2.8 PROJECT OCEANOGRAPHY: ENHANCING MIDDLE SCHOOL SCIENCE EDUCATION NATIONWIDE VIA INSTRUCTIONAL TELEVISION

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1. INTRODUCTION

Science education in this country is in the midst of a major reform initiative in which Ocean Scientists have just begun to participate. In response to poor performance on standardized tests in Math and Science, new national science content standards have been written by the National Research Council (NRC) and the American Association for the Advancement of Science (AAAS). Scientists and educators participated in the process of designing these standards, and both groups must also participate in their implementation.

The mission of Project Oceanography is to broadcast affordable, age-appropriate educational programming to middle school students, incorporating current topics in marine science to teach basic concepts and promote active learning, thereby enhancing the traditional classroom experience. Since 1996, this university-based program has been distributing TV broadcasts to classrooms across the nation via satellite and cable television broadcast networks.

Project Oceanography hosts are research scientists, so the challenge of Project Oceanography has been to match the teaching style of the researcher and professor to the attention span of the middle school student, while maintaining alignment with state and national science standards. We have been perfecting our format for instructional television for five years to meet this delicate balance in effective communication between generations while maintaining cost-effectiveness and instructional quality of the program. This paper describes what we have accomplished and attempts to evaluate the success of our efforts.

2. DISTANCE LEARNING FOR MIDDLE SCHOOL STUDENTS

The distance learning style commonly used in the university setting has been called “candid classroom”, in which a professor teaches her lesson in a traditional lecture style facing cameras broadcasting to remote classrooms in multiple locations. Enhancements beyond the traditional blackboard and overhead projector often include document cameras, video playback, computer-assisted presentation software, and real-time voice or video connectivity with remote sites. The objective of most distance learning classes at the university level is enabling cost-effective off-site education of students sufficiently motivated to pursue advanced degrees.

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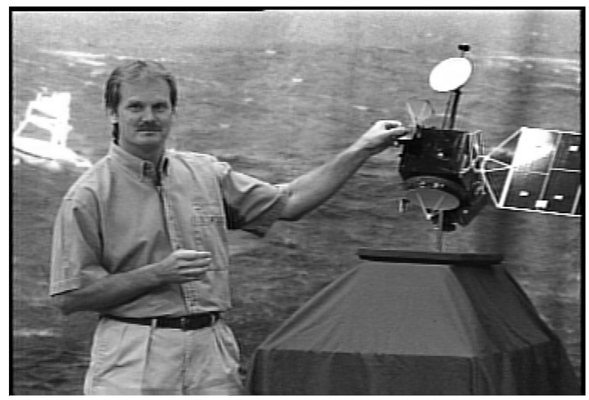
The typical middle school student audience requires a different approach, primarily consisting of production enhancements which keep the program fast-paced and interesting. Lessons are not learned unless students are actively engaged.

2.1 Hands-on access to tools scientists use

In Project Oceanography, the candid classroom is transformed into a teaching laboratory containing the tools used by the science host in her research. Live animals are a favorite with students, but not often the subject of study in the physical sciences. However, there are many other props that capture the students’ attention. Real life scientific instruments, a scale model of the TOPEX POSEIDON spacecraft, silicon wafers viewed under a video microscope, Acoustic Doppler current meters, and an autonomous underwater vehicle are but a few examples of items we have carted into our studio over the years. Simple explanation and demonstration of basic operating principles of instruments provide rare lessons which meet science standards in technology.



Dr. Gary Mitchum explains the design and operation of the TOPEX POSEIDON spacecraft during Project Oceanography’s *Satellite Oceanography,* broadcast during Fall 1998. (Special thanks to JPL for loan of the satellite model.)

2.2 Real World Relevance

Project Oceanography broadcasts have covered topics in Physical Oceanography and Air-Sea Interaction including: Ocean in Motion, Satellite Oceanography (Altimetry), Ocean Color, In Water Sensors, Sounds of the Sea (Acoustics), Microsystems Technology, Hydrodynamics, Hurricanes, and Tsunami. Many other lessons are interdisciplinary, incorporatin g elements of physical science into life science. Features of the physical environment of the oceans, cold, deep and dark, also relevant to biology, are more easily explained than are the physical properties of seawater and how they influence ocean circulation. Nevertheless, at the time of the ***Ocean in Motion*** series, the world was experiencing an El Nino. The term became a household word, was a regular feature of weather reports, and even a topic of late night talk shows. Students were highly motivated to learn about the

Engineer Larry Langbrake illustrates the principles of pressure and incompressibility of water to a student volunteer during Project Oceanography's *In Water Sensors* , broadcast in Spring 1999.

underlying causes and about our ability to predict future occurrences of this phenomenon.

Likewise, the transmission of sound is not a concept most students (or adults!) can claim to understand. Relate acoustics to marine mammal communication and behavior, however, and students become interested. This was the concept behind a six-part series titled ***Sounds of the Sea*** (Fall 2000), dealing with how marine mammals produce, sense, and react to sound. Basic physics of sound transmission in the ocean and how that differs from sound transmission in air, as well as the specialized anatomy and social behavior of whales and dolphins were included. In a question and answer session following one lesson in this series, a student in the studio audience had grasped the concepts sufficiently to ask the question "Say a humpback whale wanted to communicate with another humpback whale but a dolphin was trying to communicate with a dolphin and the humpback whale was between the two dolphins. If the humpback whale made its sound, and the dolphin made its sound, would they bounce off each other and the other dolphin won't (sic) get it or will both animals get to communicate?" This student clearly was trying very hard to conceptualize underwater sound waves because of the marine mammal implications.

2.3 Lights, camera, ACTION!

Everyone likes to see themselves on television, and a live studio audience is a key element of every Project Oceanography broadcast. Not only does this make a valuable educational field trip, it also provides our hosts with student volunteers to assist in demonstrations and with an unlimited source of questions to answer. This element gets high reviews from the students and teachers. Classroom observations have taught us that lagging attentions in remote classrooms are immediately drawn back to the program whenever a student appears on the TV screen.

If a picture is worth a thousand words, moving pictures are even more valuable. This is an element which students relate to well, but few scientists have video of their research. Ideally, all our programs would be broadcast from shipboard, or other field locations, however this exceeds our budget. We can use pre-produced video segments, and many are available from federal agencies such as NASA and NOAA. In addition to recapturing the audience's attention, video segments serve other important functions. They allow the science host to regroup, receive cues from the producer, and reinforce points the host was trying to convey. Repetition of information using visual or tactile examples is especially valuable for those students who do not learn effectively by listening alone. Animations of physical concepts are hard to find, but those which do exist, such as JPL's 3-D animation of ocean circulation around sea surface topography, convey a message impossible to explain in words alone.

2.4 And now, let's REVIEW…

One last program element was spawned by the practical need to have the science host use best teaching practices known by all good middle school teachers – review key points frequently. Advanced concepts can be explained in simple terms, but only in short segments. We now break the 25 minutes of program content into three segments, with pre-produced reviews one-third and two-thirds of the way through the program. These have energetic music, eye-catching video, and are narrated by a youthful voice. When students are asked to list facts learned during a program they have just watched, many recite the points covered by the review segments.

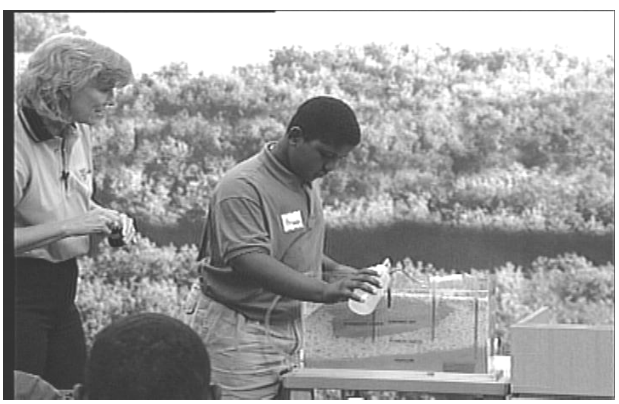
3. MEASURES OF SUCCESS

What constitutes a successful educational outreach program, and how should it be evaluated? We know it is a multi-step process which should include front end, formative, and summative evaluation, as well as evaluation of the long term impact of the project. Evaluations must include products, process, programs, tools and technology (COSSEE Workshop Final Report, 2001). We also know that it is a difficult, timeconsuming, and often expensive task. With Project Oceanography users spread across the country, we have found it difficult just to accurately count the number of users of Project Oceanography. We have tried several methods for evaluating Project Oceanography, some successful and others not.

The COSEE Report (2001) recommended six performance indicators which should be tracked for funded projects. Of these, we can document new collaborations, audience diversity, and increase in number of users. We are also able to evaluate our products, process, and tools using on-site and user surveys.

3.1 By the numbers

One of the easiest metrics to track is the increase in registered sites. Although we cannot count how many students watch each program, we do know that since 1996 we have expanded from 5 participating schools in Pinellas County, FL to 467 registered sites in 42 states, the District of Columbia, and 12 foreign countries. Of these registered sites, 76 are instructional television stations or school districts, which redistribute our broadcasts to multiple school sites within their region. The potential audience size can be estimated using figures for numbers of 6^{th}, 7^{th} and 8^{th} grade students in each registered school district. This type of estimate gives a figure above 2,000,000. This estimate is almost definitely much higher than the number of actual users, but even the school districts have difficulty providing us with accurate numbers of Project Oceanography users.



Dr. Joan Rose guides a student volunteer in demonstration of a ground water percolation model during Project Oceanography's *Neighborhood Water Quality* . broadcast in Fall 2000.

The increase in registered sites has been nearly linear since 1996, with most new sites learning of the program from the web or from attending a conference. However, conferences include meetings of scientists, educators, and educational access providers.

3.2 New collaborations

Another metric that is relatively easy to document is the number of new collaborations and partnerships formed. Project Oceanography is one of the five educational programs funded by the National Ocean Partnership Program (NOPP; Walker et al., 2000), which is itself a partnership of all the federal agencies involved in ocean endeavors of any sort. Grant guidelines stipulated multiple significant partnering relationships.

By the end of our current funding period in April 2002, we anticipate the following total collaborations:

- 28 USF scientists, 44 outside scientists, and 3 school teachers have hosted programs
- 34 partnerships with state agencies, universities, private research laboratories, schools, and museums
- Partnerships with 4 television stations and two production companies to produce 14 on-location broadcasts, 4 of which are scheduled to originate live.

3.3 User diversity

Diversity of our audience is also an assessment metric of interest, especially to our program managers. We have used mail surveys to evaluate student demographics. A total of 42 replies were received from teachers in Fall 2000, of which 17% were new to the program (no prior participation). Average duration of participation in Project Oceanography for all respondents was 1.5 years, and the average number of programs watched during the funding period was 13.5 (20 per year are broadcast). Respondents indicated the following demographics for the 4,653 students represented:

- **Ethnicity:** 66% White, 16% African American, 8% Hispanic, 5% Asian American, 1% Other
- **School Setting:** 50% urban, 26% suburban, 19% rural, 5% all (museums/aquaria)
- **Geographic Setting:** 50% FL, 12% CA, 38% other U.S.
- **Academic Program:** 50% drop-out prevention or special needs programs, 17% home schools, 12% magnet programs, 21% other or unspecified

Registered sites in urban settings outside Florida include DCPS-TV in Washington, DC, Baltimore County Schools, Fairfax, VA schools, and WPBA-TV in Atlanta, GA.

3.4 Products and tools

Our on-site evaluations of products were the most successful summative assessment of the project. In the past five years, Project Oceanography has produced:

- Over 1500 pages of marine science curriculum for use in middle school science classrooms published and distributed free of charge
- 142 half-hour live broadcasts on various topics distributed free via C-band satellite TV
- 71 hours of videotaped programs archived and available on demand on our website at: http://www.marine.usf.edu/pjocean

On-site evaluations included 337 students and their teachers from four schools and six classrooms. The teachers and students seemed pleased with the program and indicated that the materials are both effective and informative. They particularly liked the three-part program format, the reviews, word of the day, any segments containing students including question periods, interactive activities, and segments using music. They felt the variety of graphics, video, and activities kept the show moving and interesting.

Walt Jaap demonstrates advanced underwater communications equipment used in coral reef repair operations during Project Oceanography's *Coral Reefs* series, broadcast in Spring 2000.

Suggestions for improvements included more field shots, more interactive activities, more student volunteers, and more clips using music. In addition they would like to see a student co-host with the scientist.

Teachers thought all materials were age-appropriate, provided flexible curriculum enhancement, increased student enthusiasm for science, and included content not found in textbooks. They rated written materials easy to use, broadly applicable to all students, well-organized, concise, visually appealing, and overall found them to be a valuable teaching resource.

3.5 Impact at remote sites

Responses to mail surveys sent to all sites represent 2200 students from 7 states (CA, DE, FL, MI, SC, TX, WI). Most teachers who responded used Project Oceanography as a stand-alone curriculum, showing an average of 12-15 videos per year. Teachers represented a mixture of middle schools, high schools, home schools, and elementary schools, both public and private. Subject taught was mostly Marine and Environmental Science. Approximately 30% of respondents said they use written materials without the video programs. When asked what other similar programs they used in their classrooms, response was that only a few others were of equal quality: NASA, Scientific American Frontiers, and the JASON Project.

3.6 What didn't work

One metric that remains elusive is a measure of improved learning. This is not due to lack of trying, rather in the difficulty in proper design and time required to conduct such a study. In one attempt, teachers agreed to teach the same content with and without Project Oceanography broadcasts. When they saw the content, it was clear this would not be feasible without extensive training.

We also tried using content assimilation surveys to be completed by students before and after participating in a series of three programs. Difficulties encountered initially were poor reading and writing skills of students (despite meeting grade level readability criteria), and the amount of class time the teacher had to devote to this activity, about half a class period per week. As the students became accustomed to the routine, their creativity superceded their objectivity, and the surveys became useless.

There are undoubtedly more effective methods for obtaining this information, one on the horizon is standardized testing of science knowledge, which will be instituted in many states within the next few years. For our program, we must rely on the teachers firsthand observations that the program is working for her students, hence their continuation in the program year after year.

4. LESSONS LEARNED

Many of the lessons learned in producing effective TV broadcasts also apply to making any public speaking appearance effective, whether its for students in a classroom or your local rotary club. But the lesson doesn't stop with the HOW, it goes beyond to the WHY. To improve your communication skills, to get a fresh view of your own research, and because it's FUN.

4.1 References

Center for Ocean Sciences Education Excellence Workshop Report, 2001: National Sciences Foundation, 69p.

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