Chapter XIX
Engagement in Science and New Media Literacy

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ABSTRACT

This chapter introduces an inquiry designed to foster learner engagement in science and literacy in using new media. The design included an online, problem-based, science inquiry that investigated environmental pollution at the Lehigh Gap, a U.S. Superfund Site. During five weeks of classroom sessions, several sessions were enhanced by remote access to an electron microscope to analyze Lehigh Gap samples. This access allowed the students to capture images from the microscope, known as micrographs, and furthermore, allowed them to perform an elemental analysis of samples from the polluted area. Additionally, an introduction to nanoscale science and nanotechnology used for remediation of heavy metal contamination was explored. Students contributed the artifacts they generated during their research to a university database and presented them to researchers at the university working on similar problems. This approach proved highly engaging and generated design guidelines useful to others interested in student engagement, introducing nanotechnology, and using remote electron microscopy in middle school science.

INTRODUCTION

From 1898 to 1980, a zinc smelting plant near the town of Palmerton, PA, emitted sulfur dioxide at rates of up to 3,600 pounds per hour, killing plant life and animal habitats. In 1983, thirteen years after the United States Environmental Protection Agency (EPA) was formed, the Palmerton area was designated to the national priorities list of U.S. Superfund sites, a title reserved for known toxic waste sites. Now known nationally as the Palmerton Superfund Site and locally as the Lehigh Gap, the clean up of this toxic waste site, which includes a portion of the otherwise scenic Appalachian Trail, has been contentious and slow. This chapter describes a three-year, research program that engaged sixth-grade students in the authentic, environmental and health concerns resulting

from the 83 years of zinc smelting activities at the Palmerton Superfund Site. Students chose soil and plant samples from the Site and were provided with the opportunity to remotely operate a scanning electron microscope from their sixth grade classroom. The students researched current EPA solutions to remediate the polluted Site, which includes various attempts at re-vegetation, and further studied a new, university-based technique that includes using iron nanoparticles to neutralize heavy metal toxins in other polluted areas. What happens when middle school students and university faculty join forces to try and solve a community, environmental problem using the latest techniques in scanning electron microscopy and nanotechnology? The answer is real time, engaging, learning takes place for both parties involved.

Intended to engage students in a meaningful problem, this method used an online, science inquiry that investigated the Lehigh Gap, Palmerton Superfund Site during five weeks of collaborative classroom sessions. The inquiry prototype was authored in *WISE*, the Web-Based Science Inquiry Environment headquartered at UC, Berkeley. Online materials, readings, and class sessions were augmented with the remote access to an electron microscope to analyze Lehigh Gap samples. An introduction to nanoscale science and nanotechnology through the *ImagiNations* Web site at Lehigh University was also used. Students contributed the artifacts they generated during their research to a university database and presented them to researchers at the university working on a similar problem. This approach proved highly engaging and generated design and development guidelines useful to others interested in designing for student engagement and introducing nanoscale science and electron microscopy in middle school science (Harmer, 2008).

This study further found that students' engaged in science inquiry both behaviorally and emotionally and on several different levels. The various levels appeared to create two hierarchies of engagement, one based on behavioral criteria and the other based on emotional criteria (*in review*). For students involved in the collaborative, problem-solving science, which included experts and access to their microscopes, the highest levels of engagement seemed to empower students and create in them a passion towards learning. These evolving hierarchies are illustrated with students' direct quotes, which prove how students engaged in this particular design of inquiry. Students' engagement in the inquiry led to their achievements in understanding nanoscale science, nanotechnology, and electron microscopy and initiated positive attitude changes towards learning. It was found that five factors most prominently contributed to the students' engagement; cutting-edge technology, creative freedom, collaboration with scientists working on the same problem, contribution to the problem solution, and communication of the students' results outside of the classroom.

WHAT IS MISSING IN MIDDLE SCHOOL SCIENCE?

Today, eighth grade achievement standards in science and math provide evidence to support students' claim that they are bored in school (NAS, 2006; NCES 2003). For example, the most recent Program for International Student Assessment (PISA) study completed in 2003, indicated U.S. students' scores were below the Organization of Economic Cooperation and Development (OECD) average for science literacy and problem-solving internationally (NCES, 2003). In fourth grade U.S. students' science scale scores (536) ranked 6th in the world, only 29 points behind Singapore's first place (565) (NCES, 2003). However, by the time these same U.S. students reached 8th grade, their science scale scores (527) decreased 44-51 points below the world leaders, Singapore (578) and Chinese Taipei (571), dropping the U.S. rank in science to ninth place (NCES, 2003). By 12th grade, the average math and science achievement