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Technology and the Study of Wildfire: Middle School Students Study the Impacts of Wildfire

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Essential Question / Inquiry

How can technology assist students as they explore the human and environmental impacts of wildfire and communicate their findings?

Introduction

Wildfires occur in many parts of our world, and provide an excellent opportunity for students to study local and global interdisciplinary issues using technology. Colorado has for several decades been one of the fastest growing states in the USA. As more people move to Colorado, they are increasingly living on lands vulnerable to wildfires—in the grasslands and dry mountain foothills.

On October 29, 2003, with the day's temperature at 80°F, relative humidity at only 8%, west winds of 20-25 mph and gusting to 30-35 mph, conditions were perfect for wildfire. At 12:42 p.m., a 911 call alerted emergency personnel to the Cherokee Ranch fire. Several wildfires broke out along the Colorado Front Range, including one between Denver and Colorado Springs, in northern Douglas County. The fires threatened land owned by the historic Cherokee Ranch*, as well as the county of Denver, and the neighborhoods of Castle Pines and Highlands Ranch. The area is inhabited by various species of wildlife including a herd of buffalo, and is adjacent to property containing new housing developments. The wildfires burned a total of just under 1,000 acres. The cost to suppress the fires was approximately \$262,000.

In September 2004, nearly a year after the fire, a group of 111 seventh and eighth grade students and their teachers from Mountain Ridge Middle School in Highlands Ranch began a formal scientific investigation of the Cherokee Ranch fire. They sought to determine the fire's impact and to report their findings to stakeholders – county officials, firefighters, landowners, and community associations. The initial study is scheduled to conclude in spring 2005 when students will personally and formally present their findings to these same stakeholders in the community.



Mountain Ridge Middle School, Highlands Ranch, Colorado, above, where the teachers and students hailed from for this study.



The success of the field study day was the result of numerous hours of effort by teachers, parent volunteers, administrators, and even the school district's lawyers, securing permission for the students to enter the field site. Ms. Deb Fox-Gliessman, above, is the history/geography teacher on the project. The idea for this project came after she attended a Geographic Information Systems (GIS) course at the University of Denver and shared what she had learned with John McKinney, the science teacher on her teaching team. McKinney wanted to find a way to teach students about wildfire using the Cherokee Ranch Fire. A study was born!

Procedure: How 111 Students Can Conduct a Scientific Study

Overview

At Mountain Ridge Middle School, students are organized into teams where the students on the team take their core classes with a team of teachers. This particular study is being led by the four core subject teachers on the 7/8E team - Deb Fox-Gliessman (history/geography), John McKinney (science), Ann Clark (language arts), and Kathy Granas (mathematics). The various components of the study require learning, knowledge, skills, and support in all of the students' core content areas. Additionally, the study employs extensive use of spatial technology--both Global Positioning Systems (GPS) and Geographic Information Systems (GIS), as well as Internet-based research, word-processing, spreadsheet, and

presentation applications. The interdisciplinary nature of the study allows for significant differentiation based on student knowledge, skills, abilities, and interests. It exposes students to real-life situations where their school learning can be put to practical use.

The study's four phases include research into the history and behaviors of wildfires, and identification of the specifics of the Cherokee Ranch wildfire, field work in the burn area including data collection and observation, data analysis, and the preparation of reports and presentations (technical and scientific writing, PowerPoint, and oral presentations).

The study was spread throughout the school's academic year. It began in early September and is scheduled to conclude in early May. Classroom instruction related to the study is incorporated into normal curriculum for each of the four content areas and "Fire Study" work days have been arranged so that students have blocks of time to do field research, library research, data analysis, report writing, and presentation preparation.

Expertise

Teachers and students involved in this study are exploring unknown intellectual territory, and the teachers thought it important to model for students the use of community experts and resources. In assessing the need for support, the teachers first determined their own areas of expertise and then sought to fill in the gaps. They enlisted a number of outside resources to assist with the study including US Geological Survey geographers, firefighters, county and community representatives, and parents.

Pre-teaching

Two of the study teachers (Granas and Fox-Gliessman) had attended several GIS training events geared for educators, including a week-long institute conducted by GIS ETC in 2002 and a week-long institute entitled GeoTech Colorado 2004. They understood the value of spatial technologies in education and for this study.

Prior to entering the field study phase of the project, students were introduced to the Cherokee Ranch fire area by teachers and firefighters during a half-day field trip. Teachers toured the students around the area pointing out general facts about the environment, local development, plants and wildlife, and the geological and human history of the region. Firefighters demonstrated firefighting techniques and equipment used to fight the Cherokee Ranch fire, and told students of their own personal experience in fighting this particular fire. In language arts, students received specific instruction in the formulation of questions and interview techniques to support their research into the nature of wildfire and both the human and the environmental impacts of wildfire.

Additionally, students received instruction in fire behaviors, geographic and scientific inquiry, data collection (qualitative and quantitative), and measurement methods. Technical reading and writing were introduced prior to field study and during the research and data analysis phases. Students were taught to use GPS receivers to record their location in the field where data and observations were collected. They also used ESRI's ArcView GIS in order to perform data analysis and map generation for the study.

Research shows increased student interest in a subject provides real-world relevance to the subject,

In this area students examine aspects of the fire and display their work for others. Firefighters who fought the Cherokee Ranch fire provided the burn photographs. Other photographs show students learning about the fire from teachers and firefighters on their initial trip to the burn area.

Phase 1: Field Study

Students were organized into 20 field study groups of 5-6 students each. With the permission of the land owners and the school district, and accompanied by some of the firefighters they had met with a week earlier, students spent an entire school day in the burn area collecting data. One of the most unique aspects of the project was that the students were the first research group to be allowed into the burn area. Each student took great care to disturb the environment as little as possible.

The burn area was divided into a grid to avoid duplication of field data collection and to cover as much area as possible. Each line of longitude became a transect for data collection. The transects were spaced .05 minutes apart, and each group used GPS units to find and follow its assigned line of longitude, collecting data every 100 meters along its line of longitude. Each group collected data at six to ten locations in the burn area. Data related to the geological and geographic features, fire damage, and re-growth of the area were documented in writing and with cameras. Information was carefully entered onto data collection sheets and stored in a field study group file along with the names of the group members. Parent volunteers who had attended a brief training session about the project accompanied the groups into the field.



GPS units, field notes, and cameras ready for the students to use in the wildfire burn area.



Above left: Joseph Kerski, USGS Geographer, met with students prior to the trip to discuss the real-life applications of the work they were about to do, career opportunities, why spatial analysis is relevant to society, and how federal agencies map and display wildfires (www.geomac.gov). He then joined them in the field to support their efforts. He told them that they were involved with something that most college-aged students were not even doing! Above right: Parents meet with John McKinney to prepare prior to the start of the field study day.

Parents accompanied field study groups to offer support and guidance as needed.



Students confer as they prepare to board busses for the trip.



In the field! Arriving at the Cherokee Ranch burn area in multiple buses, trucks, cars, and vans, and receiving a re-orientation to the study and the site, students prepare to collect data and note observations in writing and photographs.



Students take notes and latitude-longitude coordinates (above). The GPS receiver is in a bag because of the light rain that was falling.



The lone student seen here photographs the burn area. Students worked together to construct a complete picture of the burn area. Each student in the field study groups had a specific responsibility for location, measurement, observations, documentation, or photography.



Above, a student works with a parent to verify GPS readings.



Above, students confer during the data collection activities in the burn area.



Above, a field study team pauses briefly on its trek along its assigned line of longitude. Each member of the group has specific responsibilities in the data collection process, and has been trained to recognize various forms of vegetation and degrees of damage and re-growth.



Above, a parent accompanies a student field study group in the burn area to provide support and guidance.



Some findings are unexpected, such as this burned golf ball discovered by a student.

Phase 2: Research

Following the field study phase of the project, students have been reorganized into 15 research groups of 6-8 students. Within each group one member is the technology expert. This member is responsible for data entry, table and map generation, support of data analysis, and leading the development of the PowerPoint portion of the presentation. Each group is assigned a research topic or section of the final technical report as follows:

- Fire study introduction, purpose, and description of the process (two groups)
- Pine tree damage and recovery (two groups)
- Soil chemistry and erosion (two groups)
- Gambel oak damage and recovery (two groups)
- Mahogany, grasses and cactus damage and recovery (two groups)
- Regional history of wildfires (one group)
- Cherokee Ranch wildfire: behavior, burn variables (two groups)
- Human impacts including firefighting and evacuations (two groups)

Questions to guide students in designing and accomplishing their research were developed by science teacher John McKinney and provided to each group.

At the beginning of each fire study workday, research groups met to review their work from the previous workday as well as their plan for the current workday (both are documented in their research group journal). They assigned tasks to each member of their group for the current workday. At the end of the day they met again, shared what they had learned, and documented their progress in their journal as well as planned for the next workday.

Each research group had a directory on the school server containing file folders in which it placed research information, group notes, rough drafts, data tables, and other information and products arising from its work. Additionally, each group had a paper file folder that was stored with the social studies teacher. This file contained hard copy information and the research group journal. In this way, electronic and hard copy documentation of the group's work was always available to group members and teachers. Group progress was not hindered by absences. Between workdays (usually three to six weeks apart), teachers reviewed the journals and provided written comments and feedback to help guide the students in a productive direction, and to keep students accountable for documentation of their progress. Additionally, if teachers found helpful information between workdays it was placed in the appropriate group's file folder for use during the next workday.

Phase 3: Data Analysis

Prior to the beginning of the study, students were instructed in both their math and science classes about the distinction and appropriate uses of quantitative and qualitative data. Using the file folders of data collected by each of the field study groups and the associated photographs (saved onto a disc and loaded into each research group's directory on the school's server), the students assigned to the technology team entered the raw data into Excel spreadsheets by field study group and GPS location. The Excel spreadsheets were designed to handle both quantitative and qualitative data. With the data entered, students were responsible for:

- 1) Explaining the nature and structure of the data to their team when data is used to support their research efforts,
- 2) Generating data tables and maps (using GIS) to support the analysis of the data by the research groups, and
- 3) Creating figures and maps for incorporation into the final scientific study report and associated PowerPoint presentations.

This phase runs concurrent to Phase 2: Research. Research and technology group members interact in order to brainstorm inquiry questions, analyze data, and develop ideas for figures to support information in the final report and presentation. Technology members participate fully in research group meetings at the beginning and end of each workday. In this way, both technology members and research members are informed about each other's results, efforts, and needs. Communication and documentation are key to the success of each group.

Phase 4: Report and Presentation Preparation

The product of this study is a scientific report to the stakeholders in the Cherokee Ranch fire. This

report: 1) describes the study, 2) describes the fire, 3) describes the current state of the burn area, and 4) makes recommendations for future management of the burn area. Students prepare both a written report and a formal presentation using PowerPoint and other visual media such as models and poster boards containing enlarged maps, charts, tables, and graphs. At the conclusion of the study, stakeholders will be invited to a formal presentation and “fair” where students will be stationed at booths ready to discuss their particular portion of the study. Each research group will have a booth and prepare the materials and PowerPoint presentation to be used at its booth. The final written report will be delivered to each of the stakeholders.

In order to prepare students for this portion of the study, John McKinney (science) and Ann Clark (language arts) have been working with students on the techniques involved in writing a scientific study (no creative writing here!). Students have been careful to document their sources during their research so that proper credit can be given in their final report. They have been instructed on how to read a scientific article – using various techniques to decipher complex scientific language – and in how to construct a piece of technical, scientific writing. In geography and history, Deb Fox-Gliessman is training students to use ESRI’s GIS to develop map illustrations with hotlinks to field study photos and Excel to create tables, charts and graphs. These products will be available for both the printed report and the PowerPoint presentations.



Above: Students quickly observe that oak and other shrubs had been growing during the summer of 2004, resulting in plants that were over 1 meter high.



Above: This tree, now cut in pieces, has been determined to be the cause of the fire when in high winds it fell on the power lines at right.

Outcomes and Conclusion

Academic Learning - Technology Learning - Application to Real-Life Situations

The students participating in the fire study recognized that, even though school usually emphasizes compartmentalized learning, real-life is interdisciplinary. The academic learning that is accomplished in doing a study such as this is extraordinary because connections are made between multiple disciplines. Students learned at a much higher cognitive level. The integration of spatial technologies, such as GIS and GPS used in this study, proved to be a relevant addition to an interdisciplinary unit of study. Using GIS allowed students to discover linkages between spatial information such as elevation and land use in a way that would not have been possible with paper maps.

Students have been enthusiastic about the fire study, and have had a very real sense of ownership. They realized that they were the first people to be allowed on the land after the fire, and that there were no plans to bring anyone else on the land after the students had completed their study. Consequently, they took the study quite seriously and treated the environment with care. Additionally, they recognized the real-life applications of the technologies used in their work. It simulated what students will experience when they enter the workforce in four to eight years where technology is integrated into everyday activities.



Firefighters met with students at the burn area to demonstrate and discuss firefighting techniques related to wildfires and specifically the Cherokee Ranch fire.

Connections to Community

In addition to creating learning opportunities for students academically and technologically, this study provided interested stakeholders with information and analysis related to the Cherokee Ranch fire. The work was real and useful and had not been conducted by any of the affected stakeholders. The results will assist these groups in planning for the future of the burn area, protecting it from further negative impacts from the fire (such as erosion), and from future wildfire threats. While this study itself has proved to be a service to the community, it has also afforded the students a unique opportunity to interact with various members of their own community – firefighters, land- and home-owners, business and government representatives – who were either involved in the suppression of the fire or impacted by it in other ways. It encourages students to connect with and become actively involved in their own community.

Professional Growth and Development for Teachers

As teachers, we continually search for ways to improve the learning opportunities for our students and improve our own abilities. This study stretches each of us, not just in our own content areas, but in our interdisciplinary and pedagogical skills as well. We continually reflect on: the progress and direction of the study, the opportunities for learning for our students, and their progress toward success in both academic and technology learning.

Our reflections have caused us to revise and refine various aspects of the project and even to redesign

student activities to provide further opportunities for learning and growth and to tailor activities to meet individual student needs.

As a result of this project we are growing as individual teachers and as a team. We are improving our ability to integrate our content areas, technology, and real-life situations to provide our students with meaningful, authentic learning experiences.

Acknowledgment

This project came about because of a unique team of teachers who trusted each other so much that they were willing to support each other in the development and implementation of new learning “adventures” like this one. We therefore thank Ann Clark, Kathy Granas, and John McKinney. The firefighters who were directly involved in suppressing the Cherokee Ranch fire were accessible and provided a great deal of information used in the study. They spent time with the students and directly supported our fieldwork and research phases. Various people in the administration of the Douglas County School District helped us to overcome obstacles related to logistics and liability issues and, as a result, made the field study possible. Specifically, we have enjoyed the support of our assistant principals, Dr. Susan Hansen and Mr. Gary Halstead. Many community leaders from Shea Homes, Denver Parks and Recreation, and the Cherokee Ranch organization provided information and support and have shown keen interest in our study and findings.

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