

Chapter 62

Earth System Science in Three Dimensions: Perspectives of Students and Teachers on NASA's Project 3D-VIEW

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ABSTRACT

NASA-Sponsored Project 3D-VIEW [Virtual Interactive Environmental Worlds] is a lower middle school curriculum aimed at using 3D stereo technologies to enhance students' understanding of science concepts. In Project 3D-VIEW, ten to twelve-year-old students use 3D stereo technologies, including stereophotographs, 3D-animations, 3D illustrations, and 3D interactive tools, to visualize concepts such as plate tectonics, the composition of the atmosphere, biological succession, and erosion. This mixed methods case study provides an overview of the project's successful use of 3D technologies, as evidenced by student test scores as well as a qualitative analysis of student focus groups and interviews with teachers and administrators. The findings indicate that using 3D technologies within a context of standards and research-based curriculum design can improve student engagement as well as performance on standardized tests.

ORGANIZATION BACKGROUND

U.S. Satellite Laboratory, ("U.S. Satellite") founded in 1991, is a small business dedicated to improving instruction and student achievement

in the Science, Technology, Engineering, and Mathematics (STEM) disciplines. The company has partnered with myriad organizations, both in the United States and internationally, and works under several government-funded cooperative

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agreements from agencies including the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the National Oceanic and Atmospheric Administration (NOAA). U.S. Satellite's work in the K-12 arena is divided into two major areas: STEM professional development for teachers and standards-based STEM curriculum. Staff includes trained scientists, engineers, and educators.

In the professional development "side of the house," U.S. Satellite educators design instructional experiences for teachers based upon best practices for teacher learning and application to the classroom. Professional development for a number of STEM-based classroom projects takes place both online and onsite. U.S. Satellite's online professional development utilizes a proprietary model of blended synchronous (live, in real-time) and asynchronous (self-paced) instruction. In-service and pre-service teachers engage in graduate level courses developed around US Satellite designed curriculum products as well as other STEM content and pedagogy-based topics. Most recently, U.S. Satellite designed and delivers NASA's Endeavor Science Teaching Certificate Project (NASA Endeavor, 2012).

The curriculum products use research-based instructional design and pedagogical strategies to develop students' content and process skills in the STEM disciplines. U.S. Satellite strives to bring authentic data into the classroom in order to enhance instruction and STEM practices. Data sets include weather (e.g., satellite imagery, maps), animal location tracking maps, vegetation satellite imagery, topographic maps, climactic maps, and sea surface images. All U.S. Satellite curriculum products employ technological tools for teaching and learning, including proprietary mapping systems for visualizing data, animations for illustrating science and mathematics concepts, interactive data applets, and "cyberlabs" for collecting and analyzing scientific observations. In 2011, U.S. Satellite launched a textbook and curriculum program entitled *Marine Science:*

The Dynamic Ocean, the nation's first, integrated STEM-focused marine science course designed for high schools.

Project 3D-VIEW [Virtual Interactive Environmental Worlds] was developed under a five-year cooperative agreement with NASA. The goal was to develop a curriculum program for learners using 3D stereoscopy, a technique by which offset two-dimensional images are perceived by the eye and combined in the brain to create the illusion of depth. Instructionally, "3D-VIEW" sought to increase student understanding of earth system science through the use of inquiry-based learning, NASA mission data, and 3D technological tools. Nearly 1,000 teachers from all 50 United States and Puerto Rico engaged in onsite or synchronous, online professional development to become proficient in the use of the technology tools, to understand the instructional design, and to improve Pedagogical Content Knowledge (PCK) in earth system science.

SETTING THE STAGE

In 3D-VIEW, students wear 3D glasses to view 3D stereo images, animations, and interactive tools as they explore Earth's spheres: Air (atmosphere), Life (biosphere), Water (hydrosphere), and Land (lithosphere), before examining the interaction of these spheres in the capstone Earth Systems unit. Earth, life and physical science concepts are weaved throughout the units, which take five to eight weeks each to implement, and are authentically integrated based on unit themes (e.g., earth is renewed and destroyed, the power of water). Traditional science curricula focus on rote memorization of isolated facts or cookbook lab activities, with which students have no personal connections (Lunetta, 1998). In 3D-VIEW students learn science concepts in thematic ways, helping them to build a unified conceptual understanding of increasingly sophisticated content. Research supports both achievement and affective gains for

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