

Conference Strand: Technology & Environmental Education

Integrating Geospatial Technologies into Earth and Environmental Education

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Geospatial technologies offer new opportunities to provide information to support environmental decision making. Teachers and students nationally are using these technologies to investigate the environment and to become better stewards. There are many new web-based, data driven, analysis tools and low cost curricula available for use by environmental educators. Many of these are being provided by government agencies such as NOAA, NASA, USGS and other nonprofit agencies such as American Forests. Environmental educators have an opportunity to use these new technologies to motivate others to learn new ways in which they can contribute to and become more involved in their communities.

Research on the use of geospatial technologies (GIS) in schools has shown that teachers and students are able to engage in data visualization and analysis, spatial interpretation, and real-world problem-solving . A recent report by the National Research Council, Learning to Think Spatially , states that Geographic Information Systems (GIS) has the ability to meet four educational goals: (1) support the inquiry process; (2) be useful in solving problems in a wide range of real-world contexts; (3) facilitate learning across a range of school subjects; and (4) provide a rich, generative, inviting and challenging problem-solving environment (p. 176). Additional research has further documented other important benefits of using GIS such as increased motivation , self-efficacy and attitudes toward technology (Baker, 2002), acquisition of spatial analysis skills , increased mathematics ability , and geographic and scientific content knowledge .

For more than a decade, educators and researchers have developed curriculum at the same time focusing on teacher professional development. These professional development efforts have engaged large numbers of teachers and provide compelling examples from classrooms of the potential of GIS to enhance teaching and learning. Some of the curricular materials available, educational projects and types of GIS software being used by environmental educators and teachers include:

Major GIS Software Products and Curricular Projects

Software Name	Curriculum/ Projects
ArcGIS ArcView	USGS Education Saguaro Project CITYgreen 5.0 Mapping Our School Site (MOSS) Mapping Our Environment Pathfinder Science GLOBE VISIT Casey Trees My Wonderful World Geospatial Education for 4-H Mapping Our World: GIS Lessons for Educators, ArcGIS Desktop Edition USGS Education Earth Exploration Toolbox
* ArcExplorer * ArcVoyager	ArcLessons
MapInfo	GISAS Project
* Google Earth	Google Earth Lessons Google Earth Lessons Blog
* NASA World Wind	World Wind Central
My World GIS	Investigations in Environmental Science
Autodesk	Autodesk DesignKids
* GRASS	Using Digital Tools to Enhance Learning
Idrisi	Secondary Education Project (SEP)
* ImageJ	Earth Exploration Toolbox Ocean Explorers

* Freeware

Teachers and other advocates of using geospatial technologies in schools state that what makes these technologies different and particularly compelling is that students

are able to interact with dynamic visual displays of real-world data which provides them with an opportunity to develop fluency in visual representations of data, quantitative data analysis and experience in database techniques . In addition, using GIS and place-based learning, a sense of connection to the land or to communities can be developed through environmental project-based learning . According to Smith , place-based education programs can be grouped into five types that can be used singly or combined. These include:

- Cultural studies: investigations of local history and culture that is important to the long-term viability of the community.
- Nature studies: unique environmental features of place through projects such as stream monitoring, restoration, and gardening in which there is usually a strong emphasis on science and mathematics.
- Real world problem-solving: an issue is identified and explored in greater depth and work is done within the community to solve the problem.
- Microenterprises: link with economic opportunities in communities through real enterprise partnerships.
- Community regeneration: citizens investigate issues and make recommendations to policy makers.

CITYgreen, a GIS extension by American Forests (2002), is an example of place-based inquiry that combines three of the five place-based education program components, according to Smith . Students investigate their environment using mathematics and science to solve real world problems and participate in and make recommendations to policy makers. The School Environmental Education Program by American Forests provides opportunities for students to investigate real world problems in a community context that involves nature study and community regeneration.

CITYgreen uses models to calculate the services performed by trees for reducing stormwater runoff, mitigating air quality, saving summer energy, storing and avoiding carbon, and modeling tree growth. Lyn Malone who had taught in public schools for 32

years as a social studies teacher recognized the advantages of using GIS in the classroom. In 2000, she and a colleague launched Project One, Two, Tree in response to a Rhode Island initiative that required every town to include an urban forestry component in its comprehensive plan. Malone thought it would be a great community service for the students to create a tree database that the town could expand. They piloted the project in their town of Barrington, where 80 students learned about urban forestry and used CITYgreen to create an inventory their middle school's 217 trees, analyze the range of species, and document their condition. During the next year, Malone trained middle and high school teachers from ten towns to conduct similar classes.

Drew Swierczek, is in his first year of teaching at McKinley Technology High School in Washington DC. McKinley is a newly reopened inner city school focused on providing technology skills applicable to an array of careers. Swierczek, who was charged with developing Community as Laboratory, an elective that uses CITYgreen software to teach students GIS and the environmental benefits of urban trees. Swierczek had never heard of GIS prior to joining McKinley. Subsequently, he used the CITYgreen manual to teach himself the basics of GIS. He then incorporated the CITYgreen lesson plans and created an atmosphere where both he and the students learned from each other as they learned more about CITYgreen. After learning GIS and CITYgreen, the freshmen and sophomores conducted a tree inventory of their schoolyard and ran alternative scenarios for various planting schemes. Swierczek plans next year to move out of the schoolyard to adjoining neighborhoods to inventory trees. He also envisions teaching a social studies course using GIS applications to analyze how a city park divides the city economically.

The success stories mentioned are just two in a list that is growing rapidly. CITYgreen is helping teachers and administrators bring technology into the classroom to educate students not only in core academic subjects but also in the importance of conservation in their communities. The program supports mission of growing a healthier world with trees through school and student participation by many states in the country such as Texas, North Carolina, Rhode Island, Missouri, Florida, and Georgia.

In conjunction with CITYgreen or by itself, online mapping is making it easier and easier for teachers and students to become active in the environmental health of their communities. Using Google Earth, students can look at their school grounds or their own backyard. They can investigate US National Parks or the Gombe Preserve in Africa. The National Map program and other state related online map servers such as NC One Map offer a wide variety of activities for teachers, students, and the public. Some of the categories of data that can be viewed and analyzed include roads, hydrology, geophysical, bio-habitat, and land cover. The U.S. National Snow and Ice Data Center (NSIDC) offers a wonderful library of Google Earth enabled content for teachers and students to use as they examine topics such as Glaciers, Sea Ice, Permafrost and Antarctica. Any data set online that has latitude and longitude such as a variety of animal tracking data can be visualized using Google Earth. The possibilities are infinite.

Conclusion

Students benefit from an interactive and exploratory environment. Using GIS and online mapping allows for a new dimension to learning as students are able to easily explore, analyze, and predict solutions to multiple problems. Teachers and students nationally are using these technologies to investigate the environment and to become

better stewards. There are many new web-based, data driven, analysis tools and low cost curricula available for use by environmental educators. Environmental educators have an opportunity to use these new technologies to motivate others to learn new ways in which they can contribute to and become more involved in their communities.

REFERENCES