

EstuaryLive: Linking Classrooms to the Natural World

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I. Introduction

Estuaries are dynamic yet fragile ecosystems often too sensitive or distant to bring hundreds of thousands of students for a visit. Each year, educators and outreach coordinators from NOAA's National Estuarine Research Reserve (NERRS) and EPA's National Estuary Program (NEP) offer a program called EstuaryLive that allows students to take a live interactive field trip, in their classroom, to these exciting locations via the technology of the Internet.

EstuaryLive is an interactive, field-based education program that brings estuaries to the audience through a combination of satellite and Internet technologies which together generate a 'telepresence' that links classrooms around the world to estuaries in the United States. Benefits include real-time contact with educators, scientists and other students in learning about the estuaries; engaging in research conducted on-site; and learn about the cultural, economic and social issues that impact the estuary. The program showcases our nation's estuaries—the precious ecosystems where fresh water from rivers mixes with salt water from the ocean.

This paper reviews the EstuaryLive process, its conceptualization, technology utilized, case examples,

results, and opportunities for participation. It also discusses the impact of the program as an educational tool, role it can play within the current educational environment on the use of technologies, and the need to increase ocean and coastal literacy. This paper provides an introduction to the program, and also allows the reader to travel through time and learn why and how the National Oceanographic Atmospheric Administration (NOAA) North Carolina Research Reserve first conceptualized the EstuaryLive program.

A. A Unique Educational Model for Linking Classrooms to Estuaries

EstuaryLive has reached hundreds of thousands of students all over the country and even throughout the world. Its special ability to bring together and harness the use of new technologies with on the field-real world experiences makes it quite different from distance learning programs, internet based activities, virtual expeditions or field trips. These programs allow the participants to follow a virtual field trip, focus on a particular theme or subject area, offer real time interactions, and rely on static information. All of these technology oriented programs can complement teaching and learning of a variety of subject areas (see list of virtual expeditions offered by The Bridge

website-<http://www.vims.edu/bridge/index.html>). EstuaryLive fills a very unique niche. It is the only program that educates, year after year, specifically about estuaries and is free of charge. EstuaryLive's focus on estuaries is shaped by expert educators and scientists located in each of the participating NERRS and NEP.

The place-based nature of the NERRS and NEP provides a local relevance not offered by many other programs. For example, the North Carolina Reserve currently offers field trips twice a year, in the fall and spring, and covers a variety of subject areas that respond to teachers' needs, correlated specifically to North Carolina's Standard Course of Study, all of which make it inherently more relevant to teachers and students. The development of this local program, combined with the national EstuaryLive program has, over the years, developed a loyal audience of classrooms from both North Carolina and other parts of the country.

Other two elements that make EstuaryLive unique are (1) the level of interactivity it promotes and (2) its strong science connection. During the broadcasts, participants are encouraged to submit questions that are then answered on camera. Questions include what something feels like, smells like, or even tastes like. While not all questions may be answered during the event, a strong effort is made to include as many questions as possible. As follow-up, broadcast sites respond to remaining questions via e-mail to participating classes. In addition some live sites have planned out different ways to engage their audience. For example, during the 2003 EstuaryLive program, the Jacques Cousteau NERR showed an Autonomous Underwater Vehicle in the field and asked the audience at the beginning of the broadcast to write in and guess how it propelled itself through the water. The Education Coordinator answered the question during the last segment and sent some posters and other items to the school/class that had the closest guess. This interactivity with the audience has proven to be an extremely valuable and distinct feature of the EstuaryLive program.

EstuaryLive incorporates scientific expertise during the broadcasts. Many of the program's themes highlight the types of research being conducted at NERRS and NEP, and the availability of first-hand perspectives from scientists in the field provides participants with accurate, specific responses to their questions.

EstuaryLive is not only an Internet-based field trip, but it is also a comprehensive educational program. The live broadcasts are preceded by classroom preparation using curriculum and online resources developed specifically for the program. Curricula tailored to each field trip and locality, and activities to compare these ecosystems are available on www.estuaries.gov to help teachers prepare their classroom and provide follow-up materials.

Distinct from "virtual field trips" that show static slides and information, EstuaryLive provides streaming content in real-time. Programs are subsequently archived and may be viewed at any time following the broadcast. While the content is carefully scripted for theme, it still allows for the

spontaneity of a real-time theatre. Quality content has been identified as an important factor in the use of technology in the classroom: "Content is the primary motivator for teacher searches. Content includes both materials for planning and instruction and is linked to standards and to their students' interests and needs." [1]

B. The Program, Target Audience and Goals

The EstuaryLive national program takes place two days before National Estuaries Day (which always falls on the last Saturday in September).

EstuaryLive is a multifaceted education/outreach program developed primarily for a K-12 audience, with an emphasis on middle and high school classrooms. It is structured to provide multiple levels of information to cover a wider range of educational knowledge and understandings on issues related to estuaries. This characteristic makes it suitable for students of all ages, as well as adults. Questions can be answered in the same developmental level in which they are asked. So if information is presented on a basic level, the audience can ask questions appropriate to their course of study. The program also advertises to colleges for basic marine science, ecology classes or teacher preparation programs.

The goals of EstuaryLive currently are to increase students' understanding and awareness of estuarine environments, to become stewards of the environment, and introduce students to learning through technology. EstuaryLive aims to increase teachers' ability to teach about estuaries, and increase students' understanding of the concepts of estuarine ecology.

Thanks to the combination of satellite and Internet technologies, EstuaryLive students around the world can experience, in real-time, a field trip to the unique habitat of an estuary; they can compare and contrast different estuaries around the United States; explore an estuary; interact with scientists and natural resource managers; and understand estuarine ecological, social, and economic principals.

The EstuaryLive programs combines a series of segments that make up the whole broadcast with a growing website, and together introduce and support the viewer's internet field trip. Each segment focuses on a specific estuary. For example, the 2004 program included two half-days of programming, totaling almost nine hours in eight segments, showcasing seven Reserves and one NEP. All the segments are correlated to the National Science Standards. The website—estuaries.gov—serves as the main source of information on the program. This site provides the program's schedule, themes covered in that year's program, information on each of the segments, the registration form, links to various sources of information on estuaries, and most importantly, it provides access to the live program.

B. The featured event during National Estuaries Day.

EstuaryLive was conceived in 1998 by Susan Lovelace, Education Coordinator for the North Carolina NERR and

Bill Lovin, founder and president of Marine Grafics, Inc. as a way to take students in North Carolina who could not physically visit the Reserve, on a tour of the estuary [2]. This approach bypassed the concern about balancing the increased visitation to these fragile ecosystems, with a need to educate and allow for teachers and students to learn, first hand, about the estuaries.

In 2001, the NERRS was looking to reinvigorate National Estuaries Day. Due to its ability to reach a wide audience from all parts of the country and potentially the world, EstuaryLive was adopted as the feature event for National Estuaries Day. This expanded an accomplished, site-based program developed at the North Carolina Reserve to a featured outreach and education tool for the entire NERRS. In 2002, the program became a cooperative effort between NOAA's NERRS and EPA's NEP.

For the first year of the national EstuaryLive program, twelve estuaries were featured, but only three of those field trips were live. The remaining field trips were pre-recorded, with naturalists available by phone to answer students' questions. In the following two years the pre-recorded field trips were phased out, offering two days of live, interactive estuarine field trips. To date, EstuaryLive has featured over twenty different estuaries from around the country.

C. The Partners in EstuaryLive enrich the broadcast and provide different perspectives to the themes presented.

EstuaryLive is a highly collaborative program involving a variety of partners both at national and local levels. At the national level, NOAA's NERRS and EPA's NEP partner to make the program a reality. At the local level, each live site – be it a NERR or an NEP – establishes a variety of partnerships to support the development of the program, to complement the program with the participation of an “expert”, and/or to involve students willing to be on camera and engage their fellow classmates. For example, in the 2004 EstuaryLive program, Waquoit Bay NERR involved the Director of the Indian Education Program in the Mashpee Schools, to explain and stage a traditional Wampanoag Clam Bake, and Padilla Bay NERR involved, as part of the production team, Port Townsend Marine Science Center, a regionally renowned institution for inquiry-based instruction in marine science, to help plan the program. In the 2005 broadcast, Tillamook Bay NEP will partner with Neah-Kah-Nie High School in order to have high schoolers demonstrate, on camera, the tidal cycle and explain how estuarine organisms adapt to differing salinities and conditions.

Throughout the program's life, Marine Grafics, Inc. has provided expertise, technical support to all the sites involved, and most importantly been a partner in furthering the conceptualization and application in the use of new and innovative technologies. The National Estuarine Research Reserve Association (NERRA), a non-profit established to serve as the primary advocate for the NERRS, has provided the overall coordination for the national program,



Image 1. Broadcasting from the North Carolina NERR

and is currently working in seeking additional funds to maintain and expand the program.

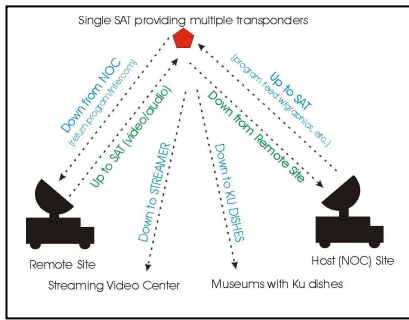
II. The Technology—Broadcasting Live

One of the most exciting aspects about the program is the technology involved in its production. EstuaryLive uses state-of-the-art satellite technology to broadcast remote field trips over the Internet and KU band satellites.

The basic idea for EstuaryLive and the use of technology was developed while Susan Lovelace and Bill Lovin were filming various Reserve habitats for the production of a video. They discussed the need to provide access to students to the field without damaging the natural environment. There were several challenges in fully conceptualizing what is now EstuaryLive. These challenges centered around the creation of a true educational experience, transporting audio and video signals from a remote Reserve island, getting the images and sounds into classrooms with a variety of technology capabilities, and how to do all of this economically.

The first broadcast of EstuaryLive took place from the Rachel Carson site of the North Carolina NERR during the fall of 1998, and was produced with the absolute minimum amount of equipment and bandwidth required to support the project. There was one microwave transmitter, one receiving antenna, one computer for the chat feature, one computer for digitizing the signal to be sent out, two cameras, a couple of monitors, and a video switcher. The image was not streamed as it is today, but single images were uploaded to a server and then viewed at about 1 frame/second, over a 56k dial-up connection.

Over the following years, North Carolina improved the technology base of their local program. In order to get a signal from the island to the mainland production trailer a microwave transmitter and receiving antennas were utilized. On the island where the field trip used to and continues to take place, a transmitting antenna is connected to the camera person and the microphone. The video and audio signal is sent to the transmitter through the air to the receiving antennas on the mainland. There is only one transmitter, but there can be as many as six receiving antennas. The camera person, the field trip leader with a



microphone, and the transmitter are all connected together by a series of cables.

Once the signal has left the island and made its way into the production trailer, the producer coordinates the production, by switching from different cameras, monitoring the audio, and encoding the signal for streaming to the Internet. He uses video and audio switchers, audio suppressors to keep the sound at just the right level, a document camera, a computer for showing digital images, a digital video player for short pre-recorded segments, and the encoder for digitizing the end product for uploading the program to the video streamer.

After the encoded signal has left the production trailer, it travels through the Internet to the server of a company that streams the video. From this server 100 or more computers can download the live streaming video at the same time.

Since then, the program has grown by leaps and bounds to where the quality is comparable to a professional television production. The current set-up for the national EstuaryLive program uses state-of-the-art satellite technology to broadcast remote field trips over the Internet and KU band satellites. In other words, it involves a satellite signal going from the local site to a central production, coordination, and integration center. The quality of the downloaded satellite broadcast is excellent, similar to the satellite technology used during news casts and sporting events.

A computer connected to the Internet is all that is needed for EstuaryLive. The quality of the Internet audio and video stream will depend on the computers and Internet connections at the site of the view. A school with high speed access, such as DSL or a cable modem, with relatively good computer equipment will receive a smoothly moving picture and excellent audio. Many school systems are able to pull the satellite signal directly from a KU band satellite and route it to their school systems video channels. Slower Internet connections, such as dial-up connections, will receive a jerkier video, but will still receive a good audio feed. It is suggested that with a dial-up connection and older computer it might be best to connect to a digital projector for facilitating a class field trip.

EstuaryLive uses Windows Media and/or RealPlayer via the world wide web to deliver streaming audio and video for land connections. It is important that participants

use the newest free version of software available to ensure the highest quality video and audio.

The best way to participate via the Internet is with 1) newer computer with a high speed connection that is coupled to a digital projector for class facilitation with 2) another computer connected for submitting questions and, if needed, 3) a connected computer for researching locations and questions. Downloading the satellite feed to a TV monitor will provide the best audio and video reception; however, classes will still have to connect to the Internet to submit questions.

One of the most recent innovations offered by the program was the development, in 2004, of an EstuaryLive program dedicated exclusively to comparing estuaries located on the Atlantic and Pacific Coasts of the United States. Three sites, New Jersey, North Carolina, and Oregon, were featured in one segment. Educators from each of the participating sites could speak with another and actively compare each of the estuaries with program participants. Participants would see a quad screen- with pictures from each of the three estuaries along with a screen with an EstuaryLive logo. While the comparative program is setting new challenges for the organizers of the program, and this is exciting, it is important for the organizers to strike a balance between the teachers needs with the appropriate use of technological applications to best support teaching and learning, and meet locally defined learning goals in schools.

III. Case Examples

Each year the number of NERRS and NEPs participating as EstuaryLive field trip hosts vary, as well as, the subject areas offered by each program. Efforts are made to balance the themes offered on a particular year to ensure that there is a geographical balance of the sites involved. The variety of themes offered allows for a flexible instructional design for each of the EstuaryLive broadcasts. This in turn allows teachers to pick the most appropriate program, tie it to a specific subject area, make it locally relevant by choosing the broadcast of an estuary that is closest to them, and/or engage participants in a broadcast which might cover a topic that can be implemented across disciplines.

The examples below demonstrate flexibility in the themes portrayed and instructional design used. In the example provided by the Padilla Bay NERR, the instructional design incorporated inquiry-based learning around current science topics, while helping teachers meet Washington State standards-based requirements. The Jacques Cousteau Reserve addressed the challenges faced in the design of the broadcast so as to effectively engage students in the process of scientific discovery within today's environment which places more emphasis on language arts and mathematics. The last example demonstrates how a current event, Hurricane Ivan, turned into a wonderful educational opportunity addressing a variety of disciplines: science, technology, language arts,

social studies, math, and history. Each of these programs, and many more, can be viewed from the archived programs section of the estuaries.gov Web site.

A Broadcast that Illustrates the Scientific Method—Washington State

The EstuaryLive 2004 broadcast from Padilla Bay NERR in Washington illustrates the flexibility of approach available with this technology. Educational reform in Washington has resulted in the creation of grade level Learning Requirements and periodic testing to measure student results. The science strand has a high reliance on understanding and applying the scientific method and inquiry learning (60% of the 8th grade science test).

To address this need, the EstuaryLive broadcast at the Padilla Bay Reserve was divided into five sections illustrating aspects of the scientific method, including observation, hypothesis, prediction, experimentation, and results.

Each section defined and illustrated application of the scientific method using estuarine science. For instance, in the observation section, students were interviewed on camera as they explored the mud flats of Padilla Bay finding various invertebrates, algae and eelgrasses. As the focus narrowed on two species of shore crabs (*Hemigrapsus nudus* and *H. oregonensis*), students noticed that this beach had more of one species than the other. Student participants read from scientific texts to find more information about these species of crabs.

Throughout the field trip, viewers were asked to submit questions about shore crabs. These questions were read on camera and discussed, then one question was selected, “Why does this beach have more *H. oregonensis* than *H. nudus*?” This led to generation of hypotheses and subsequent sections.

B. Engaging Students in Science—New Jersey

Since 2001, the Jacques Cousteau Reserve and the Barnegat Bay Estuary Program have conducted live broadcasts from southeastern New Jersey every year as part of EstuaryLive. Although the program content has differed over the years, a common theme of these broadcasts continues to be bridging the gap between the typically disjunct communities of scientific research and formal education.

In recent years the focus on learning in the formal classroom has been placed on language arts and mathematics, often leaving little or no time for science instruction. Such a situation not only limits students’ scientific content knowledge, but also their ability to relate scientific concepts to real-world applications. EstuaryLive, and in particular the Jacques Cousteau Reserve and the Barnegat Bay Estuary Program broadcasts, provides opportunities to bring research scientists together with educators and students both literally and virtually. Students not only become engaged in the process of scientific discovery, but they can appreciate the practical



Image 2. The next best thing to being there...

applications of the research through personal, interactive connections with scientists.

Several key elements have been identified that improve the value of the scientist-educator/student interactions in the EstuaryLive experience. First, not all scientists are good communicators to all audiences. It has therefore been important to seek scientists who are comfortable on camera and are able to communicate in language and terms appropriate for the intended audience and age-level. In addition, on-camera interactions between scientists and educators/students can help to replace preconceived notions that the two cultures are disparate, and can foster a sense of accessibility for both communities. Last, peer-based interactions between students on camera and those viewing the broadcast can foster viewer engagement and a sense of accessibility to the program content.

These broadcasts have employed the above approaches through the careful selection of scientists, educators, students, and content to create effective and engaging programs. Examples include middle school students assisting a scientist with marsh pool seining and organism identification, high school students presenting their field research projects on diamondback terrapins, and students demonstrating commercial clamming techniques under the guidance of a seasoned clammer.

C. A disastrous event turns into a fantastic learning opportunity! - Alabama

On Thursday, September 16, 2005 the eye of Hurricane Ivan, a very large and strong category three storm, crossed into Baldwin County, Alabama from the Gulf of Mexico. Weeks Bay NERR was on the western edge of the storm’s eye wall. This tremendous storm occurred exactly one week prior to the Estuary Live broadcast from the Weeks Bay Reserve marina.

As they say in the business, “the show must go on” and thus it did for the Weeks Bay NERR and Mobile Bay NEP staff. The Weeks Bay broadcast was divided into three distinct yet related components that included conservation issues sedimentation, habitat, and pitcher plant bogs. Real world issues were organized to deliver educational content similar to a classroom experience. The organizers assessed the damage of the live site (previously underwater) and

decided to alter the content of the first two program segments to incorporate hurricane and weather related information.

The field trip site was examined to confirm that the location was still useable; it was found to be damaged but salvageable (it had been temporarily submerged). The Internet capabilities of the location were lost so receiving questions would have to be juggled via cell phones. A previous pontoon boat component would have to be changed given the damage at the site and potential underwater obstruction that could hamper the program's segment.

Of unique interest was the fact that a weather station and a water quality monitoring data logger was still in place and functioning on the piling of a nearly destroyed dock. Reserve staff scientist Dr. Phipps was able to retrieve the data. Organizers graphically presented the collected weather data and water quality monitoring data as it pertained to barometric pressure and water levels. Contacts with the University of South Alabama (USA) Meteorology Department produced a graduating senior Chris Dyke with broadcast experience. Through the use of internet technology and previously recorded materials, the organizers were able to show before and after photos of the marina as they related to habitat and storm damage. Chris was able to reflect his interest in weather as a career, discuss the nature of hurricanes, show the path of Hurricane Ivan, interpret the data retrieved from the weather station and data logger (Figure 1), and answer questions.

The second segment of the program was altered to entertain research being conducted by USA Earth Science Assistant Professor Douglas Haywick. His work in bathymetric sedimentation within Weeks Bay included two components: core studies for historical depositional sequences as they relate to storms and recent bathymetric changes surrounding two previous hurricane events in South Alabama. Maps, an actual sediment core, and an investigation of sediment deposited by Hurricane Ivan were discussed live.

Through the Estuary Live Weeks Bay segment, students were able to see pre- and post- storm effects, view a data logger and its results, ask questions of a meteorology student, see sediment deposition in an actual

core, on map, and on-site. Finally, hurricane data can be accessed by teachers with their classes online.

IV. Educational Impact

In recent years, two publications have made a strong call in two distinct areas: (1) The National Council for Accreditation of Teacher Education report, *Technology and the New Professional Teacher: Preparing for the 21st Century Classroom* [3], which called for teacher-preparation programs to reflect the growing use of technology in K-12 schools, (2) The U.S. Commission on Ocean Policy document stating that there is an urgent need to strengthen the nation's ocean and coastal literacy [4]. The relevancy of these documents is of particular importance because "with the increased use of new technologies and the motivated expertise of today's students, [...] 10 years from now we could be looking at the greatest leap forward in achievement in the history of education. [5]." We are looking at an era where technology is playing a substantive role in everyday activities. According to a 2003 survey from the National Center for Education Statistics, 91 percent of students enrolled in grade 12 or below used computers and 59 percent used the Internet [6]. Coupled with this educators are trying to fill a gap to better infuse oceans and coastal concepts in the school curricula.

The EstuaryLive program can be an option for educators to bridge these gaps. In the 2004 EstuaryLive Evaluation we found that 65% of the teachers indicated that they participated because of the technology and to experience a virtual field trip [7]. EstuaryLive can introduce students to new technology and the possibilities that information technology presents. In addition, it can help teachers to educate students about science in new and exciting ways. Students view EstuaryLive via the Internet, email questions to naturalists in estuaries all over the country, and have their questions answered live during the broadcast. EstuaryLive can help build the next generation of stewards for our environment and help prepare a knowledgeable workforce to enhance science and technology in our nation.

A. Evaluating the Program

The NERRS and NEP involved in EstuaryLive have been actively engaged in evaluating the program and establishing a collection of research data from which to establish new strategies to improve the program, learn what works and what doesn't, and demonstrate its effectiveness. Evaluating a program like EstuaryLive can present various challenges which vary from the use and application of the technology to the fact that it is now a large-scale program covering various states and districts in the US and its reaches a large number of teachers, students, and even the public at large. Working in this context has challenged us to find new ways to assess its relevancy,

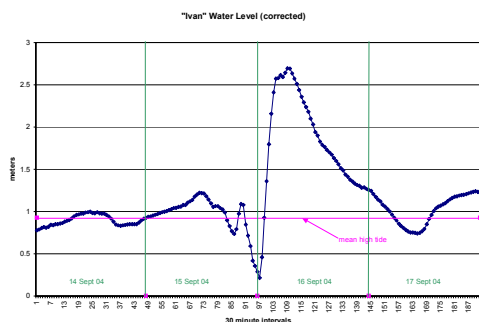


Fig 1. The graph shows the change in water levels as Hurricane Ivan hit Weeks Bay, Alabama

developing a broad picture of the program's reception and impact.

The evaluation for the 2004 EstuaryLive program showed that the broadcast reached students and teachers around the world, from as far away as Japan and Mexico, to more locally like Kansas and Michigan. A total of 13,600 students and teachers participated via the Internet. An additional 1,000,000+ individuals had access to the program via various television stations and aquariums. The program was carried by the Mystic Aquarium, the Alaska SeaLife Center, many Reserve visitor centers, and the entire South Carolina area via South Carolina Educational Television. Students emailed over 750 questions for naturalists to answer. In addition, there were over 150,000 individual visits to the estuaries.gov website.

The program used a variety of ways to evaluate the program's impact. While we are not going to go into details in the paper it is worth mentioning that an effort was made to employ new techniques and tools among which were a more detailed registration form, the creation of an EstuaryLive teacher evaluators group, and a post teacher survey developed by the College of Exploration, an independent evaluator. Tools that had been employed in the past and where used again that year included: the development of a National Estuaries Day/EstuaryLive survey for the Reserve System and the NEP and the use of demographic information provided by the streaming provider.

The post survey for teachers who participated in the program, was developed, administered via the Internet, and reviewed with the support of external program evaluators contracted for this task. The dissemination of the survey, an email request to registered teachers, may have produced a sampling bias—as no teachers who participated via satellite broadcast completed the survey. It is indeterminate how this bias impacts the interpretation of the data and findings; however, the data from the survey respondents, as summarized below, are quite powerful with respect to the impact of the EstuaryLive broadcast [7].

When teachers were asked why they were signing up to participate in the program, 65% indicated that they participated because of the technology and to experience a virtual field trip. The teachers were highly positive about the curricular materials which were provided to them via the web site—and a large number of teachers used the curriculum to pre-teach the field trip. From the survey respondents, 55% used the estuaries.gov curriculum, and 19% watched a previous, archived broadcast prior to participating in the live broadcast. Only 14% of respondents indicated that they did no preparatory activities. These findings suggest that the EstuaryLive program is impacting the classrooms of participants more broadly than "just the broadcast time" in that over 85% of teachers have changed their teaching materials and content to prepare for the broadcast. This finding is quite powerful with respect to the difficulty in measuring the longer term impact of professional development on teachers: producing long-term change in teaching in the classrooms.

The Likert scale (satisfaction) items were all very positive—with respect to other nationally-scoped ocean science education projects. EstuaryLive is achieving the "expectation level" of these teachers, or generally exceeding this level. The vast majority of respondents gave an overall rating of Excellent or Good for their EstuaryLive experience [7].

The negative which emerges from the survey is in the area of technical difficulty. A variety of technical/web issues appeared to contribute to difficulty with consistent and effective viewing of the broadcasts. One of the noted problems was the lack of familiarity with the technology requirements at the local school end of the broadcast. Some teachers fail to understand the technology utilized to bring the program into the classroom and often report being unable to connect to the program due to various technical difficulties and obstacles[7]. This is an issue frequently encountered with online projects. Today's students, of almost any age, are far ahead of their teachers in computer literacy [5]. The 2004 evaluation report indicates that the teachers feel more confident when the program was over or when it had been their second experience with the technology.

Finally, the success of any endeavor can often be evaluated best by the willingness to repeat the experience. In this regard, EstuaryLive was rated very high by its participants: over 90% of the respondents indicated that they intend to incorporate EstuaryLive into their lesson plans in the futures, including the activities and lesson plans provided on the estuaries.gov Web site[7].

B. Teachers infuse EstuaryLive in the classroom

The results from the evaluation told us that a large majority of the respondents implemented preparatory activities and follow-up activities; this is a strong finding that the EstuaryLive program has produced a change in the classroom behaviors of the teachers who participated with their students. They are teaching different material and activities, and they are infusing science content, which they have learned, at least in part, from their contact with EstuaryLive and the program's related resources. This is probably the most significant finding that emerges from the data.

V. How to Participate

Participating in EstuaryLive is simple, easy, and free. Anyone with a computer and Internet access can join the broadcast, either on an individual computer or in a classroom setting. Because EstuaryLive is broadcast through the Internet, it can be viewed throughout the United States, and even throughout the world. Viewers just need a computer with either Windows Media Player or Real Player to connect, both can be downloaded for free. Based on viewers Internet connection, they have a choice of dial-up or broadband streams. For hearing impaired viewers, they may connect to a stream with closed captioning.

Participation in the program is free of charge. Viewers can register to participate in the broadcast at the estuaries.gov website. On the day of the program, participants go to that website and look for the "View EstuaryLive" button, which will take viewers to a page where they can choose their player (Windows Media or RealPlayer) and Internet speed (high speed or lower, dial-up speed). They may also choose to watch the program using closed captioning. Once selecting the player and speed link, EstuaryLive will open the player to the live feed. From there viewers are able to take their virtual trip to an estuary.

Participants can also test their live streaming capabilities prior to the broadcast. A link will be made available to a live streaming test video which will be placed on estuaries.gov. Participants can use this test link to trouble shoot their equipment and to test potential obstacles like school system fire walls.

Preceding the broadcast, it is recommended that teachers check the estuaries.gov website to find information about the program, invite their students to review an archived broadcast, download activities or the teacher's guide. It is also important to check the site often for any last minute information. This is a live program and can be affected by natural events such as the 2004 Weeks Bay program which was hit by Hurricane Ivan one week before it went live.

VI. Opportunities for the Future

EstuaryLive Program –2005

The EstuaryLive program will take place September 22 & 23 in 2005. It will feature five sites from around the country and one comparison program (not listed below):

- Tillamook Bay National Estuary Program (NEP), Oregon
- New York-New Jersey Harbor Estuary Program, New Jersey
- Grand Bay NERR and Mobile Bay NEP, Alabama
- Jacques Cousteau NERR and Barnegat Bay NEP, New Jersey
- San Francisco Bay NERR, California

The Future

While the production quality of EstuaryLive continues to improve with the experience of the broadcast sites and by incorporating the results from evaluations, the program will benefit greatly from several planned modifications to the overall design. Specifically, the NERRS, NEP, and NERRA have been studying ways to adjust the seasonal nature of the program so that broadcasts may be better-suited to the school year and more regionally-oriented schedules. The program will continue to build out the www.estuaries.gov, develop new and general educational tools for teachers that highlight national educational standards, and offer training to overcome technological challenges. Evaluation will continue to be a critical tool to

analyze the impact of the program and analyze the factors affecting the learning outcomes of computer based technology applications. And finally, additional funding support is currently being sought that will enable more sites to host programming and increase the frequency with which the programming is offered.

Conclusion

Over the past five years there has been an explosive growth in online and multimedia instruction (e-learning) and "virtual schools." At least 15 states now provide some form of virtual schooling to supplement regular classes or provide for special needs. Within the next decade every state and most schools will be doing so [5]. This explosion in the number of technology oriented educational programs is an attractive option for the development of educational programs using more and innovative technologies. But, as the lessons learned with the EstuaryLive program are showing us that it is fundamental to evaluate to really prove the program's effectiveness and ensure that computer based technology programs respond to teachers' needs and realities, and provide for effective instructional designs in teaching and learning.

The EstuaryLive program is demonstrating to be an effective technology oriented program. Organizers will continue to work on improving the program's content and delivery. The program, as mentioned before, is unique in its emphasis on education about estuaries. It plays an important role in helping close the gap on students' understanding about coastal and estuarine environments. With this said, we end this paper with a few quotes submitted by teachers participating in the 2004 EstuaryLive broadcast: "EstuaryLive was a great teaching tool. The kids could not get over the fact that we were watching you live. They even asked if you could see us!" Another teacher indicated that the program played an important role for her students to see what estuaries really are: "My students, in most cases, if I do not take them, will never have an opportunity to see an estuary." "I thought this was a tremendous opportunity. I would really like to figure out how I can use it in my science curriculum either later this year or next."

For more resources

- EstuaryLive program: <http://www.estuaries.gov>
- NOAA/National Estuarine Research Reserves: <http://nerrs.noaa.gov>
- EPA/National Estuary Program: <http://www.epa.gov/owow/estuaries/>
- National Estuarine Research Reserve Association: <http://www.nerra.org/>

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