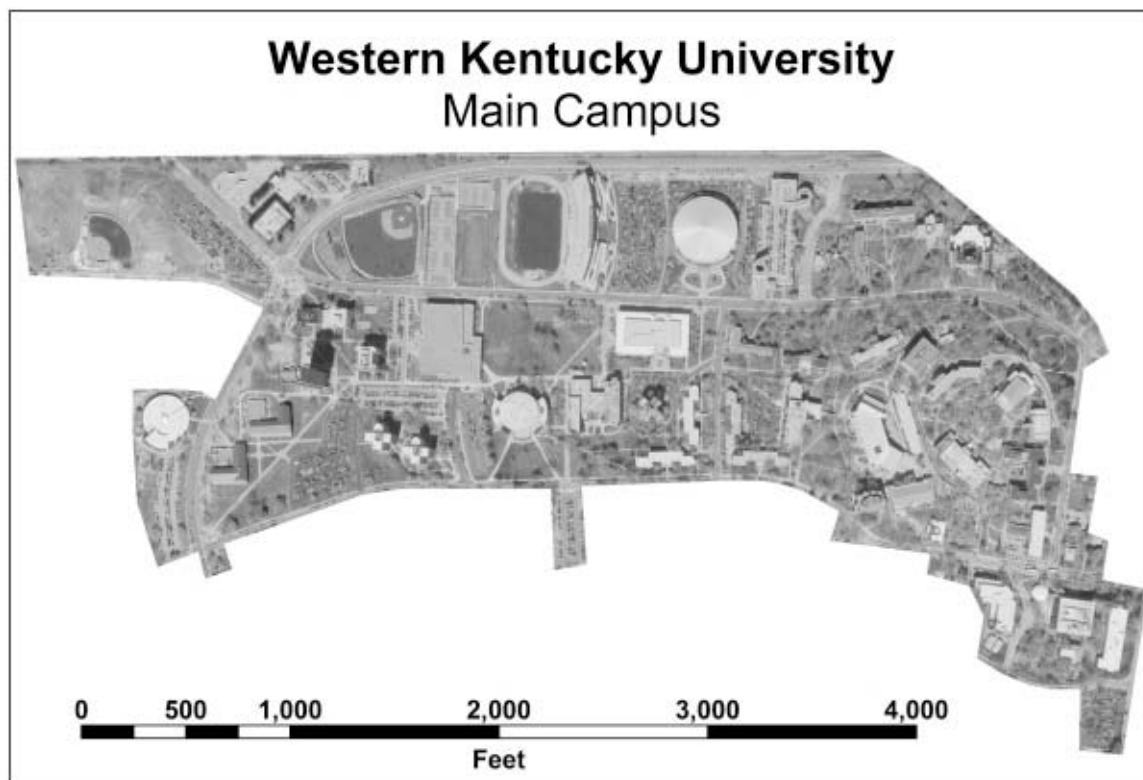


Figure 1

Main Campus of Western Kentucky University in March 2000.
Prepared by Kevin Cary.

Students can participate in a GIS project by student employment, internship or graduate assistantship. However, the student must meet some conditions. They must have taken an introductory course in geography and have had at least one GIS course. Students meeting this criterion will be involved in mapping spatial features. Students wanting to pursue advanced GIS operations such as analysis and modeling would have to have had or be enrolled in the GIS Analysis and Modeling course.

Students will have the opportunity to experience all or most aspects of a real-world GIS based project. Those that are mapping spatial features to be used in a GIS will gain the following experience:

1. Contacting potential stakeholders to identify the various attributes for spatial features.
2. Digitizing spatial features by extracting them from hard-copy maps.
3. Converting existing digital datasets into a GIS format.
4. Using a GPS unit for mapping spatial features.
5. Correcting spatial features already digitized on a base map in accordance to the National Mapping Accuracy and Standards (NMAS).

Students wanting to pursue advanced leveled GIS operations have the opportunity to explore one or more of the following areas:

1. Topology and networking.
2. Analysis and modeling.
3. Geodatabase management.
4. Internet mapping services.
5. Supervision, troubleshooting and training.

The campus-based GIS facility allows students the opportunity to gain real-world experience on real projects without having to make another move to a distant location (e.g., summer internships) from school. By the time they have completed their major at WKU, they could have earned at least two years of experience as a GIS Technician on their resume.

References

Department of Geography and Geology at Western Kentucky University (2001). *Proposal for a New Certificate Program*, Bowling Green, Kentucky.

Geographic Information Systems at Western Kentucky University (2002), <http://www.wku.edu/gis>

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Geographic Information Systems at Western Kentucky University

A Geographic Information System, or simply GIS, combines sophisticated computer technology and trained people to develop digital models of the world around us. These models can help us to understand and plan for the future of the communities and regions in which we live more effectively. Trained professionals can use GIS to produce highly detailed maps, but there is much more to GIS than making maps. A GIS includes capabilities for digital data creation, the storage and retrieval of digital data, the manipulation and analysis of those data, and the presentation of data using maps, graphs, tables, and other displays.

Digital data creation involves ways of taking the world that we see around us and representing it in a machine-readable form. Global positioning systems (GPS) technology provides a high-tech way of collecting geographic data. A hand-held GPS unit in the field receives signals from satellites to determine the latitude, longitude, and elevation to within less than one meter of a person's location on the surface of the earth. This

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technology can be used to build GIS databases for mapping features such as roads, property lines, buildings, wetlands, trees, manhole covers, and a variety of other features.

Once data are collected, they can be stored in a computer database. Users can then retrieve information from the database by making queries. A water department interested in preventive maintenance might ask the GIS to identify locations of PVC water pipes that are six inches in diameter and were last maintained prior to 1995. The capability to query the GIS database and display the results on a map is a rather simple, yet very powerful one.

GIS software also provides users with the ability to manipulate and analyze geographic data. A hydrologist could use a database that includes elevation and streams to predict the extent of flooding from a heavy rainfall event. A campus administrator could use a map of campus, including the locations of dormitories and classroom buildings, in an effort to identify the optimal number of and locations for emergency telephones. Applications for manipulating and analyzing data are widespread in social, economic, and environmental professions and are limited only by the imagination of the user.

Finally, GIS includes the capability to produce maps and other types of output. Patterns of crime can be studied by producing a map that displays different types of crimes with various colors and symbols upon a map that also shows neighborhoods coded by socio-economic characteristics. A map, graph, or table can be thought of as an archive of information. While a GIS map may be printed on paper, GIS data and analyses are often displayed in an interactive mode on a computer screen. This interactive mode is particularly useful in exploring "what if" scenarios. These scenarios have potential for facilitating

[Assistantships](#)

[United States National Map Accuracy Standards \(NMAS\)](#)

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solutions in conflict resolution scenarios, such as when local groups have opposing views concerning the location and design of a proposed development project.

Western Kentucky University's new GIS facility provides students with the training to become productive users of GIS technology and positions Western to play a constructive role in helping local and regional organizations to plan for a positive future.

Last updated: May 2, 2003

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Website launched on February 5, 2003.

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