Title:

Connecting K-12 students locally, regionally, and beyond using remotely sensed imagery and thematic events.

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Abstract:

The use of technology to explore geographic themes provides K-12 students with learning opportunities that engage them in their local community while utilizing advanced technologies. This paper provides an overview of the different geographic themes used by the Earth Observing System Education Project (EOSEP) of the University of Montana. Themes currently being used or developed include the historic Lewis and Clark Expedition, community mapping for school safety and wildland fire

planning and prevention, and the Ice Age floods of Glacial Lake Missoula. Remotely sensed imagery, including satellite imagery, geographic information systems (GIS), and global positioning systems (GPS) are some of the advance technologies that students and teachers use to explore these themes.

Introduction

The Earth Observing System Education Project (EOSEP) of the University of Montana considers community based learning an integral component of successfully engaging rural students in educational activities. Creating both a sense of and connection to place has the potential to help students develop problem solving and critical thinking skills by presenting materials that challenge the student to understand where they live. Community based inquiry also encourages cross-generational learning as students actively seek information from parents and grandparents once they are intrigued by local phenomena (historic event, natural feature, business, transportation system, or catastrophic event - to name a few). EOSEP has applied remotely sensed imagery, geographic information systems (GIS), and global positioning systems (GPS) technology to the community based learning concept and has expanded community to encompass broad geographic scales. This paper discusses the concept of linking students by geographic themes, as well as the rewards and challenges of integrating imagery and technologies into classroom and community applications.

EOSEP is a NASA funded project that strives to integrate the use of satellite and other remotely sensed imagery into the classroom setting. While many classrooms across the

world have static paper maps on their walls to illustrate certain lessons, EOSEP helps to make this imagery available in formats that are adaptable and that may be used to answer a variety of questions. To achieve this, a certain level of technology is necessary. As the use of new technology may be daunting to teachers because of existing workloads, EOSEP has created learning scenarios around geographic themes that engage teachers and students in active place-based learning, while they use remotely sensed imagery and new technologies. Geographic themes currently being utilized to create learning activities include the historic Lewis and Clark Trail, wildland fire events, and the geologic Ice Age Floods trail that connects the landscape of the United States from Montana to the Pacific Ocean.

The Lewis and Clark Information System

The bicentennial of the expedition of Lewis and Clark has created many learning opportunities and adventures that retrace portions of the trail. The Lewis and Clark Information System (LCIS) is a web-based education site designed to engage students and the larger community in learning activities related to the Lewis and Clark expedition. The Lewis and Clark Information System demonstrates the usefulness and application of satellite imagery within a thematic context. It is a dynamic website that aggregates information on the Lewis and Clark Expedition for the K-12 education community and also provides an online environment for the collection, manipulation, and comparison of data acquired along the Lewis and Clark Trail. Through comparison of past and present landscapes, teachers are able to engage students in active learning while helping them

understand the variety of factors that affect Earth's complex systems on a local, regional, and continental level.

The LCIS serves as a starting point for teachers to find information pertaining to the Lewis and Clark Expedition. The system breaks the Lewis and Clark Trail into eighteen eco-regions based on watershed and other ecological factors. Each eco-region portrays the landscape at the time of the Expedition by using narrative text for the general features identified within the system. Currently, there are four general landscape features identified within the system: Geology, Hydrology, Climate, and Ecology. By studying these four landscape features, teachers and students can establish an understanding of the environmental conditions during the time of Lewis & Clark.

Each eco-region contains additional data in the form of satellite imagery, historical lithographs, journal documents, and customized ArcIMS maps. These data will also serve as a basis for allowing teachers and students the opportunity to make determinations regarding the landscape condition at the time the Corp of Discovery passed through as well as at different time periods up to present day. LCIS will be using Skyline software to build "fly-throughs" of the trail. This technology allows the user to take a visual – virtual aerial tour of selected segments of the path followed by Lewis & Clark.

The data entry – edit system will permit the entry of current observations regarding various features of the trail. Geologic, hydrologic, climactic, and ecologic information

can be entered into the system via a web interface. Once these data are entered they can be aggregated, digitized, and geo-referenced for dissemination through interactive Web-based applications. Classrooms along the trail, as well as anywhere in the world, can extract information from the system to begin to analyze landscape change over the past 200 years. The ability to make landscape comparisons through time creates a powerful set of learning tools. The use of satellite imagery will be integral to the LCIS by providing the latest "looks" at the trail.

As part of a continued effort to provide a complete learning environment for teachers, the LCIS will house a resource page where teachers and students can find additional information on Lewis and Clark. A series of training vignettes on how to use the system will also be housed on the resource page. These vignettes will give educators the opportunity to become familiar with the LCIS prior to working with students on the system. Lesson plans created for use in conjunction with the system will be stored on the resource page, and teachers will be able to select from the plans by subject area and grade level. The resource page will also house links to electronic field guides, online mapping systems, and other Lewis and Clark websites. The aggregation of these resources will help educators engage students in active learning within the thematic context of Lewis and Clark.

The Firewise Information System and community mapping projects

Fires are a real threat across most of America and the world. The U.S. federal government has struggled to manage wildland fires for decades and their job has gotten

more complex as populations creep into heavily wooded areas and enlarge areas of concern in the wildland urban interface. In the past few years, a new approach to managing this real threat has emerged through the National Firewise Communities program, which promotes community-based cooperation among the public, private, state, federal, and local sectors to address fire hazards and build or create fire-resilient communities. The national model actively encourages participation at the local and regional level from all sectors of the community.

However, most communities interested in implementing the Firewise program lack key data parameters that will allow for the effective use of GIS. Examples include structure location, local vegetation and fuel loads, and road location and specifications within the interface area. Satellite imagery, with ground-truthing activities using GPS, can fill much of this data gap.

The internet-based Firewise Information System (FIS) has been created to integrate the national Firewise initiative into schools. The FIS engages students in systematically collecting data to assess fire related risks associated with real property in the wildland urban interface. The FIS uses the national Firewise Communities model and relies on the local school district - the core of every rural community across the American west - to coordinate a cooperative agreement with the local fire district to use GPS and GIS to collect fire information in support of creating a safer community.

The FIS is being piloted with the assistance of Frenchtown Schools and the Frenchtown Fire Department (Montana). Frenchtown teachers and students were initially introduced to GIS through *GIS 4 Montana,* a creative partnership between EOSEP and Environmental Systems Research Institute (ESRI) in which every school in Montana may obtain ArcView software and training free of charge through EOSEP. FIS Students engage in real-world utilization of GPS and GIS technologies and associated geospatial data to assess fire risks in their community, work with the local fire department to correct problems, and assist with community education concerning wildland fire risks. Data generated through the Frenchtown School/ Frenchtown Fire partnership will be entered into the FIS, which utilizes an ArcIMS system. Data may then be shared with the larger community and be applied to real world planning and fire protection issues. The FIS represents a community-based data collection and mapping project that integrates student learning with an important local issue in western Montana – wildland fire.

Another example of the use of satellite imagery and GIS technologies by schools to address local issues is the Safe to School project. This project was conducted in Lolo, Montana to help students assess the safest route to use to get to school and other points of local interest. The town of Lolo is divided by Highway 93, which runs directly through the heart of town and many students must cross it to get to school. Once a less traveled road, Highway 93 is the only route for the Bitterroot Valley and Ravalli County to access Missoula - its medical, cultural, and business center. Ravalli County has one of the fastest growth rates in the United States. Consequently, Highway 93 no longer safely

carries traffic through small towns like Lolo and communities have suffered due to the traffic increase.

Safe to Schools was initiated to ensure that the younger segment of Lolo's population understood local traffic concerns and could find safe routes through town. Initially, fifth graders were trained to use ArcView software through a series of trainings provided by EOSEP. When fifth graders were comfortable with the software, they were paired with a kindergartner, and together, they traced their paths to school and determined whether it was the safest available route. Aerial photography of the town was used and GPS locations were added to provide students with reference points that they would recognize. The project has provided a successful template for use in towns that are split by busy roads and provides important safety information to students in a learning context.

Additional communities have been impacted by the use of GIS in their local schools. High School students from Plains, a small rural town in western Montana, used GIS to develop a community map that identifies potential hazards as well as emergency resources. Drummond school 7th graders and their teacher hope to use GIS to explore the local river and begin to understand the effects of many years of heavy copper mining upstream from their community. Billings Sky View High School teachers and students, in conjunction with the Billings community, are in the process of turning a recently donated tract of land into an interpretive area, complete with informational kiosks, an interpretive path, and restroom facilities. These are a few of the many communities in Montana that are working to integrate GIS technology into current teaching practices.

Glacial Lake Missoula and the Ice Age Floods: From Source to Sea

Less well known than the expedition of Lewis and Clark, but equally as exciting for an applied geographic learning theme, is the story of Glacial Lake Missoula and the ice age floods that were released many times throughout history. Glacial Lake Missoula covered most of what is now western Montana and eastern Idaho and was capped to the west by a large ice dam. This ice dam periodically broke, resulting in massive amounts of water flooding through the dam and coursing across western Idaho, Washington and Oregon, making its way to the Pacific Ocean, near Astoria, Oregon. The flood waters followed the path of the Columbia River drainage – from Western Montana, across northern and eastern Idaho, through the Columbia River Gorge, into Oregon's Willamette Valley, and finally into the Pacific Ocean, near Astoria, Oregon.

Much of the landscape in this region is attributable to these floods and local economies and cultures reflect this. These geologic episodes have created many learning opportunities locally that will familiarize students with their region and also other areas. The understandings that evolve from studying past geologic periods allow students to comprehend the past and how it has come to help shape the existing landscape.

The Lake Missoula Floods not only drastically impacted the geography of Montana, Idaho, Washington, and Oregon, but also influenced the present patterns of human settlement and wildlife existence. For example, in Missoula the groundwater we use

daily is stored in the sands and gravel deposited by Glacial Lake Missoula. And the rich, fertile soils of the Willamette Valley are the same thick soils that were stripped by the floods in eastern Washington—leaving a landscape unsuitable for farming.

Lake Missoula Floods: From Source to Sea will be a K-12 educational project that will develop and integrate interdisciplinary curricula into the classroom; and coordinate and facilitate the sharing of the floods story among teachers and their students within the flood region and beyond. Maps and remotely sensed data in the form or satellite images will be used to demonstrate the Lake Missoula Floods phenomena. EOSEP will be working with interested teachers and students to help discover and understand just how these grand scale activities formed significant landscapes in the continental US.

The story of the Lake Missoula Floods is one of many thematic levels. Curricula will combine the fields of geology, geography, history, and ecology. Maps will be developed to show the path of the floods, demonstrate the influence of the floods on historical and modern demographics, and demonstrate geomorphologic changes. Using a system created by EOSEP, similar to the LCIS, students and teachers will be able to enter data regarding their observations of the environments affected by the flood's path. These data may be compared with existing descriptions of what the area looked like during the earlier geologic periods prior to the floods. Additionally, information on the floods will be disseminated via a Missoula Flood Website, workshops, and fieldtrips.

The story of the Missoula Floods is easily divided into four regions:

1. Glacial Lake Missoula (Montana): Where did the water come from? How high was the lake? How did the Lake impact the landscape of western Montana?
2. The Ice Dam (Idaho): How was the dam created? By what mechanism did the ice dam burst?
3. Channeled Scablands (Washington): What are coulees and how where they formed? What did the landscape look like prior to the floods?
4. Reaching the Sea (Oregon- Willamette Valley): Where did all the sediment go? What evidence do geologists have to indicate there was more than one flood?

The Missoula Floods Project will work with educators within the four regions to help them develop their portion of the story. Each region's geology, geography, and economy were and still are influenced by the occurrence of these flood events.

An important component of the Missoula Floods Project will be an interactive website. Teachers and their classrooms will be able to use the website to share their portion of the Missoula Floods story and the Missoula Floods Project will be responsible for connecting the stories.

Discussion

Challenges of technology:

EOSEP is grounded in the notion that technology needs to be the vehicle for communication, cooperation, and information. Even when schools have old equipment

and are under resourced in this area it is important for kids to understand that technology changes all the time and that they will be working with multiple types of technology during their lives in order to participate in what has been called an information economy.

The most obvious challenge presented by the use of advanced technology with schools has to do with the availability of appropriate resources. Many schools have technology that is antiquated and outmoded. EOSEP recognizes this factor and helps offset the lack of up-to-date equipment in a couple different ways; first, by owning and maintaining a mobile laboratory and secondly, by developing programs that can be accessed via a web browser. The mobile lab, approximately 40 laptops, allows EOS to go into schools with functional equipment and teach using technology that is relevant to the task. The inclusion of an online portal is an important one for EOS. This online portal, requiring only an internet connection and web browser, enables students and teachers to access, query, disseminate, produce, and analyze information in ways never before available to educators. This type of technology supercedes the need for cumbersome software installations, or minimum hardware requirements. With many schools suffering from lack of technology funding, it becomes even more important that we continue with our efforts to demonstrate what is available and can be done with appropriate technology.

Vehicles for sharing technology:

EOSEP has developed numerous ways of sharing technology. We have three on-line GIS courses that take the student from introductory concepts to an advanced understanding of remotely sensed data. These courses are tailored to the classroom teacher and are taught by a GIS professional familiar with the needs and purposes of teachers.

GIS 4 Montana is another vehicle for getting technology into the hands of Montana teachers and students. This program, supported by a partnership with Environmental Systems Research Institute (ESRI), allows us to give a daylong workshop to Montana teachers and supply them with a copy of ESRI's ArcView GIS software and some primary data to use with this software package. To date, EOSEP has trained teachers in 126 Montana schools through its GIS for Montana initiative.

EOSEP has also developed a series of topical workshops for teachers and students. We have provided pre-GIS opportunities for teachers that demonstrate how to access and use imagery with existing free web viewers. We continue to work toward meeting the data needs of teachers and students through specialized trainings. By using follow up strategies to insure that what we are teaching and disseminating is being used and understood, EOSEP demonstrates its commitment to evaluation, schools, and kids.

The evaluation process for all of our projects is in place. We use both outside and inside evaluation of our work and have developed numerous specialized evaluations providing feedback regarding workshops and in-service activities. Our web site and courses taught by EOSEP staff undergo constant evaluation both internally and externally. The project continually strives to improve our offerings and make desired resources more available to schools and other interested parties.