Chapter 28
Using Authentic Earth Data in the K–12 Classroom

Meghan E. Marrero
Mercy College, USA

Amanda M. Gunning
Mercy College, USA

Karen Woodruff
U.S. Satellite Laboratory, USA

ABSTRACT

Our planet is under intense observation—by satellites, seismometers, buoys, radar, and more. These instruments generate authentic data sets that are freely accessible online, and thus available for K-12 students and teachers to use in STEM classrooms. This chapter examines how teachers engaged in the NASA Endeavor program, a STEM teacher professional development initiative, use authentic online data in their classrooms and the effects of these activities on teaching and learning. Endeavor teachers use data in many ways, including through curriculum programs developed to scaffold earth data sets for use by students. Through qualitative analysis of teacher interviews, teacher course work, student work, and other relevant data, the researchers discovered that employing authentic online data in Endeavor teachers' classrooms helped students to construct explanations based on evidence and make real world connections to science content.

INTRODUCTION

Authentic data integrated into K-12 instruction, provides meaningful, engaging, and long-lasting connections for students. The myriad data available through scientific research addresses current research-based standards and best practices in education and it is publicly available to educators (all citizens) as a valuable teaching tool. As you read this, nearly every earth environment is being monitored. Satellites are observing changes in vegetation; monitoring the albedo of land, sea, and ice; and following the paths of caribou, eagles, sea turtles, and whales. Buoys atop the sea's surface measure atmospheric and oceanic

parameters including air and water temperature, wind speed, and changes in water column heights that might indicate a tsunami. On the ocean floor, seismographs detect nearly imperceptible tremors, and hydrophones listen for sonar waves and whale songs.

Today's technological innovations mean that these and many other examples of earth observations become robust data sets, which can be used in K-12 classrooms. Many of the data collected by these and other instruments are accessible through online portals, making them available for teaching and learning. Students are able to look for patterns in earthquake and volcano data to learn about plate tectonics, or watch how chlorophyll in the ocean varies with the seasons as they study photosynthesis and food webs.

The teachers featured in the following chapter demonstrate successful integration of authentic data with varied student groups and share evidence of students constructing explanations and making real-world connections through data analysis activities. Findings suggest that with sustained, quality professional development the use of authentic data can reach more classrooms and achieve notable results with student understanding of STEM topics.

BACKGROUND

The Science and Engineering Practices of the Next Generation Science Standards (NGSS) underscore the importance of helping students to think scientifically, such as through the practice *Analyzing and Interpreting Data* (NGSS Lead States, 2013). When students use practices such as data analysis, they often demonstrate deeper understanding of concepts, more motivation and engagement, and higher grades in science (Minner, Levy, & Century, 2010) Technological tools that include opportunity for visualizing data can help students to make connections between their local communities and global issues (Marrero & Schuster, 2010).

In this chapter, we describe three K-12 programs in which students successfully analyze and interpret earth data as they learn standards-based science content, and examine the perspectives of teachers and students using the programs. These programs are now all courses within the NASA Endeavor program, in which teachers from across the United States and from around the world complete a course sequence in STEM education (www.us-satellite.net/endeavor). We then describe a case study in which we examined examples of the ways in which these data are affecting teaching and learning. Finally, we share some examples of ways in which teachers can use freely available sources of earth data with their own students.

While our discussion focuses primarily on Earth System Science, we hope that the ideas will challenge and encourage pre- and in-service teachers to use the myriad sources of authentic data that can be easily accessed online, and incorporate these data as an effective tool for science instruction.

Authentic Data in the Classroom

In science classrooms, we encourage students to collect data as much as possible. Students as young as preschool observe each day's weather, creating a calendar of suns and clouds that illustrates their monthly data. Elementary school students grow and observe plants and the life cycle of animals such as butterflies and chicks, take data on simple machines or observations of phase changes. In middle and high school, our students conduct experiments in which they collect varied data during each laboratory or hands-on experiment. They might measure temperature changes to compare the specific heat of different liquids;

Related Content

Whatever Be Their Number: Counting on the Visible, the Audible, and the Tangible
Nathalie Sinclairand David Pimm (2015). *Integrating Touch-Enabled and Mobile Devices into Contemporary Mathematics Education (pp. 49-78).*
www.irma-international.org/chapter/whatever-be-their-number/133314

Analyzing the Role of Popular Scientific Journalism in STEM and Turkey's Science Communication Model
Hasan Gürkanand Carmen Soler Echazarreta (2023). *STEM Education Approaches and Challenges in the MENA Region (pp. 168-188).*
www.irma-international.org/chapter/analyzing-the-role-of-popular-scientific-journalism-in-stem-and-turkeys-science-communication-model/327909

Motivating Inquiry-Based Learning Through a Combination of Physical and Virtual Computer-Based Laboratory Experiments in High School Science
Niwat Srisawasdi (2018). *K-12 STEM Education: Breakthroughs in Research and Practice (pp. 704-730).*
www.irma-international.org/chapter/motivating-inquiry-based-learning-through-a-combination-of-physical-and-virtual-computer-based-laboratory-experiments-in-high-school-science/190127

Roles of Technology in the Science Classroom: Meta-Analysis, Example Vignettes, and Guidance for Teacher Practitioners and Educators
Andria C. Schwortz, Barbara Hickman, Andrea C. Burrows Borowczak, Daniel A. Daleand Adam D. Myers (2023). *Theoretical and Practical Teaching Strategies for K-12 Science Education in the Digital Age (pp. 208-237).*
www.irma-international.org/chapter/roles-of-technology-in-the-science-classroom/317356

Using Vicarious Experiences to Artificially Create the "Sweet Spot": Modeling Pedagogy and Technology Integration
Jeremy Unruh, Michelle Gilesand Jana Willis (2023). *Theoretical and Practical Teaching Strategies for K-12 Science Education in the Digital Age (pp. 238-249).*
www.irma-international.org/chapter/using-vicarious-experiences-to-artificially-create-the-sweet-spot/317357