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Enhancing Ocean Literacy Using Real-Time Data

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OCEAN LITERACY is the understanding of our relationship with the ocean and the crucial services that the ocean provides to society and other living organisms (Cava et al., 2005). In 2004, a number of ocean science and educational communities adopted seven essential ocean literacy principles[1] (Cava et al., 2005). These principles were further broken down into concepts, which were designed to teach science standards using an ocean orientation. Most state science standards do not specifically address these ocean principles but they have been categorized according to the National Science Educational Standards by discipline and overlap with the other traditional science disciplines. Hoffman and Barstow (2007) noted that no state addresses more than 20 of the 35 fundamental ocean concepts. Ten of the 35 concepts that were more biology focused were not included in their study. They also noted that more research needs to be conducted to evaluate whether students learn core science concepts and process skills using ocean literacy as the primary curriculum.

Real-time data (data that have been collected and disseminated within hours to weeks) can bring ocean science into classrooms that may be far removed from the coast, and their use can improve ocean literacy. Although these data have long been a valuable tool for ocean researchers, education applications have been much more recent as the Internet has been integrated into the classroom. However, to date, not much attention has been paid to classroom research on learning as a result of this integration (Windschitl, 1998). Edelson and Gordin (1998) and Hotaling (2005) found that access to real-time data in the classroom provides authenticity and an investment in concepts being explored that neither textbooks nor historical data bring. Hotaling (2005) also found that using real-time data engages students and gets them to use technology and information in the same manner that researchers do: students analyze real data, formulate and test hypotheses, and refine their ideas after collecting information.

Most educators recognize the potential of using both real data and real-time data to help engage students. Parsons (Wordcraft, 2006) surveyed the current usage of real-time environmental data in K–12 classrooms and found that the most cited reason for using real-time data was that these data make what happens in the classroom relevant to students' lives. Barstow et al. (2002) suggested that if educators want to reach today's technologically capable students, they must use "revolutionary" Earth system science concepts when teaching Earth science. These concepts emphasize inquiry-based learning involving computer visualizations based on real-world data, all while making sure that students understand that Earth is a system. Many states have adopted some of these concepts; however, most have not wholly embraced the active

[1] (1) Earth has one big ocean with many features. (2) The ocean and life in the ocean shape the features of the earth. (3) The ocean is a major influence on weather and climate. (4) The ocean makes the earth habitable. (5) The ocean supports a great diversity of life and ecosystems. (6) The ocean and humans are inextricably interconnected. (7) The ocean is largely unexplored.

use of visualizations and real-time data (Stevermer et al., 2007).

The National Council of Teachers of Mathematics, the American Association for the Advancement of Science, and the National Science Education Standards advocate science and activities that use real-time data as a powerful "avenue through which students can increase their science and mathematics literacy" (Eisenhower Regional Consortia, 1995).

In an effort to see if real-time data can teach ocean literacy effectively, we piloted a preliminary form of the hands-on oceanography activity published in the March 2007 issue of *Oceanography* (Adams and Matsumoto, 2007) in an undergraduate ecology lab at Georgia Institute of Technology. This inquiry-based activity addressed three of the seven ocean literacy principles and enabled students to investigate coastal processes, make predictions, and learn about nutrient loading and its effects on estuarine ecosystems. This hands-on oceanography activity was conducted independent of the lecture component of the course and was led by teaching assistants. The teaching assistants were instructed to give a very brief and general introduction to the activity, allowing the activity to be inquiry driven. Students were allowed and encouraged to work in pairs. Each pair shared a computer terminal and had access to color printers. Students were asked to predict how salinity, temperature, and nitrate levels would vary depending upon the tidal cycle after first reviewing the Monterey Bay Aquarium Research Institute's Land Ocean Biogeochemical Observatory (LOBO) Web site (http://www.mbari.org/lobo), which included relevant maps of the watershed and a link to a local newspaper article describing the project. LOBO offers a user-friendly option that graphs the variables selected by dates, and allows students to easily look for relationships between the selected variables. Real-time data from the LOBO observatories were used to test their predictions and monitor nitrate input into the slough. Students were asked to modify their predictions as necessary, and they consulted climate data to explain certain trends, which often led to rich, cross-disciplinary connections with basic geography concepts.

We found that use of real-time data enabled students to discover the vulnerability of the estuary's physical and chemical balance and to survey the effects of terrestrial agricultural practices on this system. These data engaged students by allowing them to ask relevant questions about important scientific concepts and issues. The tasks also led to an appreciation of the important role that technology plays in science. Our classroom trial demonstrated that ocean literacy awareness in students can be improved by using real-time data and that, through these types of activities, students can experience the ocean in classrooms all over the country.

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REFERENCES

Adams, L.G., and G.I. Matsumoto. 2007. Investigating coastal processes and nitrate levels in the Elkhorn Slough using real-time data. *Oceanography* 20(1):200–204. Available online at: http://www.tos.org/oceanography/issues/issue_archive/20_1.html (accessed April 20, 2009).

Barstow, D., E. Geary, and H. Yazijian, eds. 2002. *Blueprint for Change: Report from the National Conference on the Revolution in Earth and Space Science Education*, Snowmass, CO, June 21–24, 2001, 100 pp. Available online at: http://www.earthscienceedrevolution.org/acknowledge/acknowledge01.cfm (accessed April 7, 2009).

Cava, F., S. Schoedinger, C. Strang, and P. Tuddenham. 2005. *Science Content and Standards for Ocean Literacy: An Ocean Literacy Update*. Available online at: http://www.coexploration.org/oceanliteracy/documents/OLit2004_Final_000.pdf (accessed April 7, 2009).

Edelson, D.C., and D. Gordin. 1998. Visualization for learners: A framework for adapting scientists' tools. *Computers and Geosciences* 24(7):607–616.

Eisenhower Regional Consortia for Mathematics and Science Education: Eisenhower National Clearinghouse (ENC): U.S. Department of Education (DED), Office of Educational Research and Improvement. 1995. Promising Practices in Mathematics and Science Education 1995: A collection of promising educational programs and practices from the Eisenhower Mathematics and Science Regional Consortia. Reform in Math and Science Education, Eisenhower National Clearinghouse, US Department of Education.

Hoffman, M., and D. Barstow, 2007. *Revolutionizing Earth System Science for the 21st Century: Report and Recommendations from a 50-State Analysis of Earth Science Education Standards*. National Oceanic and Atmospheric Administration, Washington, DC, 59 pp.

Hotaling, L. 2005. The Gulf Stream voyage: Using real time data in the classroom. *Marine Technology Society Journal* 39(4):90–95.

Stevermer, A., E. Geary, M. Hoffman, and D. Barstow. 2007. A Status Report on K–12 Earth and Space Science Education in the United States, 2006. UCAR, Boulder, CO, 48 pp.

Windschitl, M. 1998. The WWW and classroom research: What path should we take? *Educational Researcher* 27(1):28–33.

Word Craft. 2006. SWMP/IOOS Real-Time Data in K-12 Classrooms: A Front-end Evaluation. Report. Rutgers Institute of Marine & Coastal Sciences and Jacques Cousteau National Estuarine Research Reserve, New Brunswick, NJ. Available online at: marine.rutgers.edu/outreach/rtd/files/rtd_exec_sum.pdf (accessed April 20, 2009).