Application of GIS Methods for Environmental Learning in South Texas

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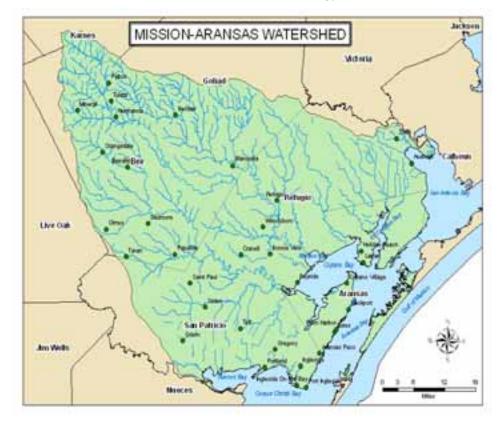
Abstract
With the application of GIS being utilized in a variety of disciplines, it is appropriate that these new techniques should be incorporated into the classroom. In developing strategies for teaching with GIS in geography, earth science, and environmental studies in South Texas, teachers are offered another opportunity for innovative techniques to reach their students. By using an expanded approach from the ESRI book, *Mapping Our World – GIS Lessons for Educators*, selected topics will be presented to illustrate the design, development, and application of the approach. The following topics are targeted for development within the project: introductory GIS skills, climate, hydrology, wetlands, migratory birds, fisheries, and vegetation using regional and local datasets. This specialized learning experience will allow rural communities to increase their regional geographic knowledge, while also integrating state knowledge skills required at each grade level.

Introduction
Examining environmental issues at the watershed level allows students to learn about their specific local region, while discovering the levels of connectivity that are shared by all individuals. By integrating GIS and local data, we can focus on the current issues with the expressed interest of developing awareness and stewardship at the watershed level. The unique qualities of the Mission-Aransas Watershed provide the opportunity to create educational materials to be used throughout the entire system. The introduction of GIS within the Mission-Aransas Watershed holds great possibilities to improve regional knowledge. The powerful technology available for the students creates a hands-on, dynamic, learning environment. Through correlation with state learning standards, teachers can illustrate the importance of water quality and other environmental issues on a regional level. At this stage, the importance will be on learning with GIS and not about GIS. The preliminary lessons will incorporate introductory GIS skills and basic watershed geography and hydrology. The students will have the opportunity to increase their regional knowledge, while fulfilling curriculum and state requirements. Local GIS activities will allow students to creatively utilize technology, while learning about their watershed. The ultimate goal for the series of GIS activities for the Mission-Aransas Watershed is to serve as a model for future areas, not only in Texas but also at a broader scale.
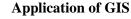
What Is A Watershed?

A watershed is defined as a region that drains to a particular body of water. Famous U.S. explorer and geologist, John Wesley Powell described it as "that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community". Watersheds, also known as drainage basins, are found in a variety of shapes and sizes. Everyone lives within a watershed. Consequently, personal actions have the potential to positively or negatively impact the system. Due to the connectivity, we must examine issues at the watershed level in order to see the bigger picture.

Our Local Watershed

The focus for this project will be the Mission-Aransas Watershed, located along the southeastern Texas coastline. The system includes six counties (Aransas, Bee, Goliad, Karnes, Refugio, and San Patricio), with county populations less than 50,000. The watershed drains an area of 5,688 km^2. Minor creeks feed into the Mission and Aransas rivers, which drain into Copano and Aransas bays. The majority of the economy is based on ranching, farming, oil/gas production, commercial fishing and tourism. From the Karankawa Indians, the first inhabitants, to the diverse populations of today, the land has provided abundant resources. The distinct qualities of this watershed continue to attract people from all backgrounds.

Application of GIS

A geographic information system (GIS) provides a unique analysis of the world by applying spatial data to develop investigations and discern relationships (Kerski, 2001). Through this computer-based system, users are capable of visualizing and manipulating spatial data (Zerger et al., 2002).

GIS lesson plans allow teachers the opportunity to incorporate new technologies and innovative techniques. When compared with paper maps, students can use GIS to visualize patterns, trends, map scale, distance and overlaying data layers, in a dynamic, learning environment (Shaunessy & Page, 2006; Wigglesworth, 2003). Through this technology, students are capable of conducting their own investigations by varying the research questions, data, and analysis (ESRI, 1998).
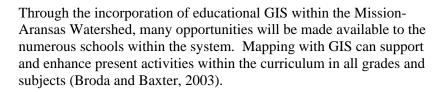
Studies have shown that current students do not have rewarding experiences exploring their local regions (Bodzin, 2002). The real-world applications of GIS technology allow students to see data as it applies to them on a local scale. Through utilization of local datasets, the important issues can be addressed in the classroom. The technology is a powerful tool to integrate education and community through environmental studies and technology.

Local GIS activities bring a level of interaction that was not available before in the classroom. Students have the opportunity to apply local data and create personal, customized layouts. With these maps, many questions can be addressed, including ecological, social, and environmental issues. The hands-on GIS applications can serve as virtual, classroom explorations of the local watershed region. Students can learn about a specific area before making their own investigations during planned field trips. Following a baseline study of the area, students can develop and address questions based on field observations.

Through the incorporation of educational GIS within the Mission-Aransas Watershed, many opportunities will be made available to the numerous schools within the system. Mapping with GIS can support and enhance present activities within the curriculum in all grades and subjects (Broda and Baxter, 2003).
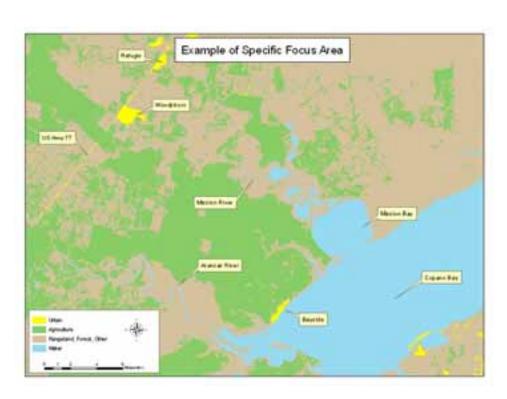
Under the State Board of Education, Texas students must meet established learning standards for each grade level under the Texas Essential Knowledge and Skills (TEKS). The information within TEKS is set forth to prepare students for future grade levels and success beyond high school. Teaching with GIS can fulfill many TEKS including the following: conducing investigations using scientific methods, critical-thinking, analyzing data, problem-solving, and using tools.

Example of Specific Focus Area

Activities
Preliminary activities include aspects at the watershed level, allowing students to become familiar with the watershed. The first lesson "Where Do I Live?" incorporates local geography and the student's ability to distinguish label important features, while establishing basic ArcMap skills. The second lesson "Follow the Water Drop" will build upon the first lesson. Students will learn how the water flows through the Mission-Aransas Watershed, by following the flow of water from a specific creek into the bays. This lesson can lead into further discussion into water quality and current issues in the watershed.

Once a sound understanding has been established, detailed studies involving historical changes, wildlife, climate, wetlands, and vegetation will be integrated.

References
Bodzin, A. M. (2002). LEO EnvironSci inquiry: Using the web to learn environmental science. *Learning & Leading with Technology, 29(5),* 32-37.

Broda, H. W. & Baxter, R. E. (2003). Using GIS and GPS Technology as an Instructional Tool. *Social Studies, 94(4),* 158-160.

Environmental Systems Research Institute (1998). *Explore your world with a geographic information system, A teaching supplement for grades 5-12 introducing GIS concepts and components* Redlands, CA: Environmental Systems Research Institute.

Kerski, J. J. (2001). A national assessment of GIS in American schools. *International Research in Geographical and Environmental Education, 10(1),* 72-84.

Shaunessy, E. & Page, C. (2006). Promoting inquiry in the gifted classroom through GPS and GIS technologies. *Gifted Child Today, 29(4),* 42-53.

Wigglesworth, J. C. (2003). What is the best route? Route-finding strategies of middle school students using GIS. *Journal of Geography, 102,* 282-291.

Zerger, A., Bishop, I. D., Escobar, F., & Hunter, G. J. (2002). A self-learning multimedia approach to enriching GIS education. *Journal of Geography in Higher Education, 26(1),* 67-80.

Program Connections
ESRI
Through their goal of increasing spatial literacy, ESRI has expressed their commitment to education. Spatial literacy means knowing where you live and who else lives there as well. GIS can incorporate the environment, ecology, and culture into an interactive database for learning. This project will follow along in the footsteps that ESRI has already set forth in the discipline of education. Ultimately, we are putting into practice "Think globally, act regionally" into the public schools within Mission-Aransas Watershed.

MANERR
The Mission-Aransas National Estuarine Research Reserve is the newest reserve in this NOAA program. The program objectives include fostering an awareness of coastal and estuarine resources and developing a stewardship approach to managing these resources. This project will be used within their education and outreach program to ensure that school children have a real connection to the watershed.

NOAA-ECSC
Under the current NOAA Environmental Cooperative Science Center (ECSC) project entitled *Assessment of Historic Land Use/Land Cover Patterns in Mission-Aransas Watershed to Support MANERR Goals*, the ECSC project will integrate the ecological environment with cultural heritage of the area. This approach ties in science, history, and social sciences into understanding land cover changes. The secondary benefits include the potential integration into future GIS lesson plans for the watershed.

TCEQ TMDL
Texas Commission on Environmental Quality addresses water quality impairments in water bodies of Texas. Five segments are currently listed on the 303(d) list. We will be providing lesson plans to increase public awareness on how segments become listed and how we live influences the water quality of the Mission-Aransas Watershed.

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