2.11 OCEANWORLD: BRINGING THE OCEAN TO THE CLASSROOM

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1. INTRODUCTION

Geoscientists are frequently asked to help improve the teaching of earth sciences; and we respond enthusiastically (e.g. Showstack, 1999). We visit classrooms, especially if we have children in school; we add educational pages to our web sites; and we conduct workshops for teachers. Yet these responses leave us wondering: Have we done enough? Is our approach effective?

Perhaps the most important question is: How do we reach the roughly 50,000,000 elementary, middle- and high- school students in the United States and their 3,000,000 math and science teachers? How do we tell all of them about the oceans, especially the important physical processes? How do we build on their interest in El Niño, global warming, and coral bleaching? How can they find out more about these topics? Can teachers bring these ideas into the classroom and still meet national and state standards?

2. AN APPROACH TO THE PROBLEM

Our initial response was, build a good web site. After all, many classrooms have internet access; and, through the web, we can bring the wonders of oceanography to many students and teachers. But Snyder (1994) points out that any time we inject an innovation into a school without taking into account the complex social nature of that institution, that innovation will fail. Hence, we ask: Are web sites effective? How do teachers get new information? Are they using the new materials? Where do they get the new material they do use?

Based on a survey of earth-science teachers in Texas, we found (among many other results): teachers wanted both student-centered material (92%) and teacher-centered material (84%) from dependable web sites (84%). Furthermore, Teachers reported that 32% of students in their schools used the web less than 20 minutes a week, while 30% used it 20 to 60 minutes a week (Hammer, Stewart, and James, 2000).

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Based on this and other information, we decided that web sites are efficient means for reaching students and teachers. We then developed Oceanworld, a web site primarily for middle- and high- school students and teachers.

3. OCEANWORLD

Oceanworld includes: 1) Pages for students that provide an introduction to oceanic topics in simple terms. 2) Pages for teachers with curricula materials and information on how the topics are tied to national and Texas standards together with information about videos and texts for use in the classroom, and a tutorial on how to use web-based instruction. 3) Pages used to teach undergraduate and graduate courses in oceanography. 4) Links to useful additional material. And, 5) interesting news.

The pages were written by teachers who have returned to college to earn advanced degrees in education; and the site is built and maintained by undergraduate students. The work is directed by professors of education and oceanography.

3.1 Student Pages

The student pages provide a brief introduction to coral reefs, currents, El Niño, fisheries, ice ages, the Jason-1 satellite system, satellites and ocean exploration, waves, and the role of the ocean in weather and climate.

Each section begins with a quotation about the ocean from a famous book or poem followed by a well known picture or painting showing an oceanic scene. This ties science to the humanities and other schoolwork. Next come a few pages which introduce the main ideas for each theme. At the end of each section we list some critical questions that get students thinking about the topic. Students can also test their understanding by completing a self-grading quiz. At the end of the section, we provide links to other sites for students.

Let's look at the pages describing currents, beginning at http://oceanworld.tamu.edu/students/currents/currentsintro.htm. There you will see Winslow Homer's painting "The Gulf Stream" followed by a quote from Thor Heyerdahl's book *Kon-Tiki*. Going forward, students read about how winds drive currents, Ekman currents, the Coriolis force, and gyres and eddies in the ocean. At the end we ask:

How do we currently measure currents?

1. drift bottles
2. satellites
3. current meters
4. all of the above

plus 14 other questions to help students find out how much of they understand about currents. Finally, we point them to award-winning Victor The Vector web site to learn more about vectors at the middle-school level. Victor's site is especially useful because it is based on ocean currents.

3.2 Teacher Pages

Teacher pages include information on 1) using technology lab stations to teach ocean science; 2) background material about the oceans; 3) classroom modules written by an NSF Presidential Awardee for Excellence in Teaching Science; 4) ties to national and Texas science education standards; and 5) other resources for teachers including supplemental texts for use in the classroom, videos, CD-ROMs, and links to web sites for teachers.

We realized that many schools have few computers in the classroom, so we included detailed information on how to teach web-based material in this setting. The Ideas and techniques were tested in the classroom.

3.3 Four Star Sites

Many agencies have developed wonderful sites for teaching about the earth. Rather than duplicating their work, we have provided links to the sites. They include such sites as the Learning Web, Whale Net, Athena, Bill Nye the Science Guy, and others.

3.4 Ask Dr. Bob

Teachers and students often have questions about the oceans. How can they get expert help? Just Ask Dr. Bob. We receive around five questions a day from students and teachers and people who just happened across the site. Some questions can now be answered easily based on earlier questions, others stump even Dr. Bob and he must turn to colleagues for help. We give prompt replies. And the replies are appreciated. Too many sites never respond, and teachers are thrilled when they get a quick reply.

3.5 Real-Time Data

Students and teachers often need to know what is happening now in the oceans. Our real-time data pages have annotated links showing a typical plot from the real-time site and a brief description of types of data offered by the site.

3.6 College Level Pages

To provide more advanced information, we have included an online textbook *Introduction to Physical Oceanography* in html and pdf formats, together with complete information on advanced undergraduate and graduate courses in oceanography and physical oceanography taught at Texas A&M University.

The courses include: 1) Introduction to Oceanography at the undergraduate level, 2) Introduction to Physical Oceanography at the undergraduate graduate level, and 3) Physical Oceanography at the graduate level. The material is sufficiently complete that it serves as the basis for distance education courses.

The class material includes syllabus, goals, lecture material, links to other material on the web, homework, and quizzes. The latest course has complete audio files of all lectures in MP3 format—each one hour lecture is roughly nine megabytes. Parts of the course material are used by professors at other universities to teach their courses. By sharing course material, courses are improved, good material can become widely used, and teaching can become more efficient.

The textbook is widely used to teach physical oceanography at other colleges and universities. Publishing the book on the web has two big advantages: 1) It can easily be updated to include new material. This is especially helpful in a rapidly developing field such as oceanography and the role of the ocean in climate and weather. 2) The cost of the 340 page book book is kept low, around $25. A commercially published book would cost 2-3 times more. The book is typeset and has high quality figures.

3.7 Assessment

Having built a web site for teachers and students, how do we know it is useful? We have built in various assessments: 1) We have used an advisory team of classroom teachers to provide advice in the early stages of the development of the site. 2) We have built feedback forms into the site so visitors can easily provide us with useful, non-personal information. 3) We keep statistical information of the number of visitors each month, the pages most frequently visited, and the class of URL (e.g. .gov, .edu, .net). 4) The development of the site was the subject of a Ph.D. thesis in education. 5) We have taught workshops on using material in the site and then followed up to learn how the participants in the workshop used the material in their classroom.

3.8 Privacy and Accessibility

We have a privacy statement. Essentially, we collect no personal information unless a reader sends us an e-mail requesting more information. We use the address only for a reply.

The site is accessible to the handicapped. We have a text-only site, we do not use frames, and it is Bobby compliant—Bobby is a web site that tests sites for compliance with new federal regulations requiring web sites developed with federal funding be accessible to those with disabilities.

3.8 Publicity

A web site is more useful if it is easily found and widely used. We have worked hard to make sure it is listed with major search engines. Plus, we have made

presentations to teacher conferences so teachers learn of the site. More importantly, the URL and name have remained unchanged for four years. We find that word of mouth is effective, and this takes time. Teacher must come to trust that the site will be available year after year, and that the material they need will be there when they need it.

4. Other Thoughts

We believe that research universities must involve undergraduates in research. Our web site was built by students. Perhaps a dozen have contributed. All learned about the oceans. Some have gone on to use the site after they became teachers. Others learned about research, how a projects such as Oceanworld are organized, and what makes effective web sites.

We started with clear guides from the Yake University on-line Web Style Guide, and information in *Visual Explanations* (Tufte, 1997). We used the talents of students from the School of Architecture's Visualization Lab, and we have learned as we went. I hope we have succeeded in building an interesting site.

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